Evaluation of Los Angeles City College's STEM Pathways Program

Impacts of STEM Pathways program participation on student outcomes

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Contents

List of Exhibits

Introduction

Los Angeles City College (LACC) launched the STEM Pathways (STEMP) program in 2016 with funding from the U.S. Department of Education.[1] The college conceived the STEMP program as a comprehensive suite of evidence-based supports working together to improve STEM outcomes for Hispanic or Latinx (Latinx) and low-income students. LACC engaged SRI Education as the independent evaluator for this grant to assess its impact on student outcomes. This report describes participation in the STEMP program components from fall 2017 through fall 2019 and presents findings from a quasi-experimental research study regarding the impact of STEMP program participation on STEM course success, continuation in STEM, and degree attainment.

The STEMP program is a collection of evidence-based initiatives that includes academic support, mentoring, and access to books and technology for STEM students at LACC. Specific supports offered through the program include peer tutoring offered through a STEM Learning Center; a Supplemental Instruction program for students in select STEM courses; a book and technology loan program; specialized support from a STEM counselor; an undergraduate research program; a math boot camp; and events geared toward STEM students.

The report begins with a description of the study context, including an overview of LACC and the STEMP program. We then describe prior research on effective STEM supports and present our research questions and data sources. Next, we discuss results from a descriptive analysis of STEMP program participation, including an examination of proportionality for students in the demographic groups targeted by the grant—Latinx students and students from low-income families. Last, we describe the methods used for the impact analysis and summarize findings regarding the impacts of STEMP program participation on students' STEM outcomes.

Study Context and STEMP Program Overview

LACC is a public community college in Los Angeles, California. It is one of the nine community colleges that make up the Los Angeles Community College District (LACCD) and one of 116 community colleges in the California community college system.

LACC serves a large and diverse student population, enrolling over 15,000 students in fall 2018, over half of whom were Latinx (54%) (Los Angeles City College, 2018). Thus, LACC easily meets the federal definition for a Hispanic-Serving Institution, which requires that undergraduate enrollment is composed of at least 25% Latinx students (U.S. Department of Education, n.d.). In addition, 6% of LACC students were Black/African American, 12% were Asian/Pacific Islander, 45% were first-generation, 57% received financial aid, and 58% were female. Although nationally Latinx students declare STEM majors at similar rates as White students, they are less

[1] In 2016, the U.S. Department of Education awarded Los Angeles City College (LACC) a 5-year, $6 million grant to develop a program aimed at increasing STEM degree completion and transfer for low-income and Hispanic/Latinx students.

likely to stay in the STEM major and less likely to complete a degree. Thus, Hispanic-Serving Institutions have high potential to increase degree completion in STEM fields for this population (Santiago et al., 2015). Programs like the STEMP program seek to attract Latinx students to the STEM field and retain them by offering supports to address common barriers (Riegle-Crumb et al., 2019).

During the period of the study, students at LACC had access to several supports to help them succeed in STEM coursework. Students could seek tutoring from LACC's Pi Shoppe, which provided tutoring to help students succeed in introductory math courses. Failure to pass these introductory courses can prevent students from enrolling in higher-level STEM courses. The STEMP program sought to complement existing supports at LACC by offering resources and services meeting known needs of the STEM student population at LACC. These included:

- **Math boot camps:** Completing the calculus course sequence was identified as a major hurdle facing STEM students. In an attempt to reduce attrition math "boot camps" were offered as late-start and intersession courses so that students could improve their grade in calculus courses they had recently taken or to prepare them for the next class in the sequence.
- **Drop-in STEM tutoring:** The STEMP program also offered supports for higher-level math courses, many of which are required for a STEM degree. These included drop-in tutoring support through the college's STEM Learning Center in math (Math 240 and above), chemistry, biology, physics, and computer science. The STEM Learning Center pre-dated the STEMP program, but LACC used funds from the grant to sustain and expand the Learning Center.
- **STEM Supplemental Instruction:** Supplemental Instruction (SI) is an evidence-based program used globally to improve postsecondary academic performance. A supplemental instructor, typically a peer who has already succeeded in the focal course, participates in the course alongside other students and offers supplemental sections to support students as they progress through the course (Dawson et al., 2014). LACC had an SI program that pre-dated the grant, but grant funds enabled the college to expand this support to STEM courses beginning in fall 2017. The courses in which SI was most frequently offered were those with low pass rates: Calculus I, II, and II, Introduction to General Chemistry, and Chemistry 101.
- **Undergraduate research experience:** The STEMP program developed an undergraduate research experience (URE) for LACC STEM students to get experience developing, leading, and presenting original research under the supervision of an experienced faculty advisor. LACC partnered with faculty from several 4-year institutions and research organizations (like the California Space Grant Consortium) to provide these research opportunities.

- **Book and technology loan program:** The STEMP program loaned STEM textbooks to help students for whom buying textbooks would be cost prohibitive. Beginning in fall 2019, this program also loaned tablets for students to use.
- **STEM counseling:** To address student challenges with understanding and navigating the requirements for a STEM degree, the STEMP program hired a counselor to provide specialized support. Due to staffing challenges, the program supported a dedicated STEM counselor for most but not all of the study period: fall 2017, and summer 2018 through spring 2019.

Over the course of the grant, the STEMP program also sponsored several events and trainings geared toward STEM students and faculty. For example, the STEMP program offered welcome events for STEM students and brought speakers to campus on STEM-related topics. Because these events were quite general in nature, we do not include STEM event attendance in the proportionality and impact analyses below.

STEMP program leaders chose to make the STEM Learning Center and STEM counseling available to all students and SI to all students in specific course sections. The URE program and book and technology loan program, however, were available only to students who applied and were accepted into the STEMP program. The prerequisites for acceptance were that students: 1) major in a STEM field that includes Calculus 1 (or higher) or Chemistry 101 (or higher) or Biology 6/7 as part of preparation for transfer; 2) currently be taking Math 115 or above; 3) have and maintain a minimum grade point average (GPA) of 2.5; and 4) agree to participate in required project activities.

The two most-used components of the STEMP program were SI and the SLC—both of which mimic the design of other evidence-based programs. Peer tutoring has been the focus of hundreds of studies since the 1970s, many of which show benefits for students' academic achievement. Topping (1996) reviewed studies of peer tutoring, 18 of which were studies of cross-year small group tutoring (similar to SI and SLC) and found positive impacts on academic achievement, as well as increased self-confidence and decreased anxiety. Leung et al.'s (2005) meta-analytic review of 76 studies sought to understand impacts of peer tutoring on students' academic achievement and self-concept. While only three of these studies looked at postsecondary peer tutoring programs, the review (similar to the results of previous meta-analyses) found that peer tutoring had positive impacts on both outcomes. Similarly, Alegre-Ansuategui et al.'s (2017) meta-analysis found that peer tutoring had positive impacts on students' math achievement, although these impacts were less dramatic among university-aged students.

A few contextual factors are important to consider when interpreting the student findings. In fall 2019, LACC began implementing new requirements to comply with California Assembly Bill (AB) 705, effective January 2018. AB 705 required that community college districts and colleges streamline the pathway toward graduation by reducing credit-bearing developmental coursework for students, instead aiming for all students to enter and complete transfer-level coursework in English and math within 1 year (California Community Colleges, 2018). The population of students seeking support from the STEMP program may have changed in fall 2019 as students who would have previously been placed into developmental coursework attained access to transfer-level courses.

Finally, in March 2020, the COVID-19 pandemic prompted LACC to shift to remote learning for the remainder of the 2019−20 academic year and for the 2020−21 academic year. To continue meeting students' needs, the STEMP program began providing most programming virtually, and stopped offering STEM events. Due to the abrupt shifts in STEMP programming and increased withdrawal rates at LACC during remote instruction, the research team did not calculate impacts for terms beyond fall 2019.

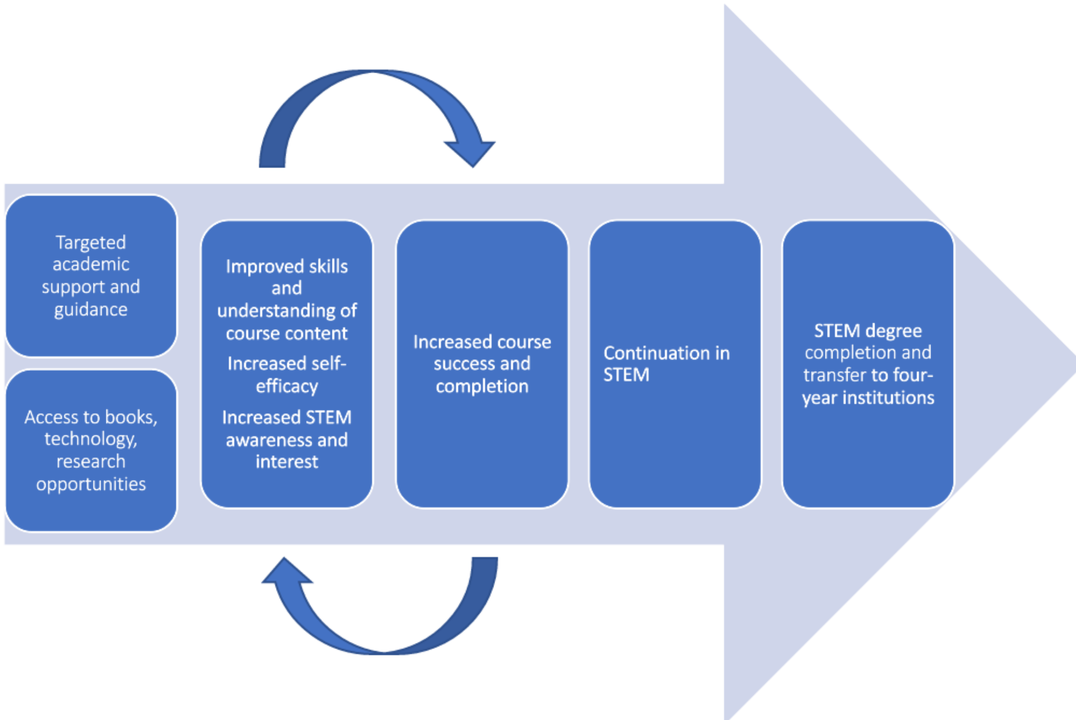
Study Purpose

The purpose of this analysis is to examine the extent to which the STEMP program reached the target student population, and to determine whether STEMP program participation helped students succeed in completing STEM coursework and continuing in STEM, setting the stage for improved STEM degree completion and transfer.

Conceptual Model

The goal of the STEMP program is to improve STEM degree completion and transfer to 4-year colleges, particularly for low-income and Latinx students. One way program participation may increase these long-term outcomes is through improving short-term academic performance and STEM persistence (Exhibit 1). Targeted academic support and access to books, technology, guidance, and research opportunities help students improve their skills and understanding of course content, as well as their sense of self-efficacy and STEM career aspirations. The improved skills and understanding enable greater course success. Practically, increased course success means students earn more credits toward their degree, and may also increase their commitment to STEM, thereby making them more likely to eventually complete a degree or certificate and transfer. This analysis focused on how STEMP program participation impacted course success, continuation in STEM, and degree completion. The study team also looked at attainment of any STEM degree or certificate and STEM associate degrees for transfer as a leading indicator of students' intention to transfer to a 4-year institution.

Exhibit 1. STEMP Program Conceptual Framework



Research Questions

SRI conducted a rigorous, quasi-experimental analysis to understand the impact of STEMP program participation on student outcomes. The following research questions guided this analysis:

1) To what extent did the STEMP program reach the target population of students who are low-income and Latinx?
2) What is the impact of participating in the STEMP program on course success?
3) Does STEMP program participation increase the likelihood that students continue in STEM?
4) Does STEMP program participation increase the likelihood that students will attain a STEM degree or certificate?

Data Sources

This evaluation report draws on two sources of data. The first is student enrollment, demographic, and historical and current coursetaking data from LACC's administrative data system. The college provided these data for all students enrolled at LACC between spring 2017 and fall 2019 who met the STEM student definition: any student who declared a STEM major or took Math 240 or a higher math course by fall 2019.[2] The second data source is STEMP program participation records, gathered directly from the STEMP program. The STEMP program staff compiled participation data across program components and assigned pseudo identifiers that enabled linking to the data from the college's administrative data system. SRI combined these STEMP program participation data with extant administrative data from LACC to examine program participation and impact.

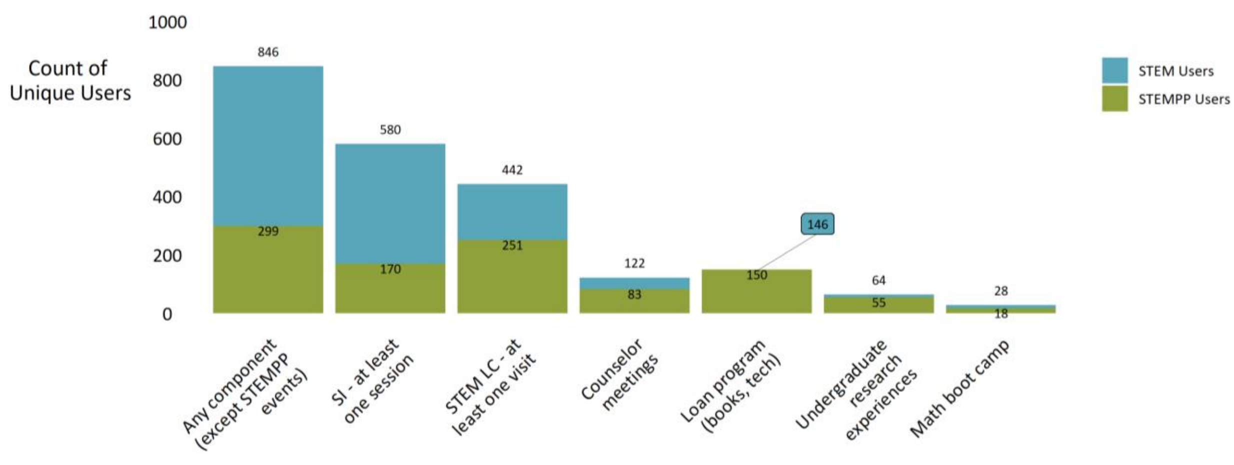
Program Participation

Together, the student enrollment data and STEMP program participation data enabled us to examine both the number of students who participated in the STEMP program and the extent to which these students were representative of the broader population of STEM students at LACC.

STEMP Program Participation

Between summer 2017 and fall 2019, 846 STEM students participated in a STEMP program component at least once (STEM users) (Exhibit 2). Of these, 35 percent (299) were STEMP program members (STEMPP users). Most STEM users accessed SI and/or the SLC at least once (69% and 52%, respectively). The majority of students who accessed the book and technology loan program and the undergraduate research experience were STEMPP users because participation in these components was largely limited to STEMP program members.

Exhibit 2. STEMP Program Participation, Summer 2017 to Fall 2019

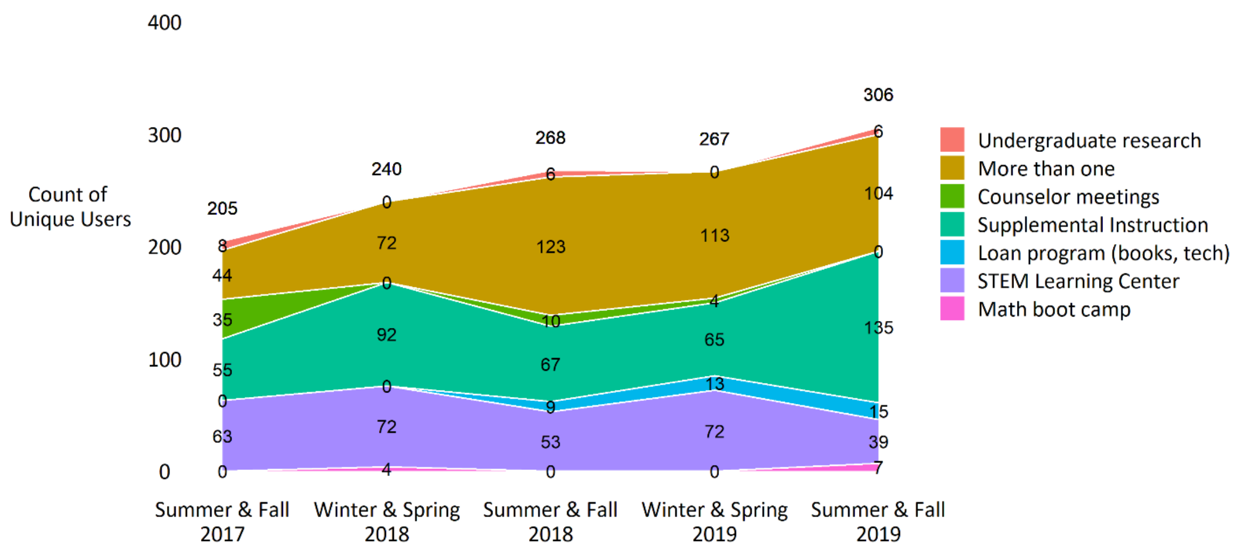


To examine trends by term, we combined the number of unique users by term and year for primary terms (fall and spring) with adjacent intersessions (summer and winter, respectively). Intersession participation is low, resulting in noisy estimates of program usage and demographics. Combining intersessions with adjacent primary terms enables us to include

[2] Math 240 is a trigonometry course and a "gateway" math course, meaning that it is a prerequisite for many other STEM courses.

intersession users while also more clearly presenting trends (Exhibit 3). In this display, students who accessed more than one component are categorized as “more than one” and are not included in the individual component use counts. In each term, SI and the SLC were the single program components accessed by the largest number of students, while counselor meetings, the book and technology loan program, undergraduate research experience, and math boot camp were used much less frequently. Some program components were not offered in every term—the undergraduate research experience was only offered in the summer terms, while the math boot camp was only offered during the winter term. Participation also fluctuated with changes in program offerings—the book and technology loan program, for example, did not get off the ground until fall 2018, and staff turnover in the STEM counseling program meant that the program did not have a dedicated STEM counselor in winter and spring 2018 or in summer and fall 2019. As SI participation expanded in summer and fall 2019, participation in the SLC decreased.

Exhibit 3. STEMP Program Participation, Summer 2017 to Fall 2019



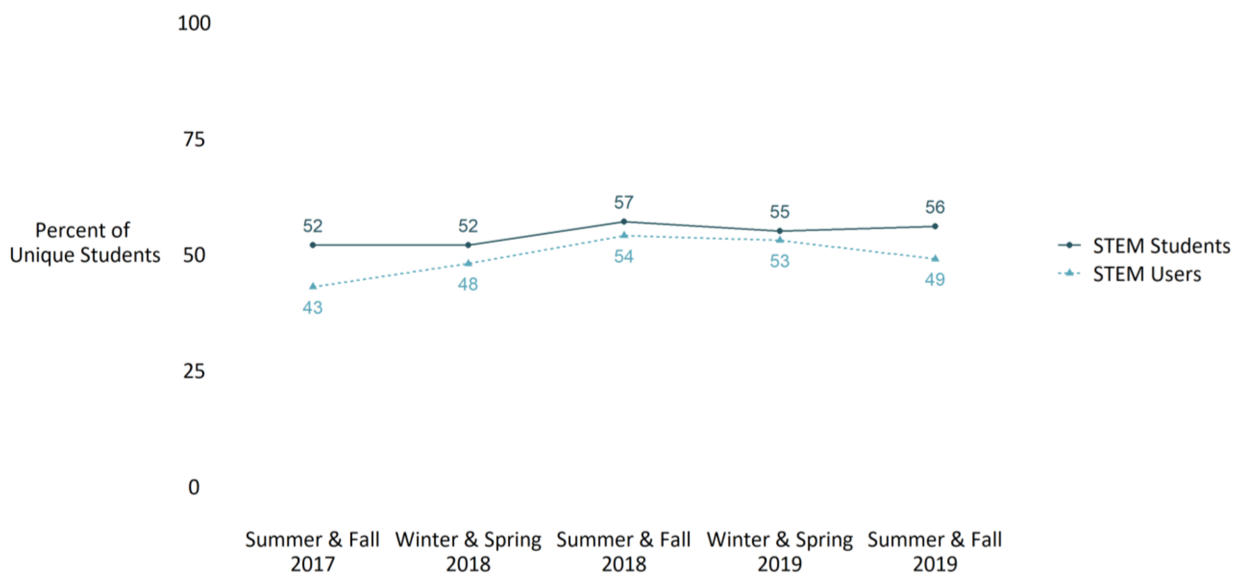
STEMP Program Proportionality

In addition to exploring trends in participation over the study period, we also examined the extent to which the STEMP program was reaching students of the target demographics through any of the program components except for STEM events.

Proportionality for Latinx Students

Exhibit 4 shows the proportion of Latinx STEMP program participants relative to the proportion of Latinx STEM students at LACC as a whole. From this figure, we see that Latinx students were initially underrepresented among STEMP participants relative to the overall STEM Latinx population by 9 percentage points. While this gap decreased to only 2 percentage points by winter and spring 2019, it grew to 7 percentage points in summer and fall 2019.

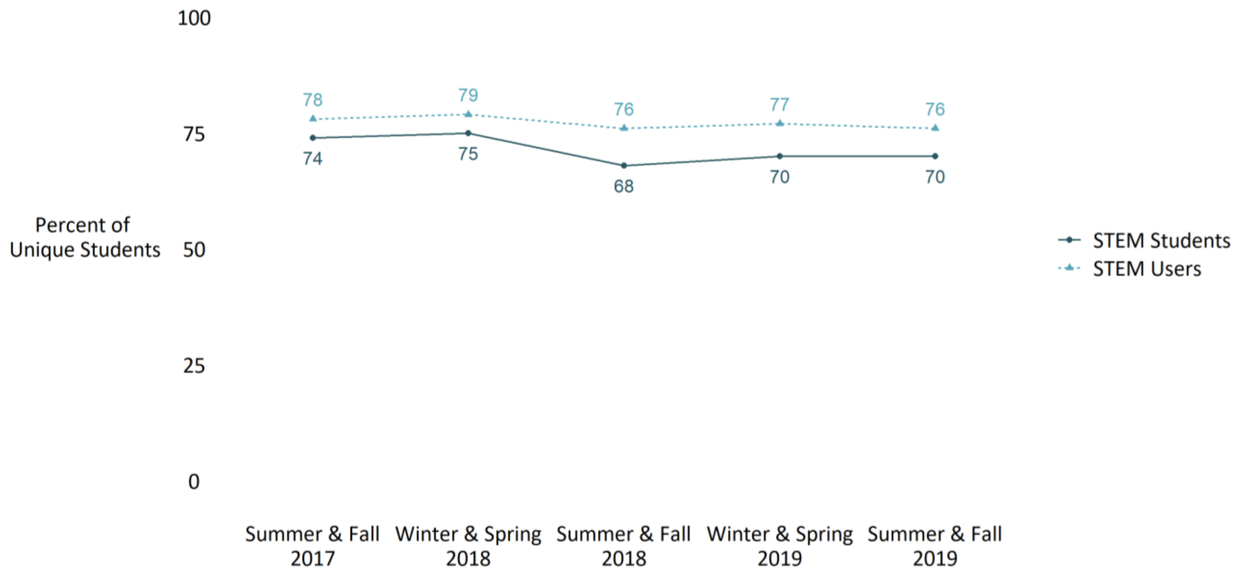
Exhibit 4. Proportionality of Participation for Latinx Students



Proportionality for Low-Income Students

In contrast to Latinx participation, the program exceeded proportionality of students who were low-income (defined as Pell Grant or California Promise Grant recipients) for all the study terms. In summer and fall 2017, 78% of STEMP program participants were low-income relative to 74% of STEM students overall (Exhibit 5). The proportion of STEMP program participants that were low-income continued to exceed parity through summer and fall 2019, when 76% of STEMP program participants were low-income, compared with 70% of LACC STEM students.

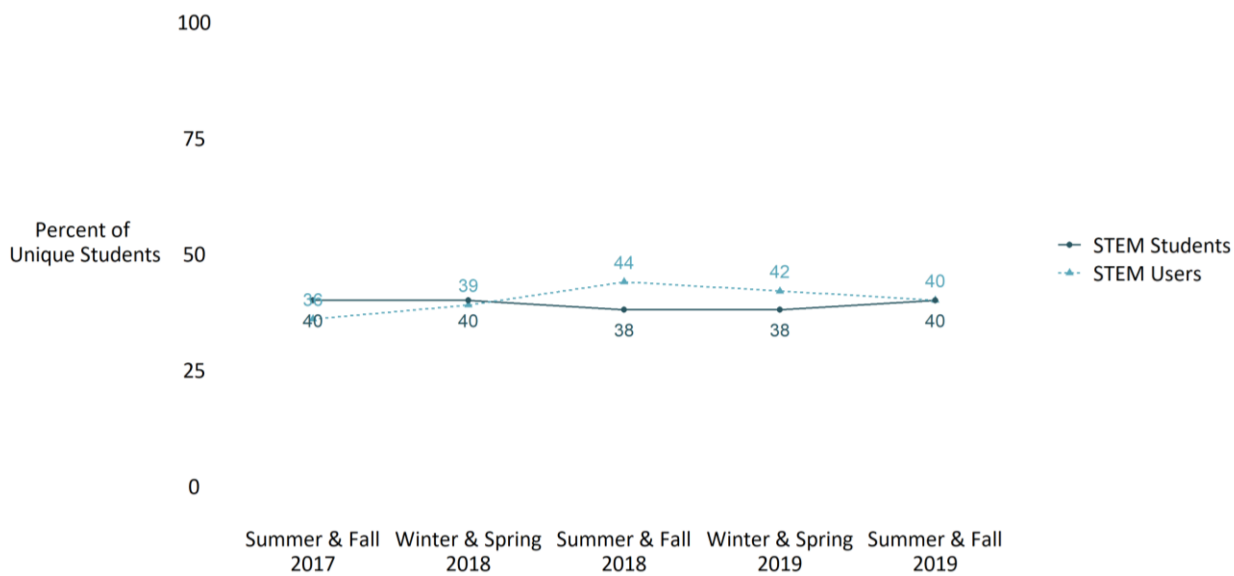
Exhibit 5. Proportionality of Participation for Pell or California Promise Grant Recipients



Proportionality for Low-Income Latinx Students

Finally, we examine student participation for those at the intersection of the two target demographic groups: Latinx students who are low-income. Exhibit 6 shows the proportion of STEMP program participants who were both Latinx and low-income relative to all STEM students at LACC. Although low-income Latinx participants were initially underrepresented in the program relative to all STEM students, by summer and fall 2018 low-income Latinx students were better represented among STEMP program participants than among the LACC STEM student population. The percentage of Latinx STEMP program participants dropped in summer and fall 2019 with the expansion of SI but remained at parity with that of the overall STEM student population.

Exhibit 6. Proportionality of Participation for Latinx Pell or California Program Grant Recipients



Taken together, these results suggest that the STEMP program had mixed success meeting its target population of students who are Latinx and/or low-income. While the program consistently reached low-income students, it generally had less success with reaching Latinx students. As the STEMP program continues, program leaders might attend particularly to strategies for engaging Latinx students.

Next, we turn to a discussion of the estimated impacts of the STEMP program on the students served.

Impact Analysis

We estimated the effects of STEMP program participation in each term using propensity score weighted regression.

Methods

We used propensity score weighting to estimate the impact of STEMP program participation on three term-specific student outcomes: STEM GPA, STEM credits, and continuation in STEM, defined as enrollment in a STEM course in either of the subsequent two terms (winter or spring for fall term and summer or fall for spring term). We did not consider the continuation in STEM outcome for fall 2019 because of the global pandemic. The college extended the withdrawal period in spring 2020 when instruction became abruptly remote, resulting in unusual observed withdrawal patterns in this term.

In addition, we examined two longer-term degree attainment outcomes: earning any STEM degree or certificate by spring 2020 and earning a STEM associate for transfer degree by spring 2020. We analyzed degree attainment for a focal cohort of students (those who participated in the spring of 2018 versus comparison students who did not). Focusing on this term allowed us to have sufficient time after program participation to reasonably observe degree attainment (2 years). Also, students could choose to participate in programming in some terms but not others, meaning that they could move between treatment and comparison status from term to term. Selecting a single focal treatment term in examining this longer-term outcome enabled us to sharply define both the treatment and comparison groups without concerns that treated students would later be comparison students.

The analytic sample for these analyses was limited to students who met our STEM student definition and were enrolled in a STEM course at LACC in the focal term. We defined the treatment group as students in the sample who participated in a STEMP program component at least once within a given term between fall 2017 and fall 2019, including intersession winter and summer terms. The comparison group was defined as any students in our sample who did not participate in a STEMP program component in that term. STEMP program participants were higher achieving than non-participants based on a number of metrics, including prior credits earned, transfer-level STEM credit, and GPAs. For the degree attainment analyses, we also conducted an exploratory analysis of high-intensity program participation, with treatment defined as three or more program interactions in spring 2018. This analysis was designed to examine whether higher levels of program participation had an impact for these longer-term outcomes.

The propensity score weighting ensured that the treatment and comparison groups were equivalent on all observed student demographic characteristics, including gender, race and ethnicity, eligibility for a California Promise Grant, and California residency status, as well as prior coursetaking and GPA, both overall and in STEM, and prior program participation (see appendix Exhibit A-2 for a full list of covariates). This methodology reduces bias due to these observable characteristics; it does not, however, eliminate bias due to unobserved differences in treatment and comparison groups, such as differences in prior educational opportunities, access to outside supports, or the nature of peer relationships. For the term-specific outcomes, we estimated the impact of STEMP program participation in each term separately, and then combined these estimates using meta-analysis. Please see Appendix A for more detail on the methodology for the main analyses, including definitions for the outcomes and predictor variables used and a description of the models employed, and Appendix B for the results of the exploratory analysis of degree attainment based on high-intensity treatment definition.

STEMP Program Impact by Term

Exhibits 7a and 7b show the results of the weighted regressions estimating the effect of STEMP program participation on STEM outcomes. For each term and outcome, we show weighted means and standard deviations for treatment and comparison groups, the coefficient (and standard error) on the STEMP program participation indicator from the weighted regression models, and the effect size.

Across all outcomes, there were positive and significant effects for STEMP program participation on students' STEM credit attainment, STEM GPA, and continuation in STEM. These effects were most consistent for STEM credit attainment (positive and significant in six out of nine terms), followed by continuation in STEM (positive and significant in four of eight terms). STEM GPA was positive and significant in three of nine terms. There were also negative and significant results for STEM GPA in fall 2019, and STEM credits and STEM GPA in winter 2019.

Estimated effect sizes for positive and significant coefficients ranged from 0.09 to 0.22 for STEM credits, 0.08 to 0.31 for STEM GPA, and 0.33 to 0.54 for continuation in STEM.[3] Effect sizes provide useful standardized measures of magnitude that allow for comparisons across different metrics. However, for outcomes such as credits earned and GPA, it is also useful to consider impacts on the scale of their original measurement. These impact results mean that students who accessed at least one program component in a term earned between 0.31 and 0.75 more STEM credits on average than similar peers who did not. This represents a modest fraction of the 15 credits per term students need to earn, on average, to receive a transfer degree in four semesters. On a 4-point scale, STEMP program participants earned a STEM GPA between 0.11 and 0.34 grade points higher than similar peers who did not use the STEMP program in the three terms with positive and significant results. Finally, in fall 2017, the predicted probability of continuing in STEM for the typical low-income female Latinx California resident student was 98.1% for STEMP participants versus 94.3% for non-STEMP participants.[4]

When comparing effects sizes over time in the main fall and spring terms, we note that across all three outcomes, the magnitude of the effect was larger in earlier terms (fall 2017 through fall 2018) than in the final two terms (spring and fall 2019).[5] One possible explanation for this trend is that the marginal effect of additional program interactions diminishes with greater use. The mean number of STEMP participants' prior program interactions increases substantially in

[3] Cohen (1988) suggested that 0.2 be considered a "small" effect size, 0.5 represents a "medium" effect size, and 0.8 a "large" effect size.
[4] These predicted probabilities are for a student without AB540 status, who is not in her first term at LACCD, and who has no dual enrollment credits, prior math, prior transfer credits, prior non-transfer credits, or prior STEMP support.
[5] The only exception is the small (0.05) effect size for GPA in fall 2017.

spring 2019, jumping from 9.9 for fall 2018 to19.9 for spring 2019 (Exhibit A-4). Thus, it may be the case that the first supports accessed by students have the greatest impact on their course outcomes while at some point the effect of additional program interactions gets smaller.

The small but negative and statistically significant effect sizes in winter and fall 2019 stand out as anomalous given the small to moderate positive and significant effect sizes in most of the terms. One possible explanation for the fall 2019 negative effect on GPA is that a major change to math course placement policy in the state of California affected student achievement. AB 705 came into effect in fall 2019, requiring the college to grant students greater latitude in placing themselves into math coursework rather than relying on placement test scores. The placement policy shift may have altered course taking patterns, course staffing, or grading standards in ways that differentially impacted treatment and comparison groups. In winter 2019, effects for both STEM credits earned and STEM GPA were negative. Since the winter 2019 (January) term was prior to changes resulting from AB 705, it is unlikely that AB 705 can explain the negative findings in this term. It may, however, be that students accessed a different mix of program components in winter 2019 than in the other intersession terms. If certain components have positive effects while others do not, this might explain the anomalous result. We examined STEMP program usage patterns across terms but did not find clear evidence of differential program usage in winter 2019, relative to other intersession terms.[6] A final possibility is that we are unable to account for unobservable characteristics related to selection into program participation and that the role of these unobservables is particularly acute in some terms.

Finally, we examined STEM degree attainment for students in the spring 2018 analytic sample only (Appendix B). The results of this analysis were promising but did not meet the conventional level of statistical significance, meaning that there is a higher than usual probability that they are due to chance. The odds of earning a STEM associate for transfer degree by spring 2020 were 83% higher for students who had at least one program interaction in spring 2018 than similar peers who did not, with an effect size of 0.37 (p=0.11).[7]

[6] The majority of students in this term (71%) used SI at least once, but SI usage is similarly high in other intersession terms (e.g., winter and summer 2018) (Exhibit A-3). For example, the program provided SI sections in Introduction to General Chemistry, Calculus I and II, and Linear Algebra in both winter 2018 and 2019, and added one SI section each for Trigonometry, Precalculus, and Differential Equations in winter 2019.The main differences in SI usage by course between these terms is due to students participating in SI for Precalculus and Differential Equations in winter 2019 (40% of SI users in winter 2019).

[7] We also looked at STEM degree attainment for students who met a higher threshold of program intensity: three or more program interactions in spring 2018. The results were similarly promising (effect size of .22 for STEM degree or certificate attainment, p=0.29; effect size of .47 for STEM associate degree for transfer attainment, p=0.13) but did not meet the conventional level for statistical significance (Appendix B).

Exhibit 7a. Outcomes by Term – Fall and Spring (Primary) Terms

	Fall 2017							Spring 2018							Fall 2018						
	C mean (sd)		T mean (sd)		β (SE)		Effect Size	C mean (sd)		T mean (sd)		β (SE)		Effect Size	C mean (sd)		T mean (sd)		β (SE)		Effect Size
STEM credits	5.79	(1.14)	6.51	(4.25)	0.74***	(0.13)	.18	5.90	(1.24)	6.68	(3.41)	0.75***	(0.11)	.22	6.08	(1.37)	6.29	(4.04)	0.52***	(0.13)	.13
STEM GPA	2.53	(0.37)	2.58	(1.29)	0.07	(0.05)	.05	2.56	(0.42)	2.90	(1.09)	0.34***	(0.05)	.31	2.35	(0.44)	2.52	(1.23)	0.16**	(0.05)	.13
Continuation in STEM	.75	(0.12)	.88	(0.33)	1.13**	(0.36)	.69	.60	(0.15)	.70	(0.46)	0.54*	(0.24)	.33	.72	(0.14)	.84	(0.37)	0.69**	(0.25)	.42
STEM degree or certificate	NA	NA	NA	NA	NA	NA	NA	.25	(0.13)	.28	(0.45)	0.20	(0.26)	.12	NA	NA	NA	NA	NA	NA	NA
STEM transfer degree	NA	NA	NA	NA	NA	NA	NA	.10	(0.09)	.14	(0.34)	0.60	(0.38)	.37	NA	NA	NA	NA	NA	NA	NA
N	*1948*		*150*					*1965*		*183*					*2014*		*190*				

	Spring 2019							Fall 2019						
	C mean (sd)		T mean (sd)		β (SE)		Effect Size	C mean (sd)		T mean (sd)		β (SE)		Effect Size
STEM credits	5.84	(1.34)	5.93	(4.00)	0.37**	(0.13)	.09	6.16	(1.45)	6.17	(4.21)	0.19	(0.13)	.05
STEM GPA	2.44	(0.43)	2.49	(1.36)	0.11*	(0.05)	.08	2.48	(0.44)	2.37	(1.30)	-0.13*	(0.05)	-.10
Continuation in STEM	.60	(0.15)	.66	(0.47)	0.31	(0.23)	.19	NA	NA	NA	NA	NA	NA	NA
N	*2042*		*197*					*1903*		*200*				

*p < .05; **p < .01; ***p < .001

Note. STEM degree outcomes examined for spring 2018 term only. Effect size for dichotomous outcomes is Cox's index.

Exhibit 7b. Outcomes by Term – Winter and Summer (Intersession) Terms

	Winter 2018							Summer 2018							Winter 2019						
	C mean (sd)		T mean (sd)		*β* (SE)		Effect Size	C mean (sd)		T mean (sd)		*β* (SE)		Effect Size	C mean (sd)		T mean (sd)		*β* (SE)		Effect Size
STEM credits	2.93	(0.73)	3.24	(1.89)	0.31*	(0.14)	.17	2.74	(0.90)	3.21	(2.46)	0.32**	(0.14)	.13	2.79	(0.86)	2.24	(2.19)	-0.65***	(0.15)	-.15
STEM GPA	2.45	(0.55)	2.55	(1.38)	0.11	(0.11)	.08	1.96	(0.58)	2.14	(1.53)	0.04	(0.10)	.03	2.37	(0.66)	1.77	(1.54)	-0.59***	(0.11)	-.38
Continuation in STEM	.82	(0.14)	.80	(0.40)	-0.03	(0.52)	-.02	.69	(0.16)	.72	(0.45)	0.10	(0.46)	.06	.87	(0.14)	.91	(0.29)	0.36	(0.56)	.22
N	*553*		*70*					*668*		*78*					*562*		*96*				

	Summer 2019						
	C mean (sd)		T mean (sd)		*β* (SE)		Effect Size
STEM credits	3.35	(0.96)	3.02	(2.21)	-0.15	(0.13)	-.07
STEM GPA	2.61	(0.63)	2.43	(1.47)	-0.16	(0.10)	-.11
Continuation in STEM	.63	(0.20)	.78	(0.41)	0.92**	(0.35)	.56
N	*663*		*116*				

*p < .05; **p < .01; ***p < .001

Note. Effect size for dichotomous outcomes is Cox's index.

Combined Estimate of STEMP Program Participation

When we combine the results for each outcome across terms, we see positive and significant results for two of the three outcomes—STEM credits and continuation in STEM (Exhibit 8). The overall estimate for each outcome is an average of the distribution of the effects of STEMP program participation in the population. This average effect size is small and statistically significant for STEM credits (0.09) and moderate and statistically significant for continuation in STEM (0.31).

Exhibit 8. Meta-Analysis Impact Estimate Across Terms

Outcome	Effect Size	SE	p
STEM GPA	0.02	0.06	0.7982
STEM Credits	0.09	0.04	0.0352
Continuation in STEM	0.31	0.08	0.0077

Note. STEM GPA and STEM Credits outcomes used results from nine terms. Continuation in STEM used results from eight terms.

Limitations

The goal of this analysis is to estimate the impact of STEMP program participation on student outcomes. Because we are unable to observe outcomes for the same students with and without STEMP program support and STEMP program access was not randomized, we have attempted to approximate this impact by employing a statistically equivalent comparison group. By weighting the comparison group to be similar to the group of STEMP program participants in each term, we have reduced any differences in the outcomes that are due to differences in the composition of the treatment and comparison groups themselves rather than STEMP program participation. For example, by ensuring the two groups have similar prior STEM GPAs, we minimize the extent to which any observed differences in the course grade earned in the focal terms result from prior achievement rather than STEMP program participation. As with any observational study employing propensity score methodologies, a key limitation is effectively accounting for all factors associated with selection into the STEMP program. There may still be unobservable characteristics that drive differences between the treatment and comparison groups. We are only able to ensure equivalence on observed characteristics, including student demographics and STEM preparation, but cannot account for other potentially important and unobserved characteristics. Some examples include access to resources outside of LACC, peer networks, or a standardized measure of prior achievement. If STEMP program participants and nonparticipants vary based on these unobserved characteristics, the impact estimates may be biased, i.e., our findings may overestimate or underestimate program impact.

Discussion

This impact analysis of STEMP program participation from fall 2017 through fall 2019 suggests that the suite of supports offered by the STEMP program provides a promising strategy for improving STEM student success. Across terms, the most robust findings were for continuation in STEM, with a small to moderate average effect size, and STEM credits earned, with a small effect size; the average effect for STEM GPA was positive but not statistically significant. In considering these effects together, it could be that the program is effective at retaining student in STEM disciplines who might otherwise have left, and that these students end up enrolling and persisting in challenging coursework.

The average effects obscure variation by term, including a positive and statistically significant effect for STEM GPA in three of nine terms and a negative and statistically significant effect for GPA in two terms, as well as a negative and statistically significant effect for STEM credits in winter 2019. This variation may, in part, result from the inability to account for unobservable characteristics related to selection into program participation, particularly for some terms and populations of students. For example, comparison students may have had access to more outside supports, or treatment students may have chosen to participate due to a particularly difficult instructor or homework assignment in some terms. This variation could also result from differences in program delivery across terms. If training, availability, or the number of staff varied over time, this might lead to differences in estimated program effects. This is one possible explanation for negative effects on STEM credits and GPA in winter 2019, where the SI usage by course differed from other intersession terms.

Finally, we examined STEM degree or certificate attainment and STEM transfer degree attainment for STEMP participants in spring 2018. The results for this analysis were not statistically significant but were positive. Many students have only a single program interaction in a term; for example, in fall 2018 nearly a third of the 183 STEMP program participants had only one program interaction. The results of our exploratory analysis for high-intensity usage (three or more program interactions) on degree attainment, while still not statistically significant, yielded an effect size of 0.47. This suggests that a focus on encouraging students to deepen their participation in the program either through accessing multiple components or increasing the intensity with which they use a single component may support the realization of the program goals of increasing STEM transfer rates.

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Appendix A: Impact Analysis Methodology

Sample and Data Elements

The administrative and STEMP program participation data LACC provided to SRI enabled us to create the outcome, demographic, enrollment, and coursetaking metrics used in the analysis.

Analytic Sample

The analytic sample is comprised of students who met our STEM student definition and were enrolled in a STEM course in a given term between fall 2017 and fall 2019, including winter and summer intersession terms. The STEM student population is defined as students who enrolled at LACC between fall 2017 and fall 2019, were not dual enrolled, and either 1) declared a STEM major or 2) enrolled in Math 240 or above within LACCD. The analytic sample includes students who participated in STEMP program components and STEM students enrolled in a STEM course in that term who did not participate in STEMP program components.

Handling Missing Data

Less than 5% of students have missing data; therefore, the study team did not impute any missing data. Only complete case analyses were used for the impact analysis.

Outcome Measures

The goal of the STEMP program was to provide students with academic support to help them succeed in STEM courses, enabling them to proceed to higher-level STEM coursework in pursuit of a degree or certificate. To capture the impact of STEMP program participation on course success and continuation in STEM, we examined course success in the focal term when a student sought help. We examined five outcomes: the number of STEM credits earned by a student in the focal term, the student's GPA in the focal term in STEM courses only, a student's continued enrollment in STEM courses in the subsequent two terms, a student's attainment of a STEM degree or certificate, or a student's attainment of a STEM associate degree for transfer (Exhibit A-1).

Exhibit A-1. Outcomes in the Focal Term

Variable	Description
STEM credits earned	Total number of STEM credits earned during the focal term.
STEM GPA	Student's STEM GPA in the focal term only. STEM GPA was calculated as the total grade points earned in STEM courses (A = 4, B = 3, C = 2, D = 1, F = 0) divided by the total number of credits attempted in STEM courses, excluding withdrawals and courses taken pass/fail.
Continuation in STEM	STEM course enrollment in one or more of the two subsequent terms following the focal term (binary indicator).
Degree Attainment	Completion of any STEM degree or certificate (binary indicator).
Transfer Degree Attainment	Completion of a transfer-level STEM AA or AS degree (binary indicator).

Demographic, Enrollment, and Coursetaking Measures

The impact analysis included available student-level measures that would reasonably be associated with both a student's likelihood of using the STEMP program and their STEM course success or progress toward degree attainment (Exhibit A-2). These measures encompass demographic indicators of race/ethnicity, gender, socioeconomic status, and California residency as well as academic performance prior to the focal term and coursetaking indicators in the focal term.

Some students were associated with multiple race/ethnicity values across data requests—in all of these instances, students were identified by the college as "unknown" in addition to another race/ethnicity. A response of "unknown" means that a student did not self-identify or that they self-identified as "other" race/ethnicity. In these cases, we assigned students the non-unknown values for race/ethnicity. When calculating course grades, some students had multiple enrollments in the same course section that were associated with multiple grades. In these instances, we kept the highest grade (A > B > C > D > F and P > NP) and dropped records where one grade was a "W" (withdrawal) or missing.

Exhibit A-2. Enrollment, Demographic, and Coursetaking Data Elements

Variable	Description
Student demographics	
Black[a]	Student self-identifies as "Black or African American" (binary indicator).
Latinx[a]	Student self-identifies as "Hispanic/Latino" (binary indicator).
Asian[a]	Student self-identifies as "Asian" (binary indicator).
Female	Student self-identifies as "Female" (binary indicator).
Age	Student's age as of beginning of focal semester, calculated from birth date.
Pell	Student received a Pell Grant (binary indicator). Note—undocumented students are not eligible for federal financial aid.
Promise Grant	Student is eligible for California Promise Grant to waive enrollment fees (binary indicator).
Non-resident	Student is not a California resident (i.e., out-of-state or out-of-country) (binary indicator).
AB540	Student has a special residency status of "AB540" (binary indicator), indicating that they are eligible to pay in-state tuition despite being classified as a California non-resident.[b] To be eligible, a student must have attended a California educational institution for 3+ years, attained a diploma, degree, or fulfilled minimum transfer requirements from a California educational institution, and have a signed exemption request.
Prior enrollment and coursetaking	
First term	Focal term is the student's first term enrolled at LACCD (binary indicator).
N terms enrolled	Total number of terms (winter, spring, summer, fall) in which student was enrolled in at least one course across all LACCD campuses prior to the focal semester, including enrollments during high school (dual credit).
Credits earned	Total number of credits student earned across all LACCD campuses prior to the focal term. Credits are considered earned if the student earned a grade "C" or better, or earned a grade of "P," "CR," or "CRX" in the course.
Any dual enrollment credits	Student earned LACCD credits while in high school (prior to focal term) through dual enrollment (binary indicator).
Prior GPA	Student's GPA across all courses prior to the focal semester. GPA was calculated as the total grade points earned (A = 4, B = 3, C = 2, D = 1, F = 0) divided by the total number of credits attempted.
Focal term coursetaking	
Credits attempted (att.)	Total credits attempted during focal term.
STEM credits att.	STEM credits attempted during focal term.
Prior STEM coursetaking	
Highest math	Tier of highest-level math course taken at any LACCD campus prior to the focal term (e.g., Tier 1 includes intermediate algebra and pre-statistics; Tier 2 includes statistics and college algebra; Tier 3 includes pre-calculus; Tier 4 includes Calculus I; Tier 5 includes Calculus II; and Tier 6 includes Calculus III and ordinary differential equations). Equal to 0 if student had no prior math course. Missing for students whose highest prior math course could not be classified into a tier.
No prior math	Student was not enrolled in a math course at any LACCD campus prior to the focal term (binary indicator).

Variable	Description
Prior transfer-level (TL) STEM credits	Total number of transfer-level STEM credits the student earned prior to the focal term. STEM courses were identified based on eligible Taxonomy of Programs (TOP) codes.[c] STEM courses were considered transfer-level if they have a transfer code of A – transferable to UC/CSU or B – transferable to CSU only.
Prior non-transfer level (NTL) STEM credits	Total number of below-transfer-level STEM credits the student earned prior to the focal semester. STEM courses were identified based on eligible TOP codes. STEM courses were considered below transfer-level if they have a transfer code of "C – non-transferable."
Prior TL STEM GPA	Student's GPA across transfer-level STEM courses taken prior to the focal term. GPA was calculated as the total grade points earned (A = 4, B = 3, C = 2, D = 1, F = 0) divided by the total number of credits attempted. STEM courses were identified based on eligible TOP codes. STEM courses were considered transfer-level if they have a transfer code of A – transferable to UC/CSU or B – transferable to CSU only. Equal to 0 if student had no prior transfer-level STEM credits attempted.
Prior NTL STEM GPA	Student's GPA across below-transfer-level STEM courses taken prior to the focal term. GPA was calculated as the total grade points earned (A = 4, B = 3, C = 2, D = 1, F = 0) divided by the total number of credits attempted. STEM courses were identified based on eligible TOP codes. STEM courses were considered below transfer-level if they have a transfer code of C – non-transferable. Equal to 0 if student had no prior below-transfer-level STEM credits attempted.
No prior NTL STEM credits	Student had no below-transfer-level STEM credits attempted prior to the focal semester (binary indicator).
No prior TL STEM credits	Student had no transfer-level STEM credits attempted prior to the focal semester (binary indicator).
Prior program participation	
Prior STEMP program participation	Student participated in any STEMP program component except STEM events in the previous two terms (binary indicator).

[a] Other race/ethnicity variables included American Indian/Alaskan Native, Pacific Islander, two or more races, and White.

[b] Students may be classified as non-residents for a variety of reasons, including being undocumented.

[c] The Taxonomy of Programs (TOP) is a California state-level system to organize and equate course and program information across multiple institutions that may use a variety of names for similar courses or programs.

Analytic Approach

This study used propensity score weighting to test the effect of STEMP program participation on student outcomes. Propensity score techniques are quasi-experimental approaches developed to approximate findings obtained from randomized controlled trials (Becker & Ichino, 2002). They have been increasingly used in observational studies with cohort designs to reduce selection bias in estimating treatment or intervention effects when randomized controlled trials are not feasible or ethical (Rosenbaum & Rubin, 1983, 1984, 1985).

Propensity Score Methodology

The propensity score is the predicted probability of participating in a treatment (for example, STEMP program participation) based on a set of potentially confounding covariates (i.e., student demographic characteristics, prior term coursetaking, and academic achievement). In this analysis, we estimated propensity scores using a logistic regression model with the enrollment, demographic, and coursetaking data elements defined in Exhibit A-2.

Propensity score techniques attempt to equalize the mean values of potentially confounding observed covariates in the treatment and comparison groups, assuring that differences in outcomes between the treatment and comparison groups are not the result of differences in mean values of those covariates. These approaches aim to generate rigorous and unbiased estimates of the effect of a treatment on the outcome of interest; however, propensity score techniques cannot account for unobserved confounders such as prior educational opportunities.

Weighting

This study estimated the average treatment effect on the treated (ATT) of STEMP program participation for each term. These ATT analyses adjusted for confounding factors using inverse propensity score estimators (Rosenbaum & Rubin, 1983). Specifically, the weight for treated students was 1.0, and the weight for comparison students was equal to $p_i/(1-p_i)$, where p_i is the propensity score for the i-th comparison student (Harder et al., 2010; Hirano et al., 2003). Comparison students with a high estimated propensity score will be assigned a large weight, which may contribute to unstable estimates when there are few of these students in the sample (Austin & Stuart, 2015). To address this issue, we trimmed the sample to exclude students with propensity scores in the 99th percentile. After applying the weights to the comparison sample, we examined the standardized mean difference (SMD) score (the difference in means for the treatment and comparison groups divided by a treatment standard deviation; Stuart et al., 2013) to ensure that they were less than 0.25, thereby assuring covariate balance (What Works Clearinghouse, 2017).

Impact Analysis Modeling

After establishing that the weights achieved baseline equivalence on observables, the study team used weighted multiple regression to estimate the impact of STEMP program participation on the continuous outcomes (STEM credits and STEM GPA) and used weighted logistic regression models for the three binary outcomes (continuation in STEM and the two degree attainment outcomes). The regression coefficients from each weighted regression model can be interpreted as the measure of association between STEMP program participation and the STEM outcome, adjusted for the estimated propensity of STEMP program participation.

All the models also controlled for student demographic characteristics and prior enrollment, coursetaking, program participation, and academic achievement. For the three term-specific outcomes (STEM credits, STEM GPA, and continuation in STEM), we estimated a separate weighted regression model for each outcome and each term.

The weighted regression model is as follows.

$$\eta_i = \beta_0 + \beta_1(STEMP_i) + \mathrm{X}_i B + e_i$$

In the multiple regression model η_i denotes the i-th student's average grade in focal courses. For the logistic regression model with the dichotomous outcomes of continuation in STEM and degree attainment, η_i is the logit link function $\eta_i = ln\left(\frac{\pi_i}{1-\pi_i}\right)$, with π_i denoting the probability that the i-th student enrolling in a STEM course in the next two terms or attaining a STEM degree. $STEMP_i$ is the treatment indicator variable, where 1 indicates participation in the STEMP program and 0 indicates no STEMP program participation. X_i is the vector of student-level prior achievement, demographic characteristics, coursetaking, and prior program participation defined in Exhibit A-2. The regression coefficient β_1 indicates the difference between STEMP program participants and non-participants in the outcome. B represents the vector of regression coefficients for demographic variables, prior coursetaking, program participation, and academic achievement variables included as controls. The study team calculated effect size as the estimated difference in the outcome between treatment and comparison groups, divided by the standard deviation in the treated group (Stuart et al., 2013).

Terms Included

We conducted the analysis for the three term-specific outcomes—STEM GPA, STEM credits, and continuation in STEM—by term from fall 2017 to fall 2019, including summer and winter intersession terms. Because of the increase in course withdrawals in spring 2020 due to the COVID-19 pandemic, we do not report on continuation in STEM for the fall 2019 term. In addition, we analyzed degree attainment for a focal cohort of students (those who participated in the spring 2018 term versus comparison students who did not). This allowed us to have a sufficient amount of time after program participation to reasonably observe degree attainment (2 years). Also, students could choose to participate in programming in some terms but not others, meaning that they could move between treatment and comparison status from term to term. Focusing on a single focal term in examining this longer-term outcome enabled us to sharply define both the treatment and comparison groups without concerns that treated students would later be comparison students.

Meta-Analytic Approach

After estimating separate models in each term for STEM credits, STEM GPA, and continuation in STEM, we combined estimates across terms using meta-analysis to provide a single estimate of the treatment effect for each outcome. We performed a random-effects meta-analysis that calculates the average effect of STEMP program participation on STEM learning outcomes across terms (all terms for STEM GPA and STEM credits; and all but fall 2019 for continuation in STEM). A random-effects model is more appropriate than a fixed-effects model because of the observed variation in the effect sizes across different terms (Hox et al., 2018). We conducted the multilevel meta-analysis of the by-term estimates using the empty "intercept-only" model using SAS PROC MIXED restricted maximum likelihood estimation.

Descriptive Statistics for Analytic Sample

The STEM Learning Center and Supplemental Instruction programs were the two most widely used components of the STEMP program, used by 22% to 77% of program participants, depending on the term (see Exhibit A-3). However, between 20% and 44% of participants used multiple components of the program each term—meaning that many SI and SLC participants likely also participated in other components of the program.

Exhibit A-3. STEMP Program Participation, by Component

	Fall 2017		Winter 2018		Spring 2018		Summer 2018		Fall 2018		Winter 2019		Spring 2019		Summer 2019		Fall 2019	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*
SLC	96	58%	31	41%	126	63%	19	22%	160	77%	45	45%	163	77%	48	39%	122	55%
SI	90	54%	56	75%	121	61%	60	70%	89	43%	72	71%	76	36%	72	59%	138	62%
Counseling	17	10%	0	0%	0	0%	8	9%	53	25%	13	13%	13	6%	0	0%	0	0%
Book loan	0	0%	0	0%	1	1%	20	23%	24	12%	18	18%	61	29%	42	34%	19	9%
URE	0	0%	0	0%	0	0%	12	14%	0	0%	0	0%	0	0%	19	15%	0	0%
Math boot camp	0	0%	7	9%	0	0%	5	6%	0	0%	0	0%	0	0%	0	0%	4	2%
Multiple	34	20%	17	23%	50	25%	28	33%	91	44%	34	34%	86	40%	43	35%	62	28%
Total students	166	100%	75	100%	200	100%	86	100%	208	100%	101	100%	213	100%	123	100%	223	100%

We also examined the total number of prior program interactions for program participants. The mean number of prior program interactions increased over time (see Exhibit A-4).

Exhibit A-4. Mean Prior Program Interactions, by Term

	Comparison		Treatment	
	Mean	*SD*	*Mean*	*SD*
Fall 2017	0.15	1.51	6.58	13.27
Spring 2018	0.47	3.40	9.75	18.88
Fall 2018	0.50	3.45	9.90	20.54
Spring 2019	0.62	3.30	19.90	33.27
Fall 2019	1.11	7.46	18.87	35.62

Exhibits A-5a and A-5b provide the unweighted descriptive statistics for the enrollment, demographic, and coursetaking data elements used in the impact analyses for students in each term who participated in the STEMP program and their peers who did not. These descriptive statistics are for the trimmed sample, excluding students with propensity scores in the 99th percentile.[8] Exhibits A-6a and A-6b present the unweighted outcomes before propensity score weighting. In Exhibits A-5a and A-5b, "C" columns show values for the comparison group—STEM students who were enrolled in a STEM course but did not participate in a STEMP

[8] See "Weighting," above. The number of treatment students in the final analytic sample is slightly less than the total shown in Exhibits A-3 due to this trimming.

component in the focal term. “T” columns show values for the treatment group—STEM students who used the STEMP program at least once during the focal term. In addition to mean values, tables also show the standard deviation (“sd”) and standardized mean difference (“SMD”) between the treatment and comparison groups.

STEMP program participants were higher achieving than non-participants based on a number of different prior coursework indicated included in the analysis. STEMP program participants, on average, earned more credits in prior terms than non-participants, including more transfer-level STEM classes, and earned higher GPAs in this coursework. Further, they had completed more advanced math coursework prior to the focal term. In the main fall and spring terms, STEMP participants attempted more STEM credits in the focal term than non-participants, but this trend does not hold for summer and winter intersession terms when students attempt fewer courses on average.

Exhibit A-5a. Descriptive Statistics Before Propensity Score Weighting – Fall and Spring (Primary) Terms

	Fall 2017					Spring 2018					Fall 2018					Spring 2019					Fall 2019				
	C mean (sd)		T mean (sd)		SMD	C mean (sd)		T mean (sd)		SMD	C mean (sd)		T mean (sd)		SMD	C mean (sd)		T mean (sd)		SMD	C mean (sd)		T mean (sd)		SMD
Demographics																									
Black	.05	(0.22)	.06	(0.24)	-.04	.05	(0.23)	.06	(0.24)	-.02	.05	(0.23)	.06	(0.24)	-.04	.05	(0.21)	.07	(0.25)	-.07	.05	(0.23)	.04	(0.20)	.07
Latinx	.50	(0.50)	.43	(0.50)	.14	.50	(0.50)	.45	(0.50)	.10	.52	(0.50)	.54	(0.50)	-.04	.53	(0.50)	.49	(0.50)	.08	.56	(0.50)	.44	(0.50)	.25
Asian	.21	(0.41)	.23	(0.42)	-.06	.21	(0.41)	.19	(0.39)	.07	.20	(0.40)	.17	(0.38)	.08	.18	(0.39)	.18	(0.38)	.01	.18	(0.38)	.23	(0.42)	-.11
Female	.40	(0.49)	.37	(0.49)	.06	.42	(0.49)	.42	(0.49)	.01	.44	(0.50)	.38	(0.49)	.13	.44	(0.50)	.38	(0.49)	.14	.44	(0.50)	.44	(0.50)	.01
Age	25.76	(8.35)	26.38	(7.48)	-.08	26.13	(8.88)	27.51	(9.34)	-.15	25.80	(8.58)	25.81	(7.18)	.00	26.09	(8.67)	25.70	(7.36)	.05	25.42	(8.04)	25.74	(7.56)	-.04
Pell	.42	(0.49)	.44	(0.50)	-.04	.47	(0.50)	.49	(0.50)	-.03	.46	(0.50)	.49	(0.50)	-.07	.49	(0.50)	.52	(0.50)	-.06	.49	(0.50)	.52	(0.50)	-.06
Promise grant	.75	(0.43)	.78	(0.42)	-.07	.77	(0.42)	.80	(0.40)	-.06	.77	(0.42)	.77	(0.42)	-.02	.76	(0.43)	.74	(0.44)	.04	.77	(0.42)	.76	(0.43)	.02
Non-resident	.13	(0.34)	.16	(0.37)	-.08	.11	(0.32)	.13	(0.34)	-.05	.11	(0.31)	.15	(0.36)	-.11	.11	(0.31)	.15	(0.36)	-.11	.11	(0.32)	.16	(0.36)	-.11
AB540	.08	(0.27)	.09	(0.28)	-.03	.07	(0.25)	.08	(0.28)	-.05	.06	(0.24)	.09	(0.29)	-.10	.07	(0.25)	.09	(0.29)	-.09	.07	(0.26)	.09	(0.29)	-.07
Prior coursetaking																									
First term	.16	(0.36)	.08	(0.27)	.29	.08	(0.26)	.05	(0.23)	.09	.14	(0.35)	.14	(0.35)	.00	.08	(0.28)	.04	(0.20)	.22	.14	(0.34)	.13	(0.33)	.04
N terms enrolled	6.67	(5.89)	8.55	(5.39)	-.35	7.43	(6.34)	8.76	(5.96)	-.22	6.93	(6.49)	7.55	(5.65)	-.11	7.18	(6.18)	7.82	(5.68)	-.11	6.52	(6.29)	7.08	(5.43)	-.10
Credits earned	38.44	(33.66)	55.45	(32.50)	-.52	43.33	(35.91)	56.05	(36.45)	-.35	39.32	(36.89)	49.28	(36.25)	-.27	40.80	(34.34)	51.97	(35.12)	-.32	35.76	(34.87)	45.34	(35.48)	-.27
Any dual enrollment credits	.22	(0.42)	.29	(0.45)	-.14	.23	(0.42)	.23	(0.42)	.01	.25	(0.43)	.24	(0.43)	.01	.25	(0.43)	.19	(0.39)	.17	.26	(0.44)	.23	(0.42)	.08
Prior GPA	2.43	(1.21)	2.85	(0.95)	-.43	2.64	(1.06)	2.88	(0.98)	-.24	2.48	(1.19)	2.80	(1.10)	-.29	2.59	(1.08)	2.91	(0.96)	-.34	2.50	(1.23)	2.84	(1.14)	-.30
Focal term coursetaking																									
Credits att.	10.51	(4.02)	11.64	(3.68)	-.31	10.63	(4.10)	10.88	(3.56)	-.07	10.43	(4.01)	11.81	(3.99)	-.34	10.23	(4.12)	11.06	(3.58)	-.23	10.20	(3.94)	11.10	(4.00)	-.23
STEM credits att.	6.02	(2.91)	8.69	(3.56)	-.75	6.19	(2.96)	8.15	(3.07)	-.64	5.91	(2.83)	8.58	(3.28)	-.81	5.89	(2.85)	8.38	(3.29)	-.76	5.68	(2.67)	8.32	(3.27)	-.81
Prior STEM coursetaking																									

	Fall 2017					Spring 2018					Fall 2018					Spring 2019					Fall 2019				
	C mean (sd)		T mean (sd)		SMD	C mean (sd)		T mean (sd)		SMD	C mean (sd)		T mean (sd)		SMD	C mean (sd)		T mean (sd)		SMD	C mean (sd)		T mean (sd)		SMD
Highest math	1.58	(1.80)	3.27	(2.06)	-.82	1.75	(1.88)	3.15	(1.88)	-.74	1.56	(1.85)	2.81	(2.14)	-.58	1.69	(1.87)	3.27	(1.93)	-.82	1.54	(1.82)	2.83	(2.08)	-.62
No prior math	.26	(0.44)	.10	(0.30)	.53	.18	(0.38)	.11	(0.32)	.19	.27	(0.45)	.22	(0.41)	.14	.21	(0.41)	.09	(0.29)	.42	.34	(0.47)	.21	(0.41)	.32
Prior TL STEM credits	9.43	(12.31)	20.99	(17.28)	-.67	11.11	(14.20)	21.26	(18.70)	-.54	9.38	(13.10)	19.79	(19.36)	-.54	10.19	(13.77)	20.42	(17.94)	-.57	8.77	(13.30)	18.46	(18.47)	-.52
Prior NTL STEM credits	3.64	(4.33)	5.32	(4.89)	-.34	3.83	(4.42)	5.27	(4.99)	-.29	3.45	(4.34)	4.62	(5.00)	-.23	3.61	(4.33)	4.72	(4.87)	-.23	2.93	(4.14)	4.17	(4.96)	-.25
Prior TL STEM GPA	1.79	(1.49)	2.51	(1.27)	-.56	1.89	(1.49)	2.59	(1.18)	-.59	1.64	(1.48)	2.37	(1.35)	-.54	1.80	(1.49)	2.63	(1.14)	-.72	1.56	(1.50)	2.50	(1.34)	-.71
Prior NTL STEM GPA	1.35	(1.54)	1.89	(1.62)	-.33	1.40	(1.53)	1.80	(1.62)	-.25	1.25	(1.50)	1.61	(1.63)	-.22	1.33	(1.53)	1.70	(1.64)	-.22	1.07	(1.46)	1.55	(1.67)	-.29
No prior NTL STEM credits	.31	(0.46)	.12	(0.33)	.60	.29	(0.45)	.09	(0.29)	.66	.35	(0.48)	.19	(0.39)	.41	.30	(0.46)	.10	(0.30)	.67	.38	(0.48)	.16	(0.37)	.59
No prior TL STEM credits	.49	(0.50)	.37	(0.48)	.25	.46	(0.50)	.39	(0.49)	.15	.51	(0.50)	.46	(0.50)	.10	.48	(0.50)	.44	(0.50)	.07	.58	(0.49)	.50	(0.50)	.15
Prior program participation																									
Prior STEMPP	.03	(0.16)	.29	(0.46)	-.58	.04	(0.20)	.42	(0.49)	-.76	.03	(0.18)	.39	(0.49)	-.73	.04	(0.19)	.56	(0.50)	-1.06	.04	(0.18)	.48	(0.50)	-.88
N	*1948*		*150*			*1965*		*183*			*2014*		*190*			*2042*		*197*			*1903*		*200*		

Exhibit A-6a. Outcomes Before Propensity Score Weighting – Fall and Spring (Primary) Terms

	Fall 2017					Spring 2018					Fall 2018					Spring 2019					Fall 2019				
	C mean (sd)		T mean (sd)		SMD	C mean (sd)		T mean (sd)		SMD	C mean (sd)		T mean (sd)		SMD	C mean (sd)		T mean (sd)		SMD	C mean (sd)		T mean (sd)		SMD
Outcomes																									
Focal course passing	3.82	(3.29)	6.51	(4.25)	-.63	4.08	(3.45)	6.68	(3.41)	-.76	3.60	(3.32)	6.29	(4.04)	-.67	3.67	(3.29)	5.93	(4.00)	-.57	3.38	(3.21)	6.17	(4.21)	-.66
Focal course grade	2.19	(1.50)	2.58	(1.29)	-.30	2.23	(1.52)	2.90	(1.09)	-.62	2.07	(1.56)	2.52	(1.23)	-.37	2.16	(1.57)	2.49	(1.36)	-.25	1.97	(1.56)	2.37	(1.30)	-.31
Continuation in STEM	.65	(0.48)	.88	(0.33)	-.70	.60	(0.49)	.70	(0.46)	-.23	.62	(0.48)	.84	(0.37)	-.58	.51	(0.50)	.66	(0.47)	-.31	NA	NA	NA	NA	NA
N	*1948*		*150*			*1965*		*183*			*2014*		*190*			*2042*		*197*			*1903*		*200*		

Exhibit A-5b. Descriptive Statistics Before Propensity Score Weighting – Summer and Winter (Intersession) Terms

	Winter 2018					Summer 2018					Winter 2019					Summer 2019				
	C mean (sd)		T mean (sd)		SMD	C mean (sd)		T mean (sd)		SMD	C mean (sd)		T mean (sd)		SMD	C mean (sd)		T mean (sd)		SMD
Demographics																				
Black	0.05	(0.23)	0.03	(0.17)	0.15	0.06	(0.24)	0.04	(0.19)	0.11	0.04	(0.21)	0.07	(0.26)	-0.11	0.07	(0.26)	0.08	(0.27)	-0.01
Latinx	0.50	(0.50)	0.50	(0.50)	0.01	0.48	(0.50)	0.51	(0.50)	-0.06	0.49	(0.50)	0.52	(0.50)	-0.05	0.45	(0.50)	0.51	(0.50)	-0.11
Asian	0.22	(0.42)	0.23	(0.42)	-0.02	0.21	(0.41)	0.21	(0.41)	0.02	0.21	(0.41)	0.17	(0.37)	0.12	0.21	(0.41)	0.21	(0.41)	0.00
Female	0.42	(0.49)	0.36	(0.48)	0.13	0.44	(0.50)	0.33	(0.47)	0.23	0.46	(0.50)	0.36	(0.48)	0.19	0.50	(0.50)	0.44	(0.50)	0.12
Age	25.18	(7.01)	25.16	(5.53)	0.00	25.23	(7.27)	25.15	(6.69)	0.01	25.75	(7.73)	24.40	(5.39)	0.25	25.94	(7.42)	25.69	(7.81)	0.03
Pell	0.48	(0.50)	0.43	(0.50)	0.11	0.42	(0.49)	0.53	(0.50)	-0.21	0.48	(0.50)	0.55	(0.50)	-0.15	0.46	(0.50)	0.53	(0.50)	-0.14
Promise grant	0.78	(0.42)	0.70	(0.46)	0.17	0.69	(0.46)	0.76	(0.43)	-0.15	0.77	(0.42)	0.82	(0.38)	-0.13	0.75	(0.43)	0.77	(0.42)	-0.05
Non-resident	0.12	(0.33)	0.16	(0.37)	-0.09	0.11	(0.32)	0.09	(0.29)	0.08	0.11	(0.31)	0.16	(0.36)	-0.13	0.11	(0.31)	0.15	(0.36)	-0.11
AB540	0.07	(0.25)	0.10	(0.30)	-0.12	0.07	(0.25)	0.05	(0.22)	0.07	0.07	(0.25)	0.14	(0.34)	-0.19	0.06	(0.25)	0.10	(0.31)	-0.13
Prior coursetaking																				
First term	0.09	(0.28)	0.13	(0.34)	-0.12	0.15	(0.36)	0.12	(0.32)	0.11	0.09	(0.28)	0.03	(0.17)	0.32	0.15	(0.36)	0.06	(0.24)	0.38
N terms enrolled	6.85	(5.95)	7.03	(5.72)	-0.03	6.32	(5.27)	7.19	(4.92)	-0.18	6.71	(5.43)	7.73	(5.80)	-0.18	6.52	(5.49)	7.53	(5.29)	-0.19
Credits earned	41.83	(33.94)	50.93	(36.61)	-0.25	38.15	(31.48)	47.27	(31.97)	-0.29	41.68	(33.94)	54.49	(37.42)	-0.34	37.03	(31.45)	49.54	(35.46)	-0.35
Any dual enrollment credits	0.22	(0.42)	0.26	(0.44)	-0.07	.28	(0.45)	0.27	(0.45)	0.02	0.23	(0.42)	0.24	(0.43)	-0.02	0.25	(0.43)	0.22	(0.42)	0.05
Prior GPA	2.66	(1.06)	2.82	(1.13)	-0.14	2.46	(1.18)	2.71	(1.06)	-0.24	02.65	(1.09)	2.93	(0.89)	-0.31	2.48	(1.21)	2.88	(0.98)	-0.41
Focal term coursetaking																				
Credits att.	4.76	(1.67)	4.59	(1.47)	0.12	5.55	(2.13)	5.42	(2.14)	0.06	4.97	(1.70)	4.72	(1.21)	0.20	5.61	(2.26)	5.28	(2.34)	0.14
STEM credits att.	4.06	(1.08)	4.17	(1.27)	-0.09	4.44	(1.40)	4.55	(1.65)	-0.07	4.23	(1.13)	4.28	(1.01)	-0.05	4.38	(1.40)	4.22	(1.51)	0.10
Prior STEM coursetaking																				
Highest math	1.90	(1.91)	3.07	(2.16)	-0.54	1.72	(1.83)	3.10	(2.07)	-0.67	2.03	(2.03)	3.43	(2.04)	-0.69	1.68	(1.81)	2.85	(1.84)	-0.64

	Winter 2018					Summer 2018					Winter 2019					Summer 2019				
	C mean (sd)		T mean (sd)		SMD	C mean (sd)		T mean (sd)		SMD	C mean (sd)		T mean (sd)		SMD	C mean (sd)		T mean (sd)		SMD
No prior math	0.17	(0.38)	0.21	(0.41)	-0.10	0.26	(0.44)	0.15	(0.36)	0.28	0.21	(0.41)	0.07	(0.26)	0.52	0.27	(0.45)	0.10	(0.31)	0.55
Prior TL STEM credits	11.17	(13.89)	21.20	(19.59)	-0.51	9.40	(12.36)	19.12	(16.44)	-0.59	11.06	(13.72)	21.99	(18.57)	-0.59	9.42	(12.48)	18.97	(19.19)	-0.50
Prior NTL STEM credits	3.91	(4.34)	4.13	(4.93)	-0.04	3.72	(4.40)	4.41	(4.57)	-0.15	3.33	(4.12)	4.82	(5.02)	-0.30	3.25	(4.12)	4.91	(5.05)	-0.33
Prior TL STEM GPA	1.89	(1.44)	2.42	(1.45)	-0.37	1.74	(1.45)	2.35	(1.31)	-0.47	1.83	(1.47)	2.62	(1.18)	-0.67	1.77	(1.48)	2.56	(1.26)	-0.62
Prior NTL STEM GPA	1.50	(1.56)	1.44	(1.63)	0.04	1.34	(1.54)	1.76	(1.73)	-0.25	1.33	(1.55)	1.78	(1.67)	-0.27	1.24	(1.51)	1.76	(1.62)	-0.32
No prior NTL STEM credits	0.27	(0.45)	0.20	(0.40)	0.19	0.31	(0.46)	0.17	(0.38)	0.38	0.28	(0.45)	0.08	(0.28)	0.71	0.29	(0.46)	0.11	(0.32)	0.57
No prior TL STEM credits	0.43	(0.50)	0.53	(0.50)	-0.20	0.49	(0.50)	0.45	(0.50)	0.09	0.50	(0.50)	0.42	(0.50)	0.16	0.53	(0.50)	0.41	(0.49)	0.25
Prior program participation																				
Prior STEMPP	0.09	(0.29)	0.27	(0.45)	-0.40	0.04	(0.20)	0.36	(0.48)	-0.66	0.05	(0.22)	0.42	(0.50)	-0.73	0.04	(0.19)	0.41	(0.49)	-0.76
N	*553*		*70*			*668*		*78*			*562*		*96*			*663*		*116*		

Exhibit A-6b. Outcomes Before Propensity Score Weighting – Summer and Winter (Intersession) Terms

	Winter 2018					Summer 2018					Winter 2019					Summer 2019				
	C mean (sd)		T mean (sd)		SMD	C mean (sd)		T mean (sd)		SMD	C mean (sd)		T mean (sd)		SMD	C mean (sd)		T mean (sd)		SMD
Outcomes																				
Focal course passing	2.88	(2.02)	3.24	(1.89)	-0.19	3.07	(2.31)	3.21	(2.46)	-0.05	2.86	(2.15)	2.24	(2.19)	0.28	3.11	(2.26)	3.02	(2.21)	0.04
Focal course grade	2.39	(1.52)	2.55	(1.38)	-0.12	2.30	(1.53)	2.14	(1.53)	0.10	2.29	(1.59)	1.77	(1.54)	0.34	2.44	(1.58)	2.43	(1.47)	0.01
Continuation in STEM	.82	(0.38)	0.80	(0.40)	0.05	0.65	(0.48)	0.72	(0.45)	-0.16	.78	(0.41)	0.91	(0.29)	-0.42	0.56	(0.50)	0.78	(0.41)	-0.55
N	*553*		*70*			*668*		*78*			*562*		*96*			*663*		*116*		

Baseline Equivalence After Propensity Score Weighting

To ensure that the propensity score method successfully created balanced treatment and comparison groups in each term, we compared SMD after propensity score weighting for each observable characteristic. Balance on observable characteristics was greatly improved after applying the propensity score weights. Data presented in Exhibits A-7a and A-7b show the baseline equivalence after weighting. To calculate SMD between treatment and comparison groups, the study team divided differences in each covariate by the treatment group standard deviations (Stuart et al., 2013). Prior to weighting, standardized differences ranged from -1.06 to 0.67 standard deviations (see Exhibits A-5a and A-5b). After propensity score weighting, standardized differences ranged from -0.17 to 0.17 (Exhibits A-7a and A-7b), which is lower than the What Works Clearinghouse 0.25 cutoff for baseline equivalence for quasi-experimental studies (What Works Clearinghouse, 2017). Therefore, STEMP program participants and nonparticipants were very similar on all potentially confounding observed covariates after propensity score weighting.

Exhibit A-7a. Descriptive Statistics After Propensity Score Weighting – Fall and Spring (Primary) Terms

	Fall 2017					Spring 2018					Fall 2018					Spring 2019					Fall 2019				
	C mean	(sd)	T mean	(sd)	SMD	C mean	(sd)	T mean	(sd)	SMD	C mean	(sd)	T mean	(sd)	SMD	C mean	(sd)	T mean	(sd)	SMD	C mean	(sd)	T mean	(sd)	SMD
Demographics																									
Black	0.06	(0.06)	0.06	(0.24)	-0.01	0.06	(0.07)	0.06	(0.24)	-0.01	0.05	(0.07)	0.06	(0.24)	-0.06	0.06	(0.07)	0.07	(0.25)	-0.03	0.03	(0.05)	0.04	(0.20)	-0.07
Latinx	0.43	(0.14)	0.43	(0.50)	0.01	0.47	(0.15)	0.45	(0.50)	0.05	0.54	(0.15)	0.54	(0.50)	0.01	0.48	(0.15)	0.49	(0.50)	-0.01	0.47	(0.16)	0.44	(0.50)	0.06
Asian	0.22	(0.11)	0.23	(0.42)	-0.02	0.17	(0.11)	0.19	(0.39)	-0.04	0.16	(0.11)	0.17	(0.38)	-0.03	0.18	(0.12)	0.18	(0.38)	-0.01	0.21	(0.13)	0.23	(0.42)	-0.02
Female	0.40	(0.14)	0.37	(0.49)	0.06	0.40	(0.15)	0.42	(0.49)	-0.03	0.39	(0.15)	0.38	(0.49)	0.02	0.40	(0.15)	0.38	(0.49)	0.05	0.45	(0.16)	0.44	(0.50)	0.02
Age	25.94	(2.33)	26.38	(7.48)	-0.06	27.36	(2.80)	27.51	(9.34)	-0.02	25.17	(2.42)	25.81	(7.18)	-0.09	25.98	(2.38)	25.70	(7.36)	0.04	26.20	(2.47)	25.74	(7.56)	0.06
Pell	0.44	(0.14)	0.44	(0.50)	-0.01	0.48	(0.15)	0.49	(0.50)	-0.02	0.45	(0.15)	0.49	(0.50)	-0.08	0.57	(0.15)	0.52	(0.50)	0.09	0.51	(0.16)	0.52	(0.50)	-0.01
Promise grant	0.80	(0.11)	0.78	(0.42)	0.04	0.80	(0.12)	0.80	(0.40)	0.00	0.75	(0.13)	0.77	(0.42)	-0.06	0.77	(0.13)	0.74	(0.44)	0.07	0.79	(0.13)	0.76	(0.43)	0.08
Non-resident	0.16	(0.10)	0.16	(0.37)	0.00	0.15	(0.11)	0.13	(0.34)	0.06	0.15	(0.11)	0.15	(0.36)	0.00	0.11	(0.10)	0.15	(0.36)	-0.10	0.15	(0.12)	0.16	(0.36)	-0.01
AB540	0.09	(0.08)	0.09	(0.28)	0.01	0.09	(0.09)	0.08	(0.28)	0.04	0.09	(0.09)	0.09	(0.29)	-0.03	0.06	(0.07)	0.09	(0.29)	-0.11	0.09	(0.09)	0.09	(0.29)	0.01
Prior coursetaking																									
First term	0.09	(0.08)	0.08	(0.27)	0.03	0.05	(0.07)	0.05	(0.23)	-0.02	0.13	(0.10)	0.14	(0.35)	-0.03	0.05	(0.07)	0.04	(0.20)	0.05	0.12	(0.10)	0.13	(0.33)	-0.02
N terms enrolled	8.35	(1.49)	8.55	(5.39)	-0.04	8.97	(1.86)	8.76	(5.96)	0.03	7.53	(1.74)	7.55	(5.65)	0.00	7.82	(1.75)	7.82	(5.68)	0.00	7.02	(1.77)	7.08	(5.43)	-0.01
Credits earned	54.54	(9.49)	55.45	(32.5)	-0.03	56.17	(10.91)	56.05	(36.45)	0.00	49.35	(10.85)	49.28	(36.25)	0.00	53.12	(11.24)	51.97	(35.12)	0.03	45.52	(11.68)	45.34	(35.48)	0.01
Any dual enrollment credits	0.29	(0.12)	0.29	(0.45)	0.00	0.26	(0.13)	0.23	(0.42)	0.08	0.28	(0.14)	0.24	(0.43)	0.08	0.20	(0.12)	0.19	(0.39)	0.04	0.20	(0.13)	0.23	(0.42)	-0.06
Prior GPA	2.85	(0.26)	2.85	(0.95)	0.00	2.86	(0.29)	2.88	(0.98)	-0.02	2.81	(0.32)	2.80	(1.10)	0.01	2.97	(0.27)	2.91	(0.96)	0.06	2.85	(0.36)	2.84	(1.14)	0.01
Focal term coursetaking																									
Credits att.	11.58	(1.08)	11.64	(3.68)	-0.02	10.88	(1.25)	10.88	(3.56)	0.00	11.99	(1.20)	11.81	(3.99)	0.05	11.28	(1.27)	11.06	(3.58)	0.06	11.11	(1.26)	11.10	(4.00)	0.00
STEM credits att.	8.59	(1.02)	8.69	(3.56)	-0.03	8.14	(1.10)	8.15	(3.07)	0.00	9.00	(1.16)	8.58	(3.28)	0.13	8.62	(1.21)	8.38	(3.29)	0.07	8.64	(1.28)	8.32	(3.27)	0.10
Prior STEM coursetaking																									

	Fall 2017			Spring 2018			Fall 2018			Spring 2019			Fall 2019		
	C mean (sd)	T mean (sd)	SMD	C mean (sd)	T mean (sd)	SMD	C mean (sd)	T mean (sd)	SMD	C mean (sd)	T mean (sd)	SMD	C mean (sd)	T mean (sd)	SMD
Highest math	3.32 (0.58)	3.27 (2.06)	0.02	3.29 (0.64)	3.15 (1.88)	0.07	2.87 (0.70)	2.81 (2.14)	0.03	3.23 (0.65)	3.27 (1.93)	-0.02	2.76 (0.67)	2.83 (2.08)	-0.04
No prior math	0.10 (0.08)	0.10 (0.30)	0.02	0.11 (0.09)	0.11 (0.32)	-0.02	0.21 (0.13)	0.22 (0.41)	0.00	0.10 (0.09)	0.09 (0.29)	0.03	0.20 (0.13)	0.21 (0.41)	-0.02
Prior TL STEM credits	21.72 (5.13)	20.99 (17.28)	0.04	21.58 (5.73)	21.26 (18.70)	0.02	19.21 (5.42)	19.79 (19.36)	-0.03	20.87 (5.50)	20.42 (17.94)	0.03	17.61 (5.79)	18.46 (18.47)	-0.05
Prior NTL STEM credits	5.02 (1.26)	5.32 (4.89)	-0.06	4.94 (1.49)	5.27 (4.99)	-0.06	4.61 (1.48)	4.62 (5.00)	0.00	4.84 (1.54)	4.72 (4.87)	0.02	4.05 (1.50)	4.17 (4.96)	-0.02
Prior TL STEM GPA	2.51 (0.34)	2.51 (1.27)	0.00	2.57 (0.37)	2.59 (1.18)	-0.02	2.38 (0.40)	2.37 (1.35)	0.01	2.68 (0.36)	2.63 (1.14)	0.05	2.51 (0.43)	2.50 (1.34)	0.00
Prior NTL STEM GPA	1.90 (0.44)	1.89 (1.62)	0.01	1.69 (0.49)	1.80 (1.62)	-0.07	1.62 (0.50)	1.61 (1.63)	0.00	1.77 (0.53)	1.70 (1.64)	0.05	1.57 (0.54)	1.55 (1.67)	0.01
No prior NTL STEM credits	0.12 (0.09)	0.12 (0.33)	0.01	0.09 (0.09)	0.09 (0.29)	0.01	0.17 (0.12)	0.19 (0.39)	-0.04	0.09 (0.09)	0.10 (0.30)	-0.02	0.15 (0.12)	0.16 (0.37)	-0.03
No prior TL STEM credits	0.37 (0.13)	0.37 (0.48)	0.00	0.42 (0.15)	0.39 (0.49)	0.07	0.45 (0.15)	0.46 (0.50)	-0.02	0.44 (0.15)	0.44 (0.50)	0.00	0.49 (0.16)	0.50 (0.50)	-0.01
Prior program participation															
Prior STEMPP	0.28 (0.12)	0.29 (0.46)	-0.02	0.40 (0.15)	0.42 (0.49)	-0.03	0.37 (0.15)	0.39 (0.49)	-0.03	0.56 (0.15)	0.56 (0.50)	-0.02	0.47 (0.16)	0.48 (0.50)	-0.01
N	*1948*	*150*		*1965*	*183*		*2014*	*190*		*2042*	*197*		*1903*	*200*	

Exhibit A-7b. Descriptive Statistics After Propensity Score Weighting – Summer and Winter (Intersession) Terms

	Winter 2018			Summer 2018			Winter 2019			Summer 2019		
	C mean (sd)	T mean (sd)	SMD	C mean (sd)	T mean (sd)	SMD	C mean (sd)	T mean (sd)	SMD	C mean (sd)	T mean (sd)	SMD
Demographics												
Black	0.03 (0.06)	0.03 (0.17)	0.03	0.04 (0.07)	0.04 (0.19)	-0.01	0.08 (0.11)	0.07 (0.26)	0.01	0.08 (0.11)	0.08 (0.27)	0.00
Latinx	0.50 (0.18)	0.50 (0.50)	0.00	0.57 (0.17)	0.51 (0.50)	0.12	0.53 (0.21)	0.52 (0.50)	0.02	0.50 (0.21)	0.51 (0.50)	-0.02
Asian	0.21 (0.14)	0.23 (0.42)	-0.05	0.18 (0.13)	0.21 (0.41)	-0.06	0.15 (0.15)	0.17 (0.37)	-0.04	0.24 (0.18)	0.21 (0.41)	0.08
Female	0.35 (0.17)	0.36 (0.48)	-0.01	0.31 (0.16)	0.33 (0.47)	-0.05	0.31 (0.19)	0.36 (0.48)	-0.11	0.39 (0.21)	0.44 (0.50)	-0.09

	Winter 2018					Summer 2018					Winter 2019					Summer 2019				
	C mean (sd)		T mean (sd)		SMD	C mean (sd)		T mean (sd)		SMD	C mean (sd)		T mean (sd)		SMD	C mean (sd)		T mean (sd)		SMD
Age	25.04	(2.33)	25.16	(5.53)	-0.02	24.38	(2.27)	25.15	(6.69)	-0.12	24.78	(2.53)	24.40	(5.39)	0.07	24.95	(2.62)	25.69	(7.81)	-0.09
Pell	0.43	(0.17)	0.43	(0.50)	-0.01	.52	(0.17)	0.53	(0.50)	-0.01	0.54	(0.21)	0.55	(0.50)	-0.03	0.59	(0.21)	0.53	(0.50)	0.12
Promise grant	0.69	(0.16)	0.70	(0.46)	-0.02	.79	(0.14)	0.76	(0.43)	0.08	0.78	(0.17)	0.82	(0.38)	-0.11	0.76	(0.18)	0.77	(0.42)	-0.02
Non-resident	0.16	(0.13)	0.16	(0.37)	0.02	.07	(0.09)	0.09	(0.29)	-0.07	0.13	(0.14)	0.16	(0.36)	-0.08	0.13	(0.14)	0.15	(0.36)	-0.06
AB540	0.09	(0.10)	0.10	(0.30)	-0.02	.05	(0.07)	0.05	(0.22)	-0.03	0.10	(0.12)	0.14	(0.34)	-0.10	0.07	(0.11)	0.10	(0.31)	-0.11
Prior coursetaking																				
First term	0.13	(0.12)	0.13	(0.34)	0.01	.11	(0.11)	0.12	(0.32)	-0.02	0.03	(0.07)	0.03	(0.17)	-0.03	0.06	(0.10)	0.06	(0.24)	0.01
N terms enrolled	6.92	(1.92)	7.03	(5.72)	-0.02	7.09	(1.84)	7.19	(4.92)	-0.02	8.15	(2.04)	7.73	(5.80)	0.07	7.38	(2.12)	7.53	(5.29)	-0.03
Credits earned	49.75	(13.05)	50.93	(36.61)	-0.03	45.21	(10.93)	47.27	(31.97)	-0.06	56.54	(13.62)	54.49	(37.42)	0.05	48.71	(13.35)	49.54	(35.46)	-0.02
Any dual enrollment credits	0.25	(0.15)	0.26	(0.44)	-0.01	.30	(0.16)	0.27	(0.45)	0.06	0.20	(0.16)	0.24	(0.43)	-0.09	0.22	(0.18)	0.22	(0.42)	-0.01
Prior GPA	2.82	(0.40)	2.82	(1.13)	0.00	2.68	(0.38)	2.71	(1.06)	-0.03	2.95	(0.35)	2.93	(0.89)	0.02	2.86	(0.40)	2.88	(0.98)	-0.02
Focal term coursetaking																				
Credits att.	4.58	(0.52)	4.59	(1.47)	0.00	5.27	(0.73)	5.42	(2.14)	-0.07	4.64	(0.66)	4.72	(1.21)	-0.07	5.44	(0.97)	5.28	(2.34)	0.07
STEM credits att.	4.14	(0.45)	4.17	(1.27)	-0.02	4.57	(0.56)	4.55	(1.65)	0.01	4.13	(0.48)	4.28	(1.01)	-0.15	4.40	(0.60)	4.22	(1.51)	0.11
Prior STEM coursetaking																				
Highest math	2.99	(0.80)	3.07	(2.16)	-0.04	3.35	(0.77)	3.10	(2.07)	0.12	3.54	(0.87)	3.43	(2.04)	0.06	2.73	(0.83)	2.85	(1.84)	-0.07
No prior math	0.22	(0.15)	0.21	(0.41)	0.01	0.14	(0.12)	0.15	(0.36)	-0.03	0.07	(0.11)	0.07	(0.26)	0.00	0.12	(0.14)	0.10	(0.31)	0.05
Prior TL STEM credits	19.75	(6.69)	21.20	(19.59)	-0.07	18.49	(5.78)	19.12	(16.44)	-0.04	22.31	(6.92)	21.99	(18.57)	0.02	17.84	(7.11)	18.97	(19.19)	-0.06
Prior NTL STEM credits	4.26	(1.74)	4.13	(4.93)	0.03	3.62	(1.57)	4.41	(4.57)	-0.17	5.08	(1.95)	4.82	(5.02)	0.05	4.81	(2.10)	4.91	(5.05)	-0.02
Prior TL STEM GPA	2.43	(0.50)	2.42	(1.45)	0.00	2.32	(0.45)	2.35	(1.31)	-0.02	2.65	(0.49)	2.62	(1.18)	0.03	2.56	(0.53)	2.56	(1.26)	-0.01

	Winter 2018					Summer 2018					Winter 2019					Summer 2019				
	C mean (sd)		**T mean (sd)**		**SMD**	**C mean (sd)**		**T mean (sd)**		**SMD**	**C mean (sd)**		**T mean (sd)**		**SMD**	**C mean (sd)**		**T mean (sd)**		**SMD**
Prior NTL STEM GPA	1.49	(0.58)	1.44	(1.63)	0.03	1.48	(0.59)	1.76	(1.73)	-0.16	1.91	(0.69)	1.78	(1.67)	0.08	1.77	(0.69)	1.76	(1.62)	0.00
No prior NTL STEM credits	0.20	(0.14)	0.20	(0.40)	0.00	0.16	(0.13)	0.17	(0.38)	-0.02	0.09	(0.11)	0.08	(0.28)	0.01	0.11	(0.13)	0.11	(0.32)	0.00
No prior TL STEM credits	0.52	(0.18)	0.53	(0.50)	-0.01	0.53	(0.17)	0.45	(0.50)	0.17	0.39	(0.20)	0.42	(0.50)	-0.05	0.40	(0.21)	0.41	(0.49)	-0.01
Prior program participation																				
Prior STEMPP	0.24	(0.15)	0.27	(0.45)	-0.08	0.38	(0.17)	0.36	(0.48)	0.03	0.42	(0.20)	0.42	(0.50)	0.02	0.40	(0.21)	0.41	(0.49)	-0.03
N	*553*		*70*			*668*		*78*			*562*		*96*			*663*		*116*		

Appendix B: Exploratory Analysis

We conducted an exploratory analysis of the two STEM degree attainment outcomes for students who met a higher threshold of program intensity: three or more program interactions in spring 2018. Within the focal term, more than 40% of STEMP program participants had one or two interactions and were excluded from this analysis. The purpose of the exploratory analysis was to determine whether more intensive program interactions was associated with greater degree attainment.

We calculated the propensity of three or more program interaction in spring 2018 using the same approach as the main analysis, achieving baseline equivalence for all covariates (Exhibit B-1). Exhibit B-2 shows the results of the weighted regressions estimating the effect of STEMP program participation on STEM degree attainment. The estimated effects were positive but did not meet the conventional level for statistical significance (effect size of .22 for STEM degree or certificate attainment, $p=0.29$; effect size of .47 for STEM associate degree for transfer attainment, $p=0.13$).

Exhibit B-1. Descriptive Statistics After Propensity Score Weighting, High-Intensity Participants

	Spring 2018				
	C mean (sd)		T mean (sd)		d
Demographics					
Black	0.06	(0.05)	0.04	(0.20)	0.08
Latinx	0.41	(0.11)	0.42	(0.50)	-0.02
Asian	0.22	(0.09)	0.20	(0.40)	0.04
Female	0.46	(0.11)	0.45	(0.50)	0.02
Age	27.35	(2.05)	26.97	(8.73)	0.04
Pell	0.49	(0.11)	0.51	(0.50)	-0.02
Promise grant	0.85	(0.08)	0.84	(0.37)	0.03
Non-resident	0.15	(0.08)	0.14	(0.35)	0.02
AB540	0.11	(0.07)	0.10	(0.30)	0.02
Prior coursetaking					
First term	0.06	(0.05)	0.06	(0.24)	0.01
N terms enrolled	8.83	(1.18)	8.90	(5.67)	-0.01
Credits earned	59.58	(7.92)	59.87	(39.1)	-0.01
Any dual enrollment credits	0.28	(0.10)	0.25	(0.44)	0.05
Prior GPA	2.92	(0.21)	2.88	(0.95)	0.04
Focal term coursetaking					
Credits att.	11.19	(0.95)	11.20	(3.63)	0.00
STEM credits att.	8.52	(0.84)	8.56	(3.15)	-0.01
Prior STEM coursetaking					
Highest math	3.47	(0.47)	3.36	(1.90)	0.06
No prior math	0.11	(0.07)	0.11	(0.32)	-0.01
Prior TL STEM credits	23.84	(4.39)	23.71	(19.64)	0.01
Prior NTL STEM credits	5.08	(1.08)	5.29	(4.87)	-0.04
Prior TL STEM GPA	2.63	(0.27)	2.60	(1.18)	0.03
Prior NTL STEM GPA	1.81	(0.37)	1.91	(1.64)	-0.06
No prior NTL STEM credits	0.09	(0.07)	0.09	(0.29)	0.01
No prior TL STEM credits	0.40	(0.11)	0.37	(0.49)	0.06
Prior program participation					
Prior STEMPP	0.34	(0.11)	0.35	(0.48)	-0.02
N	*1965*		*99*		

Exhibit B-2. STEM Degree Attainment for Fall 2018 High-Intensity Program Participants

	Spring 2018						
	C mean (sd)		T mean (sd)		β (SE)		Effect Size
STEM degree or certificate	0.24	(0.09)	0.30	(0.46)	0.37	(0.35)	0.22
STEM degree for transfer	0.10	(0.07)	0.16	(0.37)	0.78	(0.51)	0.47
N	*1965*		*99*				

Note. Effect size for dichotomous outcomes is Cox's index.