UNIVERSITY OF CALIFORNIA

Los Angeles

Addressing Racial Equity Gaps in Mathematics at the Community College Level:

A Policy Analysis of Assembly Bill 705

A dissertation submitted in partial satisfaction of the

requirements for the degree Doctor of Education

by

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2022

ABSTRACT OF THE DISSERTATION

Addressing Racial Equity Gaps in Mathematics at the Community College Level:

A Policy Analysis of Assembly Bill 705

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Doctor of Education

University of California, Los Angeles, 2022

Professor Christina Christie, Chair

This quantitative study examined the proportions of students enrolling in and completing transfer-level math pre- and post-Assembly Bill 705 (AB 705), as well as different predictors affecting the completion of transfer-level math within the first year. The study drew attention to the relationship between students' race/ethnicity and the completion of transfer-level math given the implementation of AB 705 in order to address the racial equity gaps in math completion. The research site for this study was a large community college district in Southern California due to its size and high proportion of Students of Color. The sample data set included student-level data of first-time credit students who entered any of the colleges in the district in fall terms from 2014 to 2020, which is seven entering cohorts. The analysis found that AB 705 helped all racial groups complete transfer-level math at higher proportions. However, there continued to be differences in transfer-level math completion when comparing different racial/ethnic groups. Testing various

student characteristics found significant effects for the racial/ethnicity set of predictors, as well as full-time status. Furthermore, being a STEM major significantly increased the completion of transfer-level math within the first year. The proportion of Black and Latina/o/x students switching away from STEM majors decreased post-AB 705, but these two groups continued to be the groups with the highest number of STEM major switches within the first year.

The dissertation of Laura Cruz-Atrian is approved.

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2022

DEDICATION

Para mi mamá Enedina y papá Herman. Gracias por su amor y apoyo incondicional.

Ustedes son mi adoración. Sin ustedes yo no fuera nada.

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ACKNOWLEDGEMENTS

First, I would like to honor and thank my parents, Enedina and Herman, for their unconditional support throughout this journey and for instilling the value and power of education at a very young age. They have been my inspiration since day 1.

I thank my siblings, Andres, Gerardo, and Maria, community college graduates, who paved the way to higher education for me. I thank them for buying my graphing calculator in high school and my laptops in college and grad school so that I could be successful.

The lived experiences of my extended family were present in my mind as I wrote this dissertation and viewed each single number as a real life of a community college student. I hope my educational journey and accomplishment in earning my doctorate inspires my nieces, nephews, and future children to pursue higher education and help students who look like us.

I also want to give a special thank-you to my husband and life partner, Milo. I thank him for taking care of me, for his words of encouragement, and for showing me his support throughout this journey. We sacrificed fun times so that I could finish and accomplish my goals. I will forever be grateful for his love.

To my wonderful committee—a big thank-you. To my chair, Tina, I admire you and your dedication to improving educational systems. From the moment I met you, I knew you were the perfect chair for me. You kept me inspired along the way to finish my dissertation in a timely manner. To Mark, I would have been very lost without you, especially during the final stretch. Thank you for your time, your patience, and your guidance. I would not have been able to complete this dissertation without you. To Cecilia, your invitations to your class helped me stay motivated, grounded, and refreshed. Thank you for your guidance and encouragement to use my research to inform practice and policy, and ultimately have an impact on equity. To Jim, I thank you for your support and the time you spent on my committee. Your thoughtful feedback improved my study, and you have a special place in this journey.

Lastly, I would like to thank my community college colleagues, who supported me from the beginning as I was applying to this program to the day I finished. They know who they are, and I am grateful for everything they did to support me as I juggled work and school.

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CHAPTER ONE: INTRODUCTION

About 2.1 million students enroll in a California Community College each year, including about a quarter of a million students who enroll in their first math course (California Community Colleges Chancellor's Office [CCCCO], 2019; Rodriguez et al., 2018). Traditionally, the majority of these quarter of a million students started in developmental math, which consisted of a long sequence of developmental math courses and resulted in low transfer-level math completion rates (Jaggars et al., 2015; Royer & Baker, 2018). Low math course completion rates have contributed to the alarmingly low community college graduation rates, especially for Students of Color (Acevedo-Gil et al., 2015; Logue et al., 2016; Ngo & Kwon, 2015; Schudde & Keisler, 2019). Historically, a high proportion of Students of Color have been placed in developmental education (CCCCO, 2018; Logue et al., 2019). Students who start college in developmental education take longer to reach transfer-level courses and have low graduation rates (Logue et al., 2016; Logue et al., 2019).

California's Assembly Bill 705 (AB 705), which passed in October 2017, represents an attempt to address low college graduation rates by requiring all community colleges to maximize the probability that students will complete transfer-level English and math within 1 year (California Legislative Information, 2017). As a result, colleges have decreased developmental education and eliminated placement exams. Colleges are instead using high school performance indicators to recommend students to specific math courses, as these are better predictors of college math success (Bahr et al., 2019; Ngo & Kwon, 2015; Scott-Clayton et al., 2014).

In order to comply with the requirement to implement AB 705 by fall 2019, colleges increased their number of transfer-level math class offerings, some of which were accompanied by corequisite courses or other academic support (Rodriguez et al., 2018). Corequisite courses, which are academic support classes that students take simultaneously with the targeted transfer-level math class, have shown promising results in improving transfer-level math completion rates and subsequent college completion rates (Kashyap & Mathew, 2017; Logue et al., 2016; Royer & Baker, 2018). Early research on AB 705 has shown a greater number of students enrolling in and completing transfer-level math, but lower course success rates, according to the Academic Senate for California Community Colleges (ASCCC, 2020).

California Community Colleges' transfer-level math courses are categorized into two math course sequences: Business, Science, Technology, Engineering, Mathematics (BSTEM) and Statistics, Liberal Arts, Mathematics (SLAM). Students enter a math course sequence, SLAM or BSTEM, depending on their major. A disproportionately higher number of Black and Latina/o/x students are enrolling in the SLAM course sequence relative to the BSTEM course sequence (Ngo, 2021). On the other hand, a disproportionately higher number of Asian and White students are enrolling in the BSTEM course sequence relative to the SLAM course sequence (Ngo, 2021). This may indicate a new equity gap based on the majors students are selecting, as well as a misalignment between students' major and math course sequence.

Although the text in AB 705 does not specify race/ethnicity, assessment instruments have serious implications for racial equity because Students of Color are more likely to be placed into developmental education. Therefore, AB 705 has the potential to undo the harms of developmental education on Students of Color, especially Students of Color interested in STEM fields. This study examined the implications of AB 705 for racial inequities in math completion. Specifically, the study focused on the relationship between students' race/ethnicity and transfer-level math completion.

Statement of the Problem

Background of the Problem

Community colleges play an integral role in the nation's economy by training students to enter the workforce and preparing students to transfer to 4-year universities (Acevedo-Gil et al., 2015). The nation's community colleges serve more than 30% of all college students, including a large number of low-income, first-generation Students of Color (National Center for Education Statistics, 2019). For many Students of Color, community colleges serve as an entryway to higher education and social mobility (Cohen & Brawer, 2008). However, community colleges have historically faced alarmingly low graduation rates; about one third of students graduate within 3 years (National Center for Education Statistics, 2019).

One of the factors contributing to low college completion rates has been low math completion rates, specifically due to long developmental math sequences (Logue et al., 2016; Schudde & Keisler, 2019). The completion of transfer-level math serves as one of the requirements to receive an associate degree and transfer to a 4-year university. In California Community Colleges, Intermediate Algebra is considered to be a college-level course instead of transfer-level because it fulfills the math requirement for local associate degrees but is not articulated within universities. Historically, two thirds of community college students have begun by taking developmental math, including 24% of students who are referred to one developmental course, 16% referred to two courses, and 19% referred to three courses (Jaggars et al., 2015). In California, 73% of developmental math students are referred to at least two levels below transfer-level math (Cuellar Mejia et al., 2016). Across all California Community Colleges, 41% of developmental students completed college within 6 years, compared with 70% of non-developmental students (CCCCO, 2018). Moreover, a higher proportion of Students of

Color place in developmental math. For example, in California, 87% of both Black students and Latina/o/x students enrolled in developmental education, compared with 70% of Asian students and 74% of White students (Cuellar Mejia et al., 2016). As a result, the long road to reaching and then completing transfer-level math represents a barrier to college completion (Jaggars et al., 2015; Royer & Baker, 2018).

Historically, community colleges relied on standardized exams to designate a math level for students. Thus, students are placed in specific math courses (Ngo et al., 2018; Rodriguez et al., 2018). However, research has demonstrated that high school indicators, such as grade point average (GPA), have higher predictive power than standardized placement exams in assessing college math performance (Bahr et al., 2019; Ngo & Kwon, 2015; Scott-Clayton et al., 2014). The low transfer-level math completion rates paired with the low predictability of placement exams contributed to a national movement to reform developmental education in community colleges (Bahr et al., 2019; Brower et al., 2017; Education Commission of the States, n.d.; Ngo & Kwon, 2015; Scott-Clayton et al., 2014).

AB 705 Background

In California, Assembly Bill 705 (AB 705) requires all community colleges to maximize the probability that students will complete transfer-level English and math within 1 year (California Legislative Information, 2017). With the full implementation of AB 705 in fall 2019, colleges eliminated their placement exams and instead are using high school performance indicators to recommend students for specific math courses, as these are better predictors of college math success (Bahr et al., 2019; Ngo & Kwon, 2015; Scott-Clayton et al., 2014). One of the underlying purposes of AB 705 includes providing equitable access to transfer-level courses to Students of Color. As aforementioned, Students of Color historically were placed into developmental math at a higher rate, and they then had low transfer-level math completion rates and, subsequently, lower graduation rates (CCCCO, 2018).

Because AB 705 systematically expanded access to transfer-level math, early research on AB 705 has shown a greater number of students enrolling in and completing transfer-level math across all racial/ethnic subgroups despite drops in first-time math enrollments (ASCCC, 2020). The number of first-time math students decreased from 151,658 students in fall 2018 to 133,552 students in fall 2019 (Cuellar Mejia et al., 2020). However, students starting in transfer-level math almost doubled from 56,835 students in fall 2018 to 103,839 students in fall 2019 (Cuellar Mejia et al., 2020). Also, course success rates, comprising grades A, B, C, or P, decreased for transfer-level math courses (ASCCC, 2020). For example, Black students' enrollments in transfer-level math increased from 7,705 in fall 2016 to 12,422 in fall 2019, and course completions in transfer-level math increased from 3,540 in fall 2016 to 5,335 in fall 2019 (ASCCC, 2020). However, Black students' transfer-level course success rates dropped from 49% in fall 2016 to 43% in fall 2019 (ASCCC, 2020). Latina/o/x students' trends reflect similar patterns as those of Black students. Both Black and Latina/o/x students had steeper declines in success rates than other racial/ethnic subgroups. Moreover, a disproportionately higher number of Black and Latina/o/x students are enrolling in the SLAM course sequence, while a disproportionately higher number of Asian and White students are enrolling in the BSTEM course sequence (Ngo, 2021).

According to an AB 705 implementation survey of community college chief instructional officers, the most common curriculum change includes credit corequisite support classes to complement the transfer-level math course (Research & Planning Group, 2020a). In corequisite models, students take the targeted transfer-level math class simultaneously with an academic support class (Logue et al., 2019). Moreover, the majority of colleges embedded course supports and specialized tutoring, as well as other support services outside of the classroom, to help students complete the transfer-level math class. To fully implement AB 705, math departments requested professional development, dedicated funding, equity training, and referrals to best practices. Most colleges have provided some type of professional development to their faculty, as well as learning communities (Research & Planning Group, 2020a). Colleges will continue exploring curriculum, pedagogical, and professional development opportunities to fully implement AB 705 and maximize students' probability of completing transfer-level math within their first year (ASCCC, 2020).

Existing Gaps in the Research

Corequisite support classes have been the most popular curriculum change as a result of AB 705 (Research & Planning Group, 2020a). Several studies have examined the impact of corequisites on transfer-level math completion (Brower et al., 2017; Kashyap & Mathew, 2017; Logue et al., 2016; Logue et al., 2019; Rodriguez et al., 2018; Royer & Baker, 2018). In corequisite models, the same instructor may teach both the targeted transfer-level math class and the academic support class. Corequisite courses have shown promising results in improving transfer-level math completion rates and subsequent college completion rates (Kashyap & Mathew, 2017; Logue et al., 2016; Royer & Baker, 2018). Other research studies have focused on the effect of accelerated math models (Jaggars et al., 2015; Schudde & Keisler, 2019). These models seek to decrease the time it takes students to complete developmental coursework and begin transfer-level classes.

While these studies focus on curriculum interventions and academic support models, limited research exists on the relationship between math and race/ethnicity, as well as the relationship between developmental math education and STEM (Park et al., 2020). There is a lack of research regarding the role of math in promoting STEM careers at the community college level for Students of Color, especially now that access to transfer-level math has increased. Furthermore, few studies have examined students' race/ethnicity, math choice, and STEM and non-STEM switches at the community college level. Switching course sequences can result in excessive unit accumulation and longer time to completion (Schudde et al., 2020). Given the recent implementation of AB 705, limited empirical evidence exists on the impact of the policy change on closing racial equity gaps in math completion.

Statement of Purpose

This quantitative study examined the proportions of students enrolling in and completing transfer-level math pre- and post AB 705, as well as different predictors affecting the completion of transfer-level math within the first year. The study drew attention to the relationship between students' race/ethnicity and the completion of transfer-level math given the implementation of AB 705 in order to address the racial equity gaps in math completion and examine the potential impact AB 705 may have on STEM.

Research Questions

1. What proportions of students enroll in and complete transfer-level math courses within the first year?
    a. How have these proportions changed over time, in particular pre- and post-AB 705 implementation?
    b. How have these proportions varied by student characteristics?
2. To what extent do student characteristics, college, and cohort predict completion of at least one transfer-level math course within the first year?

Overview of the Research Design

Because I sought to understand how transfer-level math completion rates vary by students' race/ethnicity and other characteristics, quantitative methods were the most appropriate method for this research study. The data set needed to answer the research questions required a breadth of information to compare student demographics and academic characteristics pre- and post-AB 705. I used quantitative methods, including descriptive statistics and logistic regression. Descriptive statistics provide the basis for every quantitative study. I used descriptive statistics and contingency tables to examine trends over time and understand the number and proportion of students in the data set. Furthermore, logistic regression allowed for a systematic manipulation of variables to isolate the impact of certain variables and examine relationships between variables (Creswell & Creswell, 2018).

Research Site

The research site for this study was a large community college district in Southern California, due to its size and high proportion of Students of Color. The district serves more than 229,000 students each year, which is about 10% of the community college student population in California (CCCCO, 2019). About 59% of the students in the district identify as Latina/o/x and 9% as Black, compared with 47% and 5%, respectively, among all California Community Colleges (CCCCO, 2019). The district consists of nine colleges covering 882 square miles across 40 cities and communities (Los Angeles Community College District [LACCD], n.d.). The math faculty make up 11% of the total Full-Time Equivalent Faculty (FTEF) across all credit disciplines in the district (LACCD, n.d.). FTEF represents a standardized measure of a faculty member's teaching load, and not the actual number of faculty members. Regular (full-time) FTEF consists of 60% of the total math FTEF, while the adjunct FTEF makes up the remaining

40% (LACCD, n.d.). Most math departments offer associate in arts degrees in math, associate in science degrees in math, and associate degrees for transfer in mathematics. In addition, students not earning a degree from a math department take math classes to meet the requirements to graduate or transfer to a 4-year university. Lastly, there are a few classes available outside of the math departments that students take to complete the quantitative requirement to graduate or transfer.

Furthermore, the district has low transfer-level math completion rates. About 9% of students in the 2015–2016 cohort completed transfer-level math within their first year, and 18% completed within 2 years (CCCCO, 2019). Moreover, the success rate of math courses in the district was about 53% in fall 2018 (CCCCO, 2019). Additionally, the district faces low college completion rates. Out of the students in the district who started at transfer level in 2011–2012, 69% earned an award or transferred within 6 years, compared with 39% of students who started in developmental education (CCCCO, 2019). The equity gaps become apparent when disaggregating the completion rates by race/ethnicity. From the 2011–2012 cohort, four out of 10 Latina/o/x students and three out of 10 Black students completed college within 6 years, compared with six out of 10 Asian students and five out of 10 White students (CCCCO, 2018).

As a response to AB 705 and in efforts to align with the intent of AB 705, the district's Chancellor's Office gave a directive to eliminate math courses two or more levels below transfer level starting in fall 2019 (District Academic Senate Executive Committee, 2019). The mathematics departments at each college redesigned their math course sequences and made additional changes in their math offerings. New classes with additional academic support (lecture and mandatory lab component, not corequisite courses) and new pre-transfer (one level below transfer-level) classes were created.

Significance of the Study

The recent implementation of AB 705 opens an opportunity to address racial equity gaps in math completion and to investigate the impact of the policy change for Students of Color. This study sought to add knowledge on the impact of the policy, specifically around helping students achieve their educational goals and declared major. While the policy change focuses on overall math completion, it is critical to examine completion by the math course sequences and majors, especially for Students of Color. AB 705 has the potential to undo the harms of developmental education on Students of Color and increase STEM participation among Students of Color. Because the long-term impacts of the bill cannot be analyzed yet and there was only 1 year of AB 705 implementation before the COVID-19 pandemic, it is important to continue monitoring its short-term impact. A new follow-up bill to AB 705, Assembly Bill 1705 (AB 1705), was introduced in early 2022. At the time of this writing, the bill has not passed and is being discussed at the state legislature (California Legislative Information, 2022). AB 1705 is a continuation of AB 705 and would require colleges to place and enroll all students in transfer-level English and math by July 1, 2023. Given the changing landscape in California Community Colleges, this study has the potential to inform both policy makers and practitioners.

CHAPTER TWO: LITERATURE REVIEW

Nationwide, community colleges serve as the entryway to higher education for many low-income, first-generation Students of Color (Cohen & Brawer, 2008; National Center for Education Statistics, 2019). For example, more than half of first-time Latina/o/x students across the nation enter higher education via a community college (Acevedo-Gil et al., 2015). Community colleges also play an integral role in the nation's economy by training students to enter the workforce and preparing students to transfer to 4-year universities (Acevedo-Gil et al., 2015). However, community colleges have historically faced alarmingly low graduation rates and wide racial equity gaps.

This literature review begins with the history of California's education policies from the California Master Plan to Proposition 209 to other policies specific to the California Community Colleges. A recent wave of reforms intends to transform the California Community College system to address the low graduation rates. One of the factors contributing to low college completion rates has been long developmental math sequences (Logue et al., 2016; Schudde & Keisler, 2019). Historically, colleges have relied on assessment exams to place students in the appropriate math level, but research has suggested that high school indicators are better predictors of success (Bahr et al., 2019; Ngo & Kwon, 2015; Scott-Clayton et al., 2014). AB 705 is part of this larger educational reform effort to improve outcomes for community college students by requiring all community colleges to maximize the probability that students will complete transfer-level English and math within 1 year (California Legislative Information, 2017). As a result, colleges have decreased developmental education and eliminated placement exams (CCCCO, n.d., Rodriguez et al., 2018). This review describes the problems with developmental education, including the racial equity gaps in the completion of transfer-level math. Given the alarmingly low completion rates in math, colleges have implemented a number of interventions to help students complete math, including corequisite support models and accelerated sequences. The review also describes the role of math in promoting STEM participation among Students of Color. Given the critical role of math in STEM participation, a student's first math course is critical for STEM majors, and switching between non-STEM and STEM majors has a major impact on student completion rates. The review concludes with the study's conceptual framework, which is critical policy analysis, to analyze AB 705 and answer the research questions. Because AB 705 is a relatively recent policy and changes continue to happen at both the state and college levels, this review includes both peer-reviewed and non-peer-reviewed resources, such as minutes from meetings and reports from associations, foundations, and nonprofits in California.

Policies Affecting California Community Colleges

The California Master Plan, enacted in 1960, structured public higher education into three systems: University of California, California State University, and California Community College (Boland et al., 2018). These three systems represented research, teaching, and open access, respectively. The goal was to provide an opportunity for higher education and social mobility for all Californians. However, since the enactment of the policy, the demographics of California have changed. More than half of the population in California is now Latina/o/x, and the number of public and private institutions has increased (Boland et al., 2018). The authors of a longitudinal study focused on California Community Colleges have argued that the CA Master Plan needs major modifications in order to equitably serve students across California, especially Students of Color and students from low-socioeconomic backgrounds (Boland et al., 2018). The study used a social stratification framework to examine how institutions contribute to racial and class inequities in higher education. Students of Color and students from marginalized educational backgrounds disproportionately attend the California Community College system instead of the University of California and California State University systems.

Proposition 209, known as the California Civil Rights Initiative, was approved by voters during the 1996 election (California Legislative Information, 1996). As a result, California's constitution was amended to prohibit state governmental institutions from considering sex, race, ethnicity, and national origin in employment and college admission policies. Therefore, the University of California and California State University systems changed their admission policies. Since Proposition 209 passed, policies aimed at addressing racial equity gaps in public education have not mentioned race or ethnicity.

In 2014, the Student Equity Plans (SEP) were adopted in California, which required community colleges to examine their access, retention, and completion data; identify equity gaps; and submit a plan to address those equity gaps (Felix & Castro, 2018). Community college districts were also provided funds to implement their plans to address inequities on their campuses (Felix & Castro, 2018). A study that examined the SEPs from the nine colleges in the largest community college district in California found that out of 178 equity activities, only 28 activities explicitly targeted equity gaps for Black and Latina/o/x students (Felix & Castro, 2018). The lack of intentional efforts to close racial educational equity gaps emphasizes the need for policies to explicitly mention race and for professional development to focus on racial equity gaps at the college level.

Furthermore, the California Community College system adopted a new performance-based funding formula in the 2018–19 state budget (California Legislative Information, 2018). Historically, California Community Colleges were funded through an enrollment-based funding model. The prior enrollment-based funding formula would pay districts for the number of Full-Time Equivalent Students (FTES) and consider the number of colleges within the district, as well as the size of the district (CCCCO, 2020a; Community College League of California, n.d.). The new Student-Centered Funding Formula (SCFF) contains three components. The first component includes a base allocation similar to the historical enrollment-based component. The second component includes a supplemental allocation to districts based on the number of low-income students enrolled and served. The last component includes a performance-based allocation that rewards districts based on certain educational outcomes. One of these outcomes includes the number of students who complete transfer-level math and English courses within their first year of enrollment.

California is one of 37 states that have implemented a performance-based funding model for at least one public educational system (Kelchen, 2018). It is expected that more states and educational systems will adopt performance-based funding models with the intent to improve student outcomes. Current empirical research assessing the impact of performance-based models on educational outcomes has focused mostly on 4-year institutions. This growing body of evidence indicates that performance-based funding models do not have a major effect on improving student outcomes (Kelchen, 2018). A multi-state longitudinal study on performance-based funding policies examined the effect of these policies on increasing the number of low-income underrepresented students enrolled at public 4-year institutions. The study found that performance-based funding models do not have a major impact on increasing enrollments among underrepresented students (Kelchen, 2018).

Changing Landscape for Developmental Math Education and Community Colleges

A national movement to reform developmental education in community colleges has begun given the low graduation rates (Education Commission of the States, n.d.; Kosiewicz & Ngo, 2019; Ngo et al., 2018). Several states, including Connecticut, Florida, North Carolina, and California, have passed legislation to require community colleges to change their placement policies (Brower et al., 2017; Education Commission of the States, n.d.). Moreover, Florida, Texas, and Tennessee have made developmental education optional for entering students or eliminated it from their curriculum. Florida's Senate Bill 1720 (SB 1720) reformed developmental education across its community colleges by making developmental education optional for exempt students and waiving placement exams for these students (Brower et al., 2017). Under the law, colleges adopted corequisite, contextualized, and other types of courses meant to expedite the developmental course sequence for students (Brower et al., 2017). Moreover, half of the community colleges in Texas implemented a pathways model with accelerated developmental education and major-relevant math courses (Schudde & Keisler, 2019). Tennessee first required students to take developmental education in high school, then required community colleges to offer developmental classes with corequisite courses for students who did not pass the developmental class in high school (Logue et al., 2019; Rodriguez et al., 2018). These policy changes reflect the need to rely on multiple measures, including cognitive and non-cognitive factors, to place students in English and math courses (Kosiewicz & Ngo, 2019; Ngo et al., 2018).

In California, Assembly Bill 705 (AB 705), which passed in October 2017, represents an attempt to address low college graduation rates by requiring all community colleges to maximize the probability that students will complete transfer-level English and math within 1 year

(California Legislative Information, 2017). AB 705 demonstrates a systemic expansion of transfer-level English and math course access for all community college students. One of the underlying goals of AB 705 includes providing equitable access to transfer-level courses to Students of Color, who are disproportionately placed in developmental education. Instead of standardized placement exams, colleges must use high school coursework, high school grades, and/or high school GPA to recommend students for English and math courses (California Legislative Information, 2017).

Early research on AB 705 has shown a greater number of students enrolling in and completing transfer-level math across all racial/ethnic subgroups despite drops in first-time math enrollments (ASCCC, 2020). The number of first-time math students decreased from 151,658 students in fall 2018 to 133,552 students in fall 2019 (Cuellar Mejia et al., 2020). However, students starting in transfer-level math almost doubled from 56,835 students in fall 2018 to 103,839 students in fall 2019 (Cuellar Mejia et al., 2020). Also, course success rates, comprising grades A, B, C, or P, decreased for transfer-level math courses (ASCCC, 2020). For example, Black students' enrollments in transfer-level math increased from 7,705 in fall 2016 to 12,422 in fall 2019, and course completions in transfer-level math increased from 3,540 in fall 2016 to 5,335 in fall 2019 (ASCCC, 2020). However, Black students' transfer-level course success rates dropped from 49% in fall 2016 to 43% (ASCCC, 2020). Latina/o/x students' trends reflect similar patterns as those of Black students. Both Black and Latina/o/x students had steeper declines in success rates compared with other racial/ethnic subgroups.

California Community Colleges' math courses are categorized into two math course sequences: Business, Science, Technology, Engineering, Mathematics (BSTEM) and Statistics, Liberal Arts, Mathematics (SLAM). Students enter a math course sequence, SLAM or BSTEM, depending on their major. BSTEM courses include College Algebra, Business Math, Trigonometry, Pre-Calculus, Linear Algebra, and other calculus-oriented courses. SLAM courses include Statistics and quantitative reasoning classes (Hayward, 2021). As a result, SLAM courses may be housed outside of mathematics departments, including in psychology departments. A disproportionately higher number of Black and Latina/o/x students are enrolling in the SLAM course sequence relative to the BSTEM course sequence (Ngo, 2021). On the other hand, a disproportionately higher number of Asian and White students are enrolling in the BSTEM course sequence relative to the SLAM course sequence (Ngo, 2021). Although the text in AB 705 does not specify race/ethnicity, assessment instruments have serious implications for racial equity because Students of Color are more likely to be placed into developmental education. Therefore, AB 705 has the potential to undo the harms of developmental education on Students of Color, especially Students of Color interested in STEM fields.

Given the recency of AB 705 and the impact of COVID-19, the long-term success of the bill will be analyzed in the future. In the meantime, community college districts, colleges, advocates, and policy makers are encouraged to continue monitoring the impact of the policy on student success. Specifically, colleges are encouraged to identify students who have not been successful under this reform, as well as students who completed corequisites, and determine their success in subsequent transfer-level courses (Rodriguez et al., 2018).

AB 705 fits within a larger effort to reform the California Community College system given the alarmingly low graduation rates (CCCCO, n.d.; Rodriguez et al., 2018). The revamping of the community college system includes changes in the funding model, curriculum, tuition, and course sequences. Specifically, these efforts include the implementation of the Student Equity and Achievement Program, which integrates the Basic Skills Initiative, the Student Equity program, and the Student Success and Support Program; the Institutional Effectiveness Partnership Initiative; and Guided Pathways (Nodine, 2019). Additionally, under the new Student-Centered Funding Formula, districts will be funded for the number of students who complete transfer-level math and English within their first year. Therefore, the success of AB 705 will have a direct impact on the funds colleges and districts receive.

Predictors of Success in Math

Historically, community colleges relied on standardized exams to designate a math level for students and thus place students on specific math courses (Ngo et al., 2018; Rodriguez et al., 2018). Some California Community Colleges piloted the Multiple Measures Assessment Project (MMAP), which was primarily a survey that collected high school information to complement the traditional placement exam. The purpose of the MMAP was to properly place students into English and math courses in order to increase their completion rates. Prior to AB 705, 90 colleges across California began using this placement tool to designate English and math classes for their students. The placement tool looked at certain high school performance indicators to determine the students' course placement.

Research has shown that high school performance indicators are better predictors of college math success than standardized placement exams (Bahr et al., 2019; Ngo & Kwon, 2015; Scott-Clayton et al., 2014). Specifically, cumulative high school GPA is a better predictor in both English and math college courses (Bahr et al., 2019; Scott-Clayton et al., 2014). A quantitative study of community colleges across California sought to identify key high school performance metrics to predict performance in community college English and math classes. The study found that cumulative high school GPA was the best predictor of performance across English and math community college classes. Moreover, cumulative high school GPA combined with specific math curriculum are the best predictors of success in community college math (Bahr et al., 2019). While these methods place students more accurately in math courses, community colleges historically have relied on standardized placement exams that led to long developmental math sequences.

Developmental Math Education as a Major Barrier to College Completion

The majority of students begin their community college experience taking developmental math and never reach transfer-level math. A study of 57 community colleges across 10 states found that 59% of students are referred to developmental math education (Jaggars et al., 2015). More specifically, approximately 24% of students are referred to take one developmental math course, 16% referred to two courses, and 19% referred to three courses (Jaggars et al., 2015). Out of the students who place in remedial education, 30% do not enroll in the required developmental courses, making it impossible to complete graduation requirements (Logue et al., 2016). Because of the long developmental math sequence, students do not complete their developmental math requirements and move on to transfer-level math courses. The students who do enroll in developmental courses are less likely to graduate than those students who begin taking transfer-level courses (Logue et al., 2019).

In California, 64% of all entering community college students take developmental math education (Cuellar Mejia et al., 2016). About 27% of students enter the math sequence at one level below transfer level, 32% at two levels below, 26% at three levels below, and 14% at four levels below. Thus, about 73% of developmental math students are referred to at least two levels below transfer-level math, which is elementary algebra or below. Across all California community colleges, 41% of developmental students completed college within 6 years, compared with 70% of non-developmental students (CCCCO, 2018).

Students of Color are particularly vulnerable to developmental math education. In the 2016 CUNY cohort, 81% of Black students and 78% of Latina/o/x students were assessed in developmental math, compared with 45% of Asian students and 67% of White students (Logue et al., 2019). In California Community Colleges, the majority of students who place in developmental math are Students of Color (CCCCO, 2018; Cuellar Mejia et al., 2016). For example, in California, 87% of both Black students and Latina/o/x students enrolled in developmental education, compared with 70% of Asian students and 74% of White students (Cuellar Mejia et al., 2016). Students who start in developmental math show lower college completion rates than other Students of Color who start in transfer-level courses. Approximately 34% of Black students and 37% of Latina/o/x students who begin in developmental education graduate from college, compared with 63% of Black students and 64% of Latina/o/x students who begin in transfer-level courses (CCCCO, 2018). Furthermore, an equity gap exists among students who complete transfer-level math within their first year. About 10% of Black students and 13% of Latina/o/x students complete transfer-level math within their first year of enrolling in college, compared with 44% of Asian students and 25% of White students (CCCCO, 2018). The average rate of transfer-level math completion within the first year for all students is 20%.

Existing Interventions to Increase Math Completion

Given the low success rates in developmental education, especially for Students of Color, colleges are exploring various instructional redesign approaches to improve transfer-level math completion. An emerging effective strategy revolves around corequisite remediation (Brower et al., 2017; Kashyap & Mathew, 2017; Logue et al., 2016; Logue et al., 2019; Rodriguez et al., 2018; Royer & Baker, 2018). Corequisite remediation models include the participation in both transfer-level courses and other academic support settings. In other words, students who need remedial education simultaneously take transfer-level courses with additional academic support specific to the transfer-level course. The support setting may be a workshop, tutoring, or course. These settings also tend to have fewer units and a smaller workload. This model differs from prerequisite models, which involves students completing standalone developmental courses before enrolling in transfer-level courses. States and colleges that moved toward corequisite remediation models demonstrated improvements in transfer-level math completion and subsequent college completion (Kashyap & Mathew, 2017; Logue et al., 2016; Royer & Baker, 2018).

Short-term impacts of corequisite models revolve around higher pass rates in developmental and transfer-level math courses. Quantitative studies that compare the effects of traditional and corequisite remediation have shown higher passage rates for students who participated in courses with corequisite models. One randomized control trial (RCT) conducted in CUNY assigned more than 700 students to three types of courses: traditional developmental elementary algebra, traditional developmental elementary algebra with weekly workshops, and transfer-level statistics with weekly workshops (Logue et al., 2016). About 56% of the students who took the transfer-level statistics course passed the course, at a rate of 16 percentage points higher than students who took traditional developmental algebra (Logue et al., 2016). A similar study placed 155 first-time students in a quantitative reasoning course with three different models: prerequisite, corequisite, and standalone (Kashyap & Mathew, 2017). Students' final grades were statistically higher in the corequisite model compared with the prerequisite model and statistically higher in the standalone model compared with the prerequisite model. The findings reflect the systemwide implementation of corequisite models. Ivy Tech Community College in Indiana implemented a systemwide corequisite model in developmental math (Royer

& Baker, 2018). During this study's five-semester timeframe, more than 50% of students who participated in the quantitative reasoning pathway passed both the developmental and the transfer-level courses (Royer & Baker, 2018).

Corequisite models increase completion rates in transfer-level math courses and decrease time spent in developmental math. They also indicate higher subsequent college completion rates. In an RCT study in CUNY, students who took transfer-level statistics were more likely to graduate college than those students who took the elementary algebra courses (Logue et al., 2019). The study also found that higher completion rates could be generalized in other academic settings and not only at CUNY. Using two quasi-experimental analyses, the study reaffirmed higher pass rates of corequisite math remediation models in different academic contexts (Logue et al., 2019).

Corequisite models demonstrate short- and long-term improvements for students in terms of higher course pass rates and subsequent higher college completion rates. Colleges with corequisite models also benefit financially. Tennessee implemented a large-scale corequisite model across its 13 community colleges in fall 2015. Belfield et al. (2016) found that the Tennessee corequisite model was both effective and efficient. Not only was the corequisite model effective in helping developmental math students pass transfer-level math, but it also was more cost effective for colleges compared with its previous prerequisite model. The researchers developed an economic model of remediation that examined students' path to transfer-level classes via corequisites and prerequisites (Belfield et al., 2016). The model also accounted for factors such as course success rates, as well as the short- and long-term costs per student under each course sequence. Although colleges had to bear higher costs during the beginning stages of corequisite implementation, the study found that corequisite remediation is more cost effective than prerequisite remediation because corequisites use 50% fewer resources than prerequisites and a greater number of students complete transfer-level coursework under the corequisite model (Belfield et al., 2016).

Like corequisite models, accelerated developmental education models provide an opportunity for states and colleges to improve math completion rates. Accelerated models focus on decreasing the time it takes students to complete developmental math and begin transfer-level coursework. Different types of accelerated developmental models in math exist (Jaggars et al., 2013; Jaggars et al., 2015; Schudde & Keisler, 2019). The most typical type of model consists of enrolling in two or more developmental courses in a single semester. Other models entail merging multiple developmental math courses into a single massive course with double the number of contact hours and units. Criticisms of accelerated models reside in the amount of time these courses take from students' schedules (Jaggars et al., 2015; Schudde & Keisler, 2019). However, advocates of accelerated models argue that combining developmental courses in a single semester or courses minimizes attrition issues (Jaggars et al., 2015; Schudde & Keisler, 2019).

Quantitative studies examining the short- and long-term impacts of accelerated math remediation models have indicated higher success rates in transfer-level math and subsequent college milestones. Denver Community College's FastStart math program combined its three-course sequence into three pairs, so that students could complete each pair in a single semester and decrease time to completion by one semester (Jaggars et al., 2015). In other words, students who needed to take two developmental courses would be able to complete the requirement in one semester instead of two semesters, and students who needed to take all three developmental courses would be able to complete the requirement in two semesters instead of three. Students in accelerated math were 11 percentage points more likely to complete transfer-level math than students in the traditional math sequence (Jaggars et al., 2015).

Another quantitative study examined the impact of an accelerated developmental math model across 20 Texas community colleges (Schudde & Keisler, 2019). This model required students to complete both developmental and transfer-level math within 1 year. Unlike other studies, this study tested the effect on short-term and long-term milestones. Results indicated that students in the accelerated model were more likely to persist to subsequent terms, earn more transfer-level credits, and complete their transfer-level math sequence. The findings account for student demographics and institutional characteristics. While corequisite and accelerated sequence interventions have proven successful, equity gaps continue to persist for Students of Color who seek social mobility through higher education. Limited research exists regarding the role of math and community colleges in promoting the participation of Students of Color in STEM fields.

The Role of Math in the Community College STEM Pathway

Given the history of developmental math at community colleges and the disproportionately high number of Students of Color placing in developmental math, STEM participation is slim among Students of Color. The low number of minoritized students with STEM-related degrees has become an equity issue, drawing the attention of educators and policy makers (Carnevale et al., 2011; Chen, 2013). Specifically, policy efforts emphasize the importance of community colleges in serving students interested in STEM-related fields (Cohen & Kelly, 2020). Because community colleges serve a larger proportion of minoritized students, community colleges have the potential to prepare minoritized students to pursue STEM-related fields. Almost half of students who earned a STEM-related degree reported to have received their education from a community college (National Center for Science and Engineering Statistics, 2018). According to projections, STEM-related jobs will continue to grow (National Science Board, 2015). Research has shown that students who graduate with STEM-related degrees have higher earnings and lower unemployment rates than non-STEM graduates (National Science Board, 2015).

Few studies have focused on the STEM pipeline that includes community colleges and the potential of community colleges for diversifying the STEM field (Cohen & Kelly, 2020; Wang, 2016). Yet, studies have shown that students' performance in math significantly affects participation in STEM (Park & Ngo, 2021). The role of mathematics has been recognized as a gateway course to STEM success and participation (Cohen & Kelly, 2020). Math courses are critical for students pursuing STEM fields, especially in community colleges (Cohen & Kelly, 2020). Prior to AB 705, the majority of California community college students were placing into developmental math education, hindering their opportunity to complete transfer-level math courses (Burks, 2017; Melguizo & Ngo, 2020; Scott-Clayton et al., 2014). Taking math courses in college significantly influences STEM students' momentum and aspirations (Crisp et al., 2009; Wang, 2013, 2015).

One study examined the relationship between community college students' first math courses, student characteristics, and STEM outcomes (Cohen & Kelly, 2020). This explanatory observational study analyzed transcript data from four community college cohorts in STEM majors over 3 years. The study found that students who first enrolled in developmental math were more likely to switch their major to a non-STEM major, had higher attrition rates, earned fewer credits, performed poorly in science, and had lower graduation and transfer rates. Students who completed their developmental math courses then failed their transfer-level math coursework, indicating that developmental education did not prepare them for the math courses needed for the STEM degrees. Moreover, this study found that student characteristics such as demographics and socioeconomic status have limited predictive utility for STEM outcomes. Lastly, the study suggested that community college students with STEM majors may benefit from courses focused on enhancing skills to succeed in advanced mathematics and science. Students may also need clarity on transferable courses and structured STEM pathways focused on reaching key milestones.

A large study focused on California Community Colleges and math courses in STEM pathways found the unmet potential of community colleges in preparing students to pursue STEM majors (Bahr et al., 2017). Almost 3 million community college students were analyzed in the study. The study examined how these students participated in STEM curriculum in order to transfer to a 4-year institution. Out of the students who enrolled in STEM courses, including minoritized students, only a low number of students progressed into advanced levels of STEM coursework. Equity gaps in STEM for women and Students of Color persisted through entry, progress, and completion (Bahr et al., 2017).

Moreover, few studies have examined the relationship between developmental math and STEM outcomes for community college students (Hagedorn & DuBray, 2010; Park & Ngo, 2021; Park et al., 2020). One recent study found that 53% to 98% of students who graduated from a large urban school district and attended a large urban community college district experienced math misalignment (Park et al., 2020). Math misalignment occurs when students are placed in lower-level math courses, despite the math courses taken and completed in high school (Melguizo & Ngo, 2020). The study also found that math misalignment hindered STEM-aspiring students from pursuing STEM pathways (Park et al., 2020). In other words, students with aspirations to pursue a STEM-related major who experienced math misalignment were less likely to complete STEM courses than STEM-aspiring students who did not experience math misalignment.

Another quantitative study, using regression discontinuity, tested the impact of developmental math on STEM participation in community colleges (Park & Ngo, 2021). This longitudinal study examined the impact on various subgroups including Students of Color, women, STEM-oriented students, and STEM-aspiring students. STEM-oriented students are those who took STEM-related courses before college, while STEM-aspiring students are those who declared a STEM major in their college applications (Wang, 2015). The study found that students who placed in lower math levels were not only less likely to progress in math but also less likely to participate in STEM, including students who were placed at the margin of developmental math and transfer-level math (Park & Ngo, 2021). Also, placements in low math levels may have affected Students of Color more than women in completing STEM courses. STEM-oriented students who placed in low math levels were less likely to complete transferable units (Park & Ngo, 2021).

Furthermore, community college students encounter significant conflicting messages when entering community college that hinder the STEM momentum they built in high school (Fong & Melguizo, 2017; Wang, 2017). Research has shown that students who begin their STEM career at a community college are most likely to transfer to a 4-year institution if they complete a significant number of STEM units during their first year (Wang, 2015). Another study showed that community college students who successfully transferred to a 4-year university completed at least one 3-unit STEM class during the first year of community college (Wang, 2016). Because many STEM courses at the community college level have prerequisites or corequisites in math, math is a critical component of pursuing and continuing STEM majors. In other words, community college students with STEM-aspiring majors depend on the timely entry and completion of transfer-level math courses (Park et al., 2020). Because AB 705 has opened access to transfer-level math courses, it provides an opportunity to ensure STEM-aspiring students take the math courses needed to continue the STEM pathway. However, if AB 705 is not implemented correctly and STEM-aspiring students are guided incorrectly, equity gaps in STEM will grow (Park et al., 2020). Students, especially female students and Students of Color, are more likely to self-select or be advised into lower-level math courses (Kosiewicz & Ngo, 2019).

The Impact of Switching Majors

Few empirical studies have examined the reasons for and impact of switching majors at the community college level (Schudde et al., 2020). Switching majors occurs when students leave their declared major for a different major. Switching majors results in excessive completed units and longer time to graduation. The lack of streamlined course sequences at community colleges has led policy makers and community colleges to implement guided pathways (Bailey et al., 2015). Guided pathways help reduce major switching by placing students into broad fields of study, also known as meta-majors, and encouraging students to follow the curricular pathway within their meta-major (Schudde et al., 2020).

A national study examined switching between meta-majors, which are broad clusters of similar majors, at the community college level and found that 40% of students switch between meta-majors (Schudde et al., 2020). Moreover, a different study found that major switching increases the time to complete a degree, slows students' progress toward attaining their degree, and reduces overall graduation rates (Jenkins & Cho, 2012). Research also has indicated that students with undeclared majors who switch to a declared major are more likely to progress toward degree attainment but tend to have more excessive unit accumulation. Major switching may be dependent on major choice. The choice in major has critical implications for students' educational trajectory, course-taking patterns, and overall college outcomes (Schudde et al., 2020). Although the research on major choice has focused on 4-year institutions, major choice is focused on the STEM and non-STEM dichotomy (Schudde et al., 2020).

Chen (2013) found that about 20% of students in associate degree programs choose a STEM major. However, many of these STEM-aspiring students drop out of college or switch their major. Chen (2013) indicated that 69% of students who enter a STEM field in college end up leaving the STEM field. Specifically, about half of students who leave the STEM field do so because they switch their major to a non-STEM major. Students who take fewer STEM courses during their first year of college, take lower levels of math courses in the first year, and perform poorly in STEM classes are most likely to switch their major from STEM to non-STEM. Overall, the probability of leaving the STEM field due to dropping out of college was higher for students with poorer academic performance (based on GPA) than for students with high academic performance. On the other hand, the probability of exiting the STEM field by switching majors was higher for students with high academic performance than for students with low academic performance.

Math serves as an important and critical entry point to STEM. Students' performance in math affects participation and completion in STEM (Cohen & Kelly, 2020; Park & Ngo, 2021). The type of math that students enter guides their STEM and non-STEM participation. In other words, the type of math students enroll in depends on their major. If students switch majors, especially from non-STEM to STEM, students must complete additional math courses, leading to longer time-to-completion rates and discouragement. For these reasons, the type of math students first enroll in serves as a critical entry point for STEM-aspiring students. Because AB 705 has increased access to transfer-level math classes, students can directly enroll in the math course specific to their major without going through the developmental course sequence.

Critical Policy Analysis

Critical policy analysis (CPA) (Young & Diem, 2017) was used as the conceptual framework to guide this study. CPA puts race at the forefront. Because this study was focused on the relationship between race and math, this lens provided a framework to answer the research questions. AB 705 has the potential to undo the negative impacts of developmental education on minoritized students, specifically on STEM-aspiring community college students. CPA helps uncover the racial implications of AB 705 and the impact of the policy on transfer-level math completion.

CPA provides a lens to understand the context, history, and complexity of policies and their underlying ideology (Young & Diem, 2017). Common traditional theories and approaches in educational leadership and policy focus on systems analysis, structural analysis, cost-benefit analysis, and political models. On the other hand, CPA relies on critical theories, feminist theories, and critical race perspectives. While the traditional theories focus on political and economic structures, CPA interrogates decision makers, critiques policy processes, investigates the roots of policymaking, and examines policy developments, interpretation, and implementation (Young & Diem, 2017).

Moreover, CPA identifies power and privilege embedded or hidden within policy decisions (Wright et al., 2020). CPA provides a critical lens and questions the negative impact of policies on people of color. Through CPA, values, beliefs, and biases are examined to determine which are legitimized and which marginalized (Prunty, 1985). These values are often overlooked and underanalyzed in policymaking (Stein, 2004). CPA also investigates how policies can either promote or undermine certain groups, while giving or taking power away from these groups (Prunty, 1985). In summary, CPA is a tool to examine how policies affect marginalized communities of color.

CPA provides a lens to critically examine the implicit and explicit language of AB 705, the implementation of AB 705, and efforts to improve the bill to close racial equity gaps. This lens served as a guide to answer the research questions, analyze the data, and describe the findings. Most importantly, this lens was used to frame the language of the findings and recommendations. The framework provided an anti-deficit perspective when describing students' race/ethnicity and any findings associated with students' race/ethnicity and outcomes. This anti-deficit and critical perspective also was used when describing colleges' responsibility to equitably implement AB 705 and policy makers' opportunities to address any unintended consequences of the policy.

Conclusion

Recent reforms in the California Community College system have aimed to increase graduation rates and close equity gaps. One of the factors contributing to low college completion rates has been long developmental math sequences (Logue et al., 2016; Schudde & Keisler, 2019). The recent implementation of AB 705 provides an opportunity to improve college math completion rates and close racial equity gaps. Prior research focused on curriculum support systems, specifically corequisite and accelerated models. However, limited research has examined the relationship between math and race/ethnicity, and the role of math in promoting STEM careers at the community college level for Students of Color. CPA guided this study and put race at the forefront. This lens provided a framework to answer the research questions, analyze the data, and describe the findings. Although the text in AB 705 does not specify race/ethnicity, assessment instruments have serious implications for racial equity because Students of Color are more likely to be placed into developmental education. Therefore, AB 705 has the potential to undo the harms of developmental education on Students of Color, especially Students of Color interested in STEM fields. CPA helps uncover the racial implications of AB 705 and the potential unintended consequences of policy changes, in order to equitably implement the policy.

CHAPTER THREE: METHODS

For many Students of Color, community colleges serve as an entryway to higher education and social mobility (Cohen & Brawer, 2008). However, community colleges have historically faced alarmingly low graduation rates; about one third of students graduate within 3 years (National Center for Education Statistics, 2019). One of the factors contributing to low college completion rates has been low math completion rates, specifically due to long developmental math sequences (Logue et al., 2016; Schudde & Keisler, 2019). Historically, a high proportion of Students of Color has been placed in developmental education (CCCCO, 2018; Logue et al., 2019). Students who start college in developmental education take longer to reach transfer-level courses and have low graduation rates (Logue et al., 2016; Logue et al., 2019). California's Assembly Bill 705 (AB 705), which passed in October 2017, represents an attempt to address low college completion rates by requiring all community colleges to maximize the probability that students will complete transfer-level English and math within 1 year (California Legislative Information, 2017). As a result, colleges have decreased developmental education and eliminated placement exams. Colleges are instead using high school performance indicators to recommend students for specific math courses, as these are better predictors of college math success (Bahr et al., 2019; Ngo & Kwon, 2015; Scott-Clayton et al., 2014).

With the full implementation of AB 705 in fall 2019, colleges increased their number of transfer-level math classes, some of which were accompanied by corequisite courses or other academic support (Rodriguez et al., 2018). Corequisite courses, which are academic support classes that students take simultaneously with the targeted transfer-level math class, have shown promising results in improving transfer-level math completion rates and subsequent college completion rates (Kashyap & Mathew, 2017; Logue et al., 2016; Royer & Baker, 2018). Early research on AB 705 has shown that more students are enrolling in and completing transfer-level math, but course success rates are lower (ASCCC, 2020). Moreover, disproportionately higher numbers of Black and Latina/o/x students are enrolling in the Statistics, Liberal Arts, Mathematics (SLAM) course sequence, while disproportionately higher numbers of Asian and White students are enrolling in the Business, Science, Technology, Engineering, Mathematics (BSTEM) course sequence (Ngo, 2021). Limited research has focused on the role of math in promoting STEM careers at the community college level for Students of Color, especially now that access to transfer-level math courses has increased (Cohen & Kelly, 2020; Wang, 2016). Therefore, this quantitative study examined the proportions of students enrolling in and completing transfer-level math pre- and post-AB 705, as well as different predictors affecting the completion of transfer-level math within the first year. The study drew attention to the relationship between students' race/ethnicity and the completion of transfer-level math given the implementation of AB 705 in order to address the racial equity gaps in math completion and examine the potential impact AB 705 may have on STEM.

Research Questions

1. What proportions of students enroll in and complete transfer-level math courses within the first year?
    a. How have these proportions changed over time, in particular pre- and post-AB 705 implementation?
    b. How have these proportions varied by student characteristics?
2. To what extent do student characteristics, college, and cohort predict completion of at least one transfer-level math course within the first year?

Research Design and Rationale

The data set needed to answer the research questions required a breadth of information to compare student demographics and math completion pre- and post-AB 705. Quantitative methods allow for the summary and analysis of large quantities of data. Qualitative methods would not have been appropriate for this study because of the need to analyze large data sets and trends pre- and post-AB 705. The study focused on math course attempts and completion variations based on students' race/ethnicity and other characteristics; qualitative methods would not have answered these types of questions.

Specifically, this study used descriptive statistics and logistic regression. Descriptive statistics provide the basis for every quantitative study. I used descriptive statistics and contingency tables to examine trends over time and understand the number and proportion of students in the data set. Furthermore, logistic regression allowed for a systematic manipulation of variables to isolate the impact of certain variables and examine relationships between variables (Creswell & Creswell, 2018). The research questions contained both independent and dependent variables. Independent variables included student characteristics such as race/ethnicity, gender, low-income status, full-time status, college, and entry cohort. Dependent variables included transfer-level math completion. Because I sought to understand predictors leading to the completion of transfer-level math, quantitative methods were the most appropriate method for this research study.

Research Site

The research site for this study was a large community college district in Southern California due to its size and high proportion of Students of Color. The district serves more than 229,000 students each year, which is about 10% of the community college student population in

California (CCCCO, 2019). About 59% of the students in the district identify as Latina/o/x and 9% as Black, compared with 47% and 5%, respectively, among all California Community Colleges (CCCCO, 2019). The district consists of nine colleges covering 882 square miles across 40 cities and communities (LACCD, n.d.). The math faculty make up 11% of the total Full-Time Equivalent Faculty (FTEF) across all credit disciplines in the district (LACCD, n.d.). FTEF represents a standardized measure of a faculty member's teaching load, and not the actual number of faculty members. Regular (full-time) FTEF consists of 60% of the total math FTEF, while the adjunct FTEF makes up the remaining 40% (LACCD, n.d.). Most math departments offer associate in arts degrees in math, associate in science degrees in math, and associate degrees for transfer in mathematics. In addition, students not earning a degree from a math department take math classes to meet the requirements to graduate or transfer to a 4-year university. Lastly, there are a few classes available outside of the math departments that students take to complete the quantitative requirement to graduate or transfer.

Furthermore, the district has low transfer-level math completion rates. About 9% of students in the 2015–2016 cohort completed transfer-level math within their first year, and 18% completed within 2 years (CCCCO, 2019). Moreover, the success rate of math courses in the district was about 53% in fall 2018 (CCCCO, 2019). Additionally, the district faces low college completion rates. Out of the students in the district who started at transfer level in 2011–2012, 69% earned an award or transferred within 6 years, compared with 39% of students who started in developmental education (CCCCO, 2019). The equity gaps become apparent when disaggregating the completion rates by race/ethnicity. From the 2011–2012 cohort, four out of 10 Latina/o/x students and three out of 10 Black students completed college within 6 years, compared with six out of 10 Asian students and five out of 10 White students (CCCCO, 2018).

As a response to AB 705 and in efforts to align with the intent of AB 705, the district's Chancellor's Office gave a directive to eliminate math courses two or more levels below transfer level starting in fall 2019 (District Academic Senate Executive Committee, 2019). The mathematics departments at each college redesigned their math course sequences and made additional changes in their math offerings. New classes with additional academic support (lecture and mandatory lab component, not corequisite courses) and new pre-transfer (one level below transfer-level) classes were created.

Sample Selection

This study utilized administrative data from the district's Student Information System. The sample data set included student-level data of first-time credit students who entered any of the colleges in the district in fall terms from 2014 to 2020, which is seven entering cohorts. First-time students were defined as those who attempted any class within the district, not including dual enrollment classes. Dual enrollment classes are classes students concurrently take while in high school. Dual-enrolled classes were excluded from the data set. Students who attempted or completed math classes as a dual-enrolled student were also excluded.

Because AB 705 applies to students with degree or transfer-seeking goals, students with educational goals related to obtaining an associate degree or transferring were included in the data set. Students with unknown and undecided educational goals were also included. Students with goals to earn basic skills, career or job advancement goals, vocational-related educational goals, or personal development goals were excluded from the data set. This educational goal is captured in the students' initial college application and is static on record even though students might change their educational goal. Out of the educational goals included and relevant to AB 705, the transfer goal was the most frequently identified for all colleges. Together, degree and transfer-related educational goals made up more than 80% of students' educational goals in the sample for all colleges, except one college.

It is important to note that new students can enter college in any of the four terms: summer, fall, winter, or spring. For the purposes of this study, only students entering in the fall semesters were included in the data set. Examining only fall entry cohorts allows for a more controlled year-to-year comparison to better understand the impact of AB 705. Fall entry cohorts were selected because they represent 51%–55% of all entering students. The distribution of first-time students by entering term and academic year is detailed in Table 1.

Table 1

Distribution of First-Time Students by Entering Term and Academic Year

Term	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	2020–21
Winter	4%	5%	6%	5%	5%	6%	7%
Spring	28%	26%	24%	23%	22%	20%	15%
Summer	14%	15%	15%	18%	20%	20%	27%
Fall	55%	54%	54%	54%	53%	53%	51%
Total	100%	100%	100%	100%	100%	100%	100%

For the purposes of AB 705 research, 1 year reflects a calendar year and includes four nominal terms, which corresponds to the definition from the Multiple Measures Assessment Project and the Research & Planning Group (2020b). The district and its colleges in this study had two primary terms and two intersession terms. For example, for the fall 2014 cohort, students' first year included fall 2014 (primary), winter 2015 (intersession), spring 2015 (primary), and summer 2015 (intersession). The data set included information on courses students enrolled in within their first year. This study focused on when students began college, instead of when students began their math sequence. Therefore, there were students who did not take math in their first term of college. This information will be detailed in the next chapter.

Because AB 705 was implemented in fall 2019, this study included five pre-AB 705 implementation cohorts and two post-AB 705 implementation cohorts (see Table 2). Keeping five cohorts prior to AB 705 implementation allowed for the observation of trends pre-AB 705 and increased the confidence that changes observed in post-AB 705 cohorts resulted from the policy change. The final sample for the study included a total of 106,303 first-time students.

Table 2

Pre- and Post-AB 705 Cohorts

Cohort	Pre- or post-AB 705	Cohort start terms	1-year end terms	*n*
1	Pre-AB 705	Fall 2014	Summer 2015	17,117
2	Pre-AB 705	Fall 2015	Summer 2016	16,775
3	Pre-AB 705	Fall 2016	Summer 2017	16,345
4	Pre-AB 705	Fall 2017	Summer 2018	16,264
5	Pre-AB 705	Fall 2018	Summer 2019	15,060
6	Post-AB 705	Fall 2019	Summer 2020	15,142
7	Post-AB 705	Fall 2020	Summer 2021	9,600

Lastly, it is important to note that the sample included credit students enrolled at census. Class census usually happens after the second week of the start of the class for 16-week classes. Enrollments at census are crucial because this is the number the district reports and gets funded for. Also, after census, students are locked into the class and receive a grade for the course. If a student drops the class before census, the student does not receive a grade. If a student drops the class after census, the student will receive a withdrawal ("W") grade. Therefore, students were counted as having an enrollment if they received any grade. The possible grades included A, B, C, D, F, W, I, P, and NP. An incomplete course was marked as "I," a pass as "P," and no pass as "NP."

Variable Overview

Cohort

As mentioned already, *cohort* refers to the year students entered college. As detailed in Table 2, there were a total of seven cohorts in the study, including five pre-AB 705 cohorts and two post-AB 705 cohorts.

College

For the purposes of this study, *college* is the entry college in which first-time students enrolled. Students may take classes in more than one college within and outside the district simultaneously during the same term, as well as term to term. The data set included course enrollments in any college within the district. There may have been variation in course offerings, support services, advising/counseling processes, and policies at each college. There has been a consistent proportion of first-time students by college over time. However, there was a sharp decrease in first-time students in the fall 2020 cohort across all colleges, mostly due to the pandemic. Table 3 details the number and proportion of students by cohort and college.

Table 3

Number and Proportion of Students by Cohort and College

	Cohort													
	2014		2015		2016		2017		2018		2019		2020	
College	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
1	2,064	12.1	1,944	11.6	1,708	10.4	1,721	10.6	1,432	9.5	1,311	8.7	991	10.3
2	3,200	18.7	3,205	19.1	3,331	20.4	3,179	19.5	2,953	19.6	2,851	18.8	2,253	23.5
3	1,546	9.0	1,618	9.6	1,339	8.2	1,410	8.7	1,399	9.3	1,328	8.8	545	5.7
4	1,339	7.8	1,343	8.0	1,274	7.8	1,333	8.2	1,329	8.8	1,258	8.3	743	7.7
5	2,951	17.2	2,772	16.5	2,919	17.9	2,920	18.0	2,514	16.7	2,654	17.5	1,791	18.7
6	927	5.4	798	4.8	668	4.1	661	4.1	636	4.2	751	5.0	345	3.6
7	1,574	9.2	1,485	8.9	1,301	8.0	1,435	8.8	1,321	8.8	1,498	9.9	837	8.7
8	2,086	12.2	2,219	13.2	2,207	13.5	2,028	12.5	2,057	13.7	2,047	13.5	1,261	13.1
9	1,430	8.4	1,391	8.3	1,598	9.8	1,577	9.7	1,419	9.4	1,444	9.5	834	8.7
Total	17,117	100.0	16,775	100.0	16,345	100.0	16,264	100.0	15,060	100.0	15,142	100.0	9,600	100.0

Race/Ethnicity

This study used the ethnicity/race students self-reported during the initial college application. There were eight ethnic/racial categories: Asian, Black/African American, Hawaiian/Pacific Islander, Hispanic/Latina/o/x, Native American, Multi-Racial/Multi-Ethnic, Caucasian/White, and Unknown. The proportion of racial/ethnic subgroups varied by college. For example, four of the nine colleges had relatively higher proportions of Asian students. In another college, almost half of its first-time students were Black/African American. Two colleges had relatively high proportions of Latina/o/x students. Two other colleges had the highest proportion of White students.

Gender

This study used the gender students self-reported during the initial college application. There were four gender categories: Female, Male, Non-Binary, and Unknown. Females made up more than half of the sample across the different cohorts. Also, the non-binary group had a relatively larger proportion in the most recent cohort, 2020, as it has become more common to report. The proportions of genders varied by college. Only one college had more male than female students.

Full-Time Status

Full-time status was based on the number of units students enrolled in during the entry term. If a student enrolled in fewer than 12 units, they were flagged as part-time. If a student enrolled in 12 or more units, they were flagged as full-time. Although the number of units enrolled may vary term to term, this study used the units enrolled during the entry term to determine full-time status. More than 70% of the sample was considered part-time. It is important to mention that the opportunity to attempt and complete transfer-level math was less for part-time students than full-time students given the 1-year definition.

Low-Income

Receiving a California Promise Grant (formerly known as the Board of Governors Grant) was used as a proxy for low-income status. Although receiving the grant may vary term to term based on financial need, this study flagged students as low income if they received the grant during the entry term. The proportion of students who received this grant increased starting with the 2018 cohort, with the exception of the most recent cohort. The increase in the proportion of students receiving the grant may be due to the new funding formula, which considers the number of low-income students.

Math Courses

The Taxonomy of Program (TOP) is a system of numerical codes unique to the California Community College system that is used to collect and report information on programs and courses (CCCCO, 2004). As part of the curriculum development process, each course, certificate, and degree is assigned the TOP code that is closest to describing the content. TOP codes have a total of six digits and are assigned at different levels using two-digit pairs. The first two digits typically describe the discipline, the next two digits describe the subdiscipline, and the last two digits describe the field. At the local college level, the titles of programs and courses differ and vary across colleges. Therefore, TOP codes provide a method to categorize programs and courses.

For the purposes of this study, TOP codes that begin with 1701 were used to identify math courses, both transfer-level and below-transfer-level courses. This study also included non-math courses that met the quantitative reasoning transfer requirement in other TOP codes, including 0505.00 (Business Administration), 0706.00 (Computer Science, Transfer), 0901.00 (Engineering, Transfer), 1799.00 (Other Mathematics), 2001.00 (Psychology), and 2204.00 (Economics). These quantitative reasoning courses with other TOP codes were identified by looking at the most recent college catalog for each of the colleges in the district. See Appendix A for a list of math and quantitative reasoning classes used in the study. This study used *math courses* as an umbrella term that includes math and non-math quantitative reasoning courses.

Transfer-Level Math Courses

Math courses flagged as below transfer level included courses cataloged with pre-transfer codes. Math courses flagged as transfer level included courses coded as transferable and that had transfer status codes indicating being transferable to the University of California (UC) and/or California State University (CSU) systems. This definition reflects the methodology used by the California Community Colleges Chancellor's Office in the Transfer-Level Completion Dashboard (CCCCO, 2020b).

Below-transfer-level courses included developmental math courses and Intermediate Algebra. It is important to note that in California Community Colleges, Intermediate Algebra and its equivalent courses are considered college level instead of transfer level because these courses fulfill the requirement for local associate degrees but are not articulated within universities. The majority of associate degrees, including all STEM degrees and associate degrees for transfer (ADTs), require the completion of math or quantitative reasoning courses that are transferable to the university.

Course Sequence

Transfer-level math courses are categorized into two course sequences: Business, Science, Technology, Engineering, Mathematics (BSTEM) and Statistics, Liberal Arts, Mathematics (SLAM). Students enter a math course sequence, SLAM or BSTEM, depending on their major. BSTEM courses are calculus oriented, which is required for some business programs and for all STEM degrees. BSTEM courses include College Algebra, Business Math, Trigonometry, Pre-Calculus, Calculus, Linear Algebra, Finite Math, and other calculus-oriented courses. SLAM courses include Statistics and quantitative reasoning courses. As a result, some SLAM courses are housed outside of the mathematics discipline, including in the business, engineering, or psychology disciplines. Appendix A includes the list of math courses and their corresponding math course sequence.

Successful Course Completion

Students who successfully complete a class receive grades A, B, C, or P. Students who remain in a class receive any grade other than W. Students who attempt a course enroll in the course and are counted regardless of grade received.

STEM Majors

The data set includes the TOP code for students' initial declared major, as well as the TOP code for students' last declared major within their first year. These TOP codes are used to identify STEM majors, as well as major switches within students' first year. Specifically, there are four categories for major switches: STEM major to non-STEM, non-STEM to STEM, remained as STEM, and remained as non-STEM. Some business programs require the completion of transfer-level math that may be fulfilled with Statistics or a liberal arts math course. Therefore, majors are categorized as STEM or non-STEM. A list of STEM programs is detailed in Appendix B. The list was adopted from a recent study from the RP Group, which lists the STEM TOP codes across the California Community College system (Hayward, 2021). Table 4 provides a summary of the frequency distribution for the variables.

Table 4

Frequency Distribution for Variables

Variable	Sample (n = 106,303)	
	n	%
Post-AB 705 cohort	24,742	23.3
College		
1	11,171	10.5
2	20,972	19.7
3	9,185	8.6
4	8,619	8.1
5	18,521	17.4
6	4,786	4.5
7	9,451	8.9
8	13,905	13.1
9	9,693	9.1
Race/ethnicity		
Asian	9,688	9.1
Black/African American	10,343	9.7
Hawaiian/Pacific Islander	274	0.3
Hispanic/Latino	65,254	61.4
Native American	156	0.1
Two or more races	2,942	2.8
White	15,398	14.5
Unknown	2,248	2.1
Gender		
Non-binary	29	0.0
Female	55,679	52.4
Male	50,466	47.5
Unknown	129	0.1
Full-time status	29,247	27.5
Low-income	52,315	49.2
STEM major	9,604	9.0

Data Analysis

I analyzed the data from the sample using R, an open-course, free statistics software environment (R Development Core Team, 2022). R includes basic statistics functionalities built in and extendable features that may be installed through packages. I used R to re-code, manipulate, and describe the data, as well as to conduct statistical tests. After I restructured the data, coded new variables, and created dummy variables, I used contingency tables to build up to the regression models and conducted likelihood-ratio tests to compare models. Because most of the variables were discrete, I used contingency tables to summarize and compare variables. The main variables included race/ethnicity, gender, low-income status, full-time status, major, cohort pre- and post-AB 705, enrollment in transfer-level math within the first year, and completion of transfer-level math within the first year. Regression models allowed for several predictor variables and interaction variables to be evaluated simultaneously. I investigated the extent to which predictor variables have an effect on the completion of transfer-level math within students' first year. See Table 5 for a summary of the data analysis methods.

I also explored multi-level regression models to test colleges as a random effect instead of a fixed effect. In educational settings, the college environment may have different effects on certain students. Outcome variables may be influenced by the college environment. I explored multi-level models using college as a level and treating college as a random effect. The decision to treat an effect as random or fixed depends on the goals of the study (Owen, 2021). This study examined the differences among the nine colleges instead of seeking to draw conclusions that are generalizable to the California Community College system. Therefore, treating the college effect as a fixed effect instead of a random effect seemed to be the most appropriate.

Table 5

Summary of Data Analysis Methods

Research questions	Variables	Methods
What proportions of students enroll in and complete transfer-level math courses within the first year? a. How have these proportions changed over time, in particular pre- and post-AB 705 implementation? b. How have these proportions varied by student characteristics?	IV: pre/post AB 705 cohort, college, race/ethnicity, gender, low-income status, full-time status, major DV: completed transfer-level math	Contingency tables
To what extent do student characteristics, college, and cohort predict completion of at least one transfer-level math course within the first year?	IV: pre/post AB 705 cohort, college, race/ethnicity, gender, low-income status, full-time status, major DV: completed transfer-level math	Logistic regression

Validity and Reliability

Validity refers to the extent that the measures used actually measure what they were designed to measure. In other words, validity is a property or characteristic of the interpretations of the data. To enhance the validity of the study, I examined similar variables and omitted those that were highly correlated with each other. For example, the California Promise Grant and Pell Grant may be used as a proxy for low income. However, I included only the California Promise Grant in the models and omitted the Pell Grant variable. I also omitted students' age from the models after doing a histogram and contingency tables. Students' age was not normally distributed, and there were few outliers. Furthermore, I carefully examined the variables to ensure accurate interpretation of the coefficients in the logistic regression.

Reliability refers to stability or consistency repeated over time for different instruments. To enhance reliability, I operationalized variables and consistently used the same definitions. I carefully reviewed the data set for accuracy and completeness. During this process, I decided what data to include and exclude. Also, I made decisions on how to re-code certain variables. I referred back to the literature and recent research studies to determine how to re-code certain variables and be consistent with studies on California Community Colleges. Specifically, I used definitions and operationalizations from the California Community College Chancellor's Office, the RP Board Group, and the district. I kept detailed notes of the decisions and process, which I summarized in the Variable Overview section. I also carefully examined the data for any anomalies that might have affected the measurement of each variable or affected the variables over time.

Positionality

I am currently employed as the dean of an institutional effectiveness office at a community college. Institutional effectiveness offices oversee institutional data, research studies, program evaluation, and survey development. The office I lead and other institutional effectiveness offices in other colleges have conducted several studies on the impact of AB 705. In this study, I positioned myself as a UCLA student conducting research for dissertation purposes. This differentiation is critical because of my current role and years of experience as a research analyst at three community colleges.

Furthermore, critical quantitative inquiry was used to answer the research questions, select the appropriate data analysis methods, interpret findings, and advocate for changes that decrease racial equity gaps. In critical quantitative inquiry, the interplay between research questions, theory, methods, and policy/advocacy makes the scholarship meaningful (Rios-Aguilar, 2014). Critical quantitative scholars use methods to reveal inequities. During the analysis, I also practiced ongoing methodological self-reflection on the research practices and statistical approaches, including dichotomous variables, validity, and reliability. In terms of methods, methodological sophistication does not automatically lead to more relevant results. It is also important to note that statistical significance is not equivalent to importance, and non-significance is not the same as unimportance. Lastly, critical quantitative inquiry ensures research findings are used to inform and improve practices and policies. Therefore, the results of the study will be used to advise both practitioners and policy makers.

Ethical Issues

The first set of ethical issues I considered related to the beginning stages of the study, specifically getting IRB approval from both the university and the district. A related ethical consideration included protecting institutional anonymity. Neither the district nor the colleges are mentioned by name and are given pseudonyms. However, experts who know the community college system may be able to identify the district given the student demographic profile and size of the district.

The second set of ethical issues related to reporting and storing data. All student identifiable data from the data files and reports were omitted. Numbers that contained fewer than 10 students were not included in any of the study's findings. Descriptive statistics based on small counts (fewer than 10 students) were suppressed. This was not an issue given the size of the data set. The owner of the data is the district because the data were pulled from the Student Information System. However, the methods used to create additional fields are owned by me.

Lastly, all data files will be deleted from all electronic devices upon the completion of the dissertation.

Conclusion

This study used quantitative methods to examine the proportions of students enrolling in and completing transfer-level math pre- and post-AB 705, as well as different predictors affecting the completion of transfer-level math within the first year. The study drew attention to the relationship between students' race/ethnicity and the completion of transfer-level math given the implementation of AB 705 in order to address the racial equity gaps in math completion and examine the potential impact AB 705 may have on STEM. Limited research has focused on community colleges' role in diversifying the STEM field and addressing racial equity gaps in math completion by the type of math course sequence. The data set included seven cohorts of first-time entering college students in a large community college district in Southern California. Given the size of the data set and the recent implementation of AB 705, quantitative methods allowed for the historical comparison of student demographics and academic characteristics pre- and post-AB 705. By examining race/ethnicity and math courses, this study sheds light on math equity gaps and the impact of the policy change. AB 705 has the potential to rectify the harms of developmental education on Students of Color and increase their STEM participation. Therefore, the study has the potential to inform both policy makers and practitioners.

CHAPTER FOUR: FINDINGS

This quantitative study examined the proportions of students enrolling in and completing transfer-level math pre- and post-AB 705, as well as different predictors affecting the completion of transfer-level math within the first year. The study drew attention to the relationship between students' race/ethnicity and the completion of transfer-level math given the implementation of AB 705 in order to address the racial equity gaps in math completion and examine the potential impact AB 705 may have on STEM. Contingency tables were carefully examined to understand trends and changes pre- and post-AB 705. Contingency tables helped explore variables and assisted in summarizing the data. This analysis was used to answer the first research question. I used this analysis to build up to the regression models. I investigated a series of seven multiple logistic regression models to determine the best fit. I used the final model to answer the second research question. This chapter begins with describing the sample, followed by describing the findings from the contingency tables. Lastly, this chapter describes the process of finding the best-fitted logistic model, as well as the findings from the logistic regression analysis. The following research questions guided the study:

1. What proportions of students enroll in and complete transfer-level math courses within the first year?
    a. How have these proportions changed over time, in particular pre- and post-AB 705 implementation?
    b. How have these proportions varied by student characteristics?
2. To what extent do student characteristics, college, and cohort predict completion of at least one transfer-level math course within the first year?

Sample Characteristics

Out of the 106,303 students in the sample, about 77% belonged to a pre-AB 705 cohort and 23% belonged to a post-AB 705 cohort. The proportion of students in the sample was not evenly distributed by college, which reflected the district's population. Almost 20% of the sample came from College 2, and less than 5% came from College 6. The proportions of students by college slightly changed from pre-AB 705 to post-AB 705. For example, students in College 3 accounted for 9% of the pre-AB 705 sample and 7.6% of the post-AB 705 sample. Furthermore, more than 61% of students in the sample identified as Latina/o/x, followed by 14% White students, almost 10% Black students, and 9% Asian students. The proportions of racial/ethnic groups slightly changed from pre-AB 705 to post-AB 705. More than half of the sample were female students. The distribution of students by gender remained consistent pre- and post-AB 705. In addition, nearly one third of the sample represented full-time students. The proportion of full-time students slightly increased to almost 31% in the post-AB 705 cohorts, compared with almost 27% in the pre-AB 705 cohorts. About half of the sample was considered low income based on the California Promise Grant. The proportion of low-income students increased in the post-AB 705 cohorts. Lastly, about 9% of the sample had a declared major in a STEM area. A higher proportion of students declared a STEM major in the post-AB 705 cohorts. Appendix B details the list of STEM programs, as well as the frequency data for the sample. Table 6 displays the frequency distribution for the variables by pre- and post-AB 705 cohort.

Table 6

Frequency Distribution for Variables by Pre- and Post-AB 705 Cohort

Variable	Pre-AB 705		Post-AB 705		Total	
	n	%	*n*	%	*n*	%
Cohort	81,561	76.7	24,742	23.3	106,303	100.0
College						
1	8,869	10.9	2,302	9.3	11,171	10.5
2	15,868	19.5	5,104	20.6	20,972	19.7
3	7,312	9.0	1,873	7.6	9,185	8.6
4	6,618	8.1	2,001	8.1	8,619	8.1
5	14,076	17.3	4,445	18.0	18,521	17.4
6	3,690	4.5	1,096	4.4	4,786	4.5
7	7,116	8.7	2,335	9.4	9,451	8.9
8	10,597	13.0	3,308	13.4	13,905	13.1
9	7,415	9.1	2,278	9.2	9,693	9.1
Race/ethnicity						
Asian	7,624	9.3	2,064	8.3	9,688	9.1
Black/African American	8,217	10.1	2,126	8.6	10,343	9.7
Hawaiian/Pacific Islander	219	0.3	55	0.2	274	0.3
Hispanic/Latino	49,679	60.9	15,575	62.9	65,254	61.4
Native American	116	0.1	40	0.2	156	0.1
Two or more races	2,348	2.9	594	2.4	2,942	2.8
White	11,951	14.7	3,447	13.9	15,398	14.5
Unknown	1,407	1.7	841	3.4	2,248	2.1
Gender						
Non-binary	16	0.0	13	0.1	29	0.0
Female	42,627	52.3	13,052	52.8	55,679	52.4
Male	38,875	47.7	11,591	46.8	50,466	47.5
Unknown	43	0.1	86	0.3	129	0.1
Full-time status	21,709	26.6	7,538	30.5	29,247	27.5
Low-income	38,688	47.4	13,627	55.1	52,315	49.2
STEM major	6,334	7.8	3,270	13.2	9,604	9.0

Research Question 1 Findings

Math Attempts

In order to complete transfer-level math, students must first enroll in the course. Because AB 705 systematically opened access to transfer-level math courses, course attempts at both transfer level and below transfer level were examined to better understand enrollment patterns over time. The proportion of students attempting any math course during their first year ranged from about 50% to 59%. See Table 7 for the distribution of math attempts within the first year. The number of first-year students attempting any math during their first year sharply decreased by 34%, from 7,234 students in 2019 to 4,783 students in 2020. This decrease reflects the 37% decrease in the number of first-year students from 2019 to 2020 due to the COVID-19 pandemic.

Although the proportion of first-year students attempting any math within their first year decreased in 2019 and 2020, the proportion of students attempting transfer-level math increased. In 2018, more than 21% of first-time students completed transfer-level math, while about 37% of first-time students completed transfer-level math in both the 2019 and 2020 cohorts. Also, the number of students attempting transfer-level math almost doubled from 3,188 students in 2018 to 5,667 students in 2019, the first year of AB 705. This observation reflects statewide trends where students starting in transfer-level math almost doubled (Cuellar Mejia et al., 2020). Attempting transfer-level math within the first year increased over the years, especially during the post-AB 705 years, 2019 and 2020.

The proportion of students attempting transfer-level math out of students attempting any math also increased over the years, especially in the post-AB 705 cohorts. The last column in Table 7 displays the students who attempted transfer-level math as a proportion of students who attempted any math within their first year. Out of the students in the 2018 cohort who attempted any math during their first year, almost 38% attempted a transfer-level math course. The proportion of students who attempted transfer-level math out of students who attempted any math increased to 78.3% in the 2019 cohort and 73.8% in the 2020 cohort.

Table 7

Math Attempts Within the First Year by Entry Cohort

Cohort	Attempted any math				Attempted transfer-level math				Proportion of TLM over any math
	No		Yes		No		Yes		
	n	%	*n*	%	*n*	%	*n*	%	%
2014	8,037	47.0	9,080	53.0	15,150	88.5	1,967	11.5	21.7
2015	7,346	43.8	9,429	56.2	14,757	88.0	2,018	12.0	21.4
2016	6,795	41.6	9,550	58.4	14,138	86.5	2,207	13.5	23.1
2017	6,720	41.3	9,544	58.7	13,615	83.7	2,649	16.3	27.8
2018	6,580	43.7	8,480	56.3	11,872	78.8	3,188	21.2	37.6
2019	7,908	52.2	7,234	47.8	9,475	62.6	5,667	37.4	78.3
2020	4,817	50.2	4,783	49.8	6,072	63.3	3,528	36.8	73.8

Note. TLM is the acronym for transfer-level math.

Math Completions

Examining the proportion of students who completed transfer-level math reveals a gradual increase year to year even before AB 705. Course completions included A, B, C, and P grades. Less than 8% of first-time students in the 2014 cohort completed transfer-level math, while more than 13% of first-time students in the 2018 cohort completed transfer-level math. Table 8 shows the distribution of transfer-level math completion for each cohort in the sample. The proportion of students completing transfer-level math was the highest in the post-AB 705 cohorts. Almost 19% of first-time students in the 2019 cohort completed transfer-level math and more than 21% of first-time students in the 2020 cohort completed transfer-level math.

Furthermore, examining the completion of transfer-level math with only grades A and B revealed similar gradual increases over time. Less than 6% of first-time students in the 2014 cohort completed transfer-level math with an A or B grade, while more than 9% of first-time students in the 2018 cohort completed transfer-level math with an A or B grade. The proportion of students completing transfer-level math with an A or B grade was the highest in the post-AB 705 cohorts. About 13% of first-time students in the 2019 cohort completed transfer-level math with an A or B grade, and 15% of first-time students in the 2020 cohort completed transfer-level math with an A or B grade. The last column in Table 8 shows the grades A and B as a proportion of all completion grades A, B, C, and P. For example, the 2019 cohort had a total of 2,829 completions with any grade (A, B, C, or P), and 1,972 of these completions were with A or B grades only, which is about 69.7% of all completion grades. In the 2020 cohort, 1,440 completions with A or B grades made up 71% of all 2,029 completion grades. There were no major differences in grade distribution in the pre- and post-AB 705 cohorts. The proportion remained fairly consistent, ranging from 69.2% to 71.6% across the seven cohorts.

Table 8

Transfer-Level Math Completion Within the First Year by Entry Cohort

	Completed transfer-level math				Completed transfer-level math with grades A or B				Grade prop
	No		Yes		No		Yes		
Cohort	*n*	%	*n*	%	*n*	%	*n*	%	%
2014	15,783	92.2	1,334	7.8	16,178	94.5	939	5.5	70.4
2015	15,386	91.7	1,389	8.3	15,781	94.1	994	5.9	71.6
2016	14,882	91.0	1,463	9.0	15,307	93.6	1,038	6.4	71.0
2017	14,587	89.7	1,677	10.3	15,078	92.7	1,186	7.3	70.7
2018	13,074	86.8	1,986	13.2	13,686	90.9	1,374	9.1	69.2
2019	12,313	81.3	2,829	18.7	13,170	87.0	1,972	13.0	69.7
2020	7,571	78.9	2,029	21.1	8,160	85.0	1,440	15.0	71.0

Note. Completion is defined as students receiving grades A, B, C, or P. Grade prop represents grades A and B as a proportion of all completion grades.

Race/Ethnicity

Examining attempts in transfer-level math by race/ethnicity pre- and post-AB 705 showed that all groups attempted transfer-level math at higher proportions in the post-AB cohorts than in the pre-AB 705 cohorts. For example, 31% of Asian students attempted transfer-level math within their first year before AB 705 compared with 47% of Asian students post-AB 705. About 8% of Black students attempted transfer-level math pre-AB 705 compared with 26% post-AB 705. About 13% of Latina/o/x students attempted transfer-level math pre-AB 705 compared with 38% post-AB 705. About 18% of White students attempted transfer-level math pre-AB 705 compared with 39% post-AB 705.

Similar trends were observed when looking at the completion of transfer-level math pre- and post-AB 705. All racial/ethnic groups completed transfer-level math at higher proportions in the post-AB cohorts than in the pre-AB 705 cohorts. For example, 24% of Asian students completed transfer-level math within their first year pre-AB 705, compared with 35.3% of Asian students post-AB 705. About 5% of Black students completed transfer-level math pre-AB 705, compared with 12% post-AB 705. About 7% of Latina/o/x students completed transfer-level math pre-AB 705, compared with 17% post-AB 705. About 14% of White students completed transfer-level math pre-AB 705, compared with 24% post-AB 705. Table 9 details the distribution of transfer-level math attempts and completion within the first year by race/ethnicity.

Table 9

Transfer-Level Math Attempts and Completion Within the First Year by Race/Ethnicity

	Attempted transfer-level math				Completed transfer-level math			
	No		Yes		No		Yes	
Cohort	*n*	%	*n*	%	*n*	%	*n*	%
Pre-AB 705								
Asian	5,302	69.5	2,322	30.5	5,796	76.0	1,828	24.0
Black/African American	7,528	91.6	689	8.4	7,830	95.3	387	4.7
Hawaiian/Pacific Islander	195	89.0	24	11.0	205	93.6	14	6.4
Latina/o/x	43,425	87.4	6,254	12.6	46,057	92.7	3,622	7.3
Native American	99	85.3	17	14.7	109	94.0	7	6.0
Two or more races	2,000	85.2	348	14.8	2,130	90.7	218	9.3
Unknown	1,224	87.0	183	13.0	1,284	91.3	123	8.7
White	9,759	81.7	2,192	18.3	10,301	86.2	1,650	13.8
Total	69,532	85.3	12,029	14.7	73,712	90.4	7,849	9.6
Post-AB 705								
Asian	1,097	53.1	967	46.9	1,336	64.7	728	35.3
Black/African American	1,565	73.6	561	26.4	1,877	88.3	249	11.7
Hawaiian/Pacific Islander	34	61.8	21	38.2	44	80.0	11	20.0
Latina/o/x	9,720	62.4	5,855	37.6	12,941	83.1	2,634	16.9
Native American	24	60.0	16	40.0	36	90.0	4	10.0
Two or more races	381	64.1	213	35.9	482	81.1	112	18.9
Unknown	624	74.2	217	25.8	695	82.6	146	17.4
White	2,102	61.0	1,345	39.0	2,473	71.7	974	28.3
Total	15,547	62.8	9,195	37.2	19,884	80.4	4,858	19.6

Gender

Female, male, and non-binary students attempted transfer-level math at higher rates in the post-AB 705 cohorts than in the pre-AB 705 cohorts. For example, 13.4% of female students in pre-AB 705 cohorts attempted transfer-level math, compared with 37.3% of female students in post-AB 705 cohorts. More than 16% of male students in pre-AB 705 cohorts attempted transfer-level math, compared with 37.2% of male students in post-AB 705 cohorts.

Similar trends were observed when looking at the completion of transfer-level math pre- and post-AB 705. For example, 8.9% of female students in pre-AB 705 cohorts completed transfer-level math, compared with 20.1% of female students in post-AB 705 cohorts. More than 10% of male students in pre-AB 705 cohorts completed transfer-level math, compared with 19.1% of male students in post-AB 705 cohorts. Table 10 displays the distribution of transfer-level math attempts and completion within the first year by gender.

Table 10

Transfer-Level Math Attempts and Completion Within the First Year by Gender

	Attempted transfer-level math				Completed transfer-level math			
	No		Yes		No		Yes	
Cohort	*n*	%	*n*	%	*n*	%	*n*	%
Pre-AB 705								
Female	36,895	86.6	5,732	13.4	38,832	91.1	3,795	8.9
Male	32,585	83.8	6,290	16.2	34,824	89.6	4,051	10.4
Non-binary	15	93.8	1	6.3	15	93.8	1	6.3
Unknown	37	86.0	6	14.0	41	95.3	2	4.7
Total	69,532	85.3	12,029	14.7	73,712	90.4	7,849	9.6
Post-AB 705								
Female	8,190	62.7	4,862	37.3	10,423	79.9	2,629	20.1
Male	7,275	62.8	4,316	37.2	9,372	80.9	2,219	19.1
Non-binary	5	38.5	8	61.5	8	61.5	5	38.5
Unknown	77	89.5	9	10.5	81	94.2	5	5.8
Total	15,547	62.8	9,195	37.2	19,884	80.4	4,858	19.6

Full-Time Status

Both part-time and full-time students attempted transfer-level math at higher rates in the post-AB 705 cohorts than in the pre-AB 705 cohorts. Full-time students had higher rates of attempting transfer-level math than part-time students did in both pre- and post-AB 705 cohorts. Ten percent of part-time students in pre-AB 705 cohorts attempted transfer-level math during their first year, compared with 28.4% of part-time students in post-AB 705 cohorts. About 28% of full-time students in pre-AB 705 cohorts attempted transfer-level math, while 57.2% of full-time students in post-AB 705 cohorts attempted transfer-level math.

In addition, both part-time and full-time students completed transfer-level math at higher rates in the post-AB 705 cohorts than in the pre-AB 705 cohorts. Full-time students had higher rates of completing transfer-level math than part-time students did in both pre- and post-AB 705 cohorts. Almost 6% of part-time students in pre-AB 705 cohorts completed transfer-level math during their first year, compared with 12% of part-time students in post-AB 705 cohorts. About 21% of full-time students in pre-AB 705 cohorts completed transfer-level math, while 37% of full-time students in post-AB 705 cohorts completed transfer-level math. Table 11 displays the distribution of transfer-level math attempts and completion within the first year by full-time status.

Table 11

Transfer-Level Math Attempts and Completion Within the First Year by Full-Time Status

	Attempted transfer-level math				Completed transfer-level math			
	No		Yes		No		Yes	
Cohort	*n*	%	*n*	%	*n*	%	*n*	%
Pre-AB 705								
Part-time	53,881	90.0	5,971	10.0	56,472	94.4	3,380	5.6
Full-time	15,651	72.1	6,058	27.9	17,240	79.4	4,469	20.6
Total	69,532	85.3	12,029	14.7	73,712	90.4	7,849	9.6
Post-AB 705								
Part-time	12,321	71.6	4,883	28.4	15,137	88.0	2,067	12.0
Full-time	3,226	42.8	4,312	57.2	4,747	63.0	2,791	37.0
Total	15,547	62.8	9,195	37.2	19,884	80.4	4,858	19.6

Income Status

Students who were considered low-income based on receiving the California Promise Grant as well as students who did not receive the grant attempted transfer-level math at similar rates pre-AB 705, 15.4% and 14.2%, respectively. However, a higher proportion of low-income students attempted transfer-level math than students not considered low-income post-AB 705. Almost 42% of low-income students attempted transfer-level math post-AB 705, compared with 31.6% of students not considered low-income post-AB 705. Both non-low-income and low-income students attempted transfer-level math at higher rates in the post-AB 705 cohorts than in the pre-AB 705 cohorts. For example, 15.4% of low-income students attempted transfer-level math pre-AB 705, compared with 41.7% of low-income students in post-AB 705 cohorts.

Similarly, both non-low-income and low-income students completed transfer-level math at higher rates in the post-AB 705 cohorts than in the pre-AB 705 cohorts. About 10% of non-low-income students in pre-AB 705 cohorts completed transfer-level math during their first year, compared with 17.4% post-AB 705. About 10% of low-income students in pre-AB 705 cohorts completed transfer-level math, compared with 21% post-AB 705. Table 12 displays the distribution of transfer-level math attempts and completion within the first year by income status.

Table 12

Transfer-Level Math Attempts and Completion Within the First Year by Income Status

	Attempted transfer-level math				Completed transfer-level math			
	No		Yes		No		Yes	
Cohort	*n*	%	*n*	%	*n*	%	*n*	%
Pre-AB 705								
Not low-income	36,783	85.8	6,090	14.2	38,794	90.5	4,079	9.5
Low-income	32,749	84.6	5,939	15.4	34,918	90.3	3,770	9.7
Total	69,532	85.3	12,029	14.7	73,712	90.4	7,849	9.6
Post-AB 705								
Not low-income	7,604	68.4	3,511	31.6	9,178	82.6	1,937	17.4
Low-income	7,943	58.3	5,684	41.7	10,706	78.6	2,921	21.4
Total	15,547	62.8	9,195	37.2	19,884	80.4	4,858	19.6

STEM Majors

A total of 9,604 students, which is about 9% of the sample, had declared majors in a STEM area during their first term. This included 6,334 students in pre-AB 705 cohorts and 3,270 students in post-AB 705 cohorts. By the end of the first year, 88.6% of STEM-declared students in the pre-AB 705 stayed in STEM, compared with 95.3% of students in post-AB 705 cohorts. About 11.4% of STEM-declared students in the pre-AB 705 cohorts switched to a non-STEM major, compared with 4.7% of students in post-AB 705 cohorts. Therefore, there were fewer major switches away from STEM in the post-AB 705 cohorts. Table 13 shows the distribution of STEM majors, including students who stayed as a STEM major and students who switched from a STEM major to a non-STEM major.

In addition, there were fewer STEM major switches for all racial/ethnic groups post-AB 705. For example, 8.3% of Asian students in pre-AB 705 cohorts switched from a STEM to a non-STEM major, compared with 4.5% of Asian students in post-AB 705 cohorts. About 12.8% of Black students in pre-AB 705 cohorts switched from a STEM to a non-STEM major, compared with 7.1% of Black students in post-AB 705 cohorts. About 12.6% of Latina/o/x students in pre-AB 705 cohorts switched from a STEM to a non-STEM major, compared with 4.7% of Latina/o/x students in post-AB 705 cohorts. About 9.3% of White students in pre-AB 705 cohorts switched from a STEM to a non-STEM major, compared with 4.9% of White students in post-AB 705 cohorts. Black students continued to switch from STEM to non-STEM majors more often than other racial/ethnic groups.

Table 13

STEM Majors by Race/Ethnicity

	STEM major stay		STEM major switch		Total	
Cohort	*n*	%	*n*	%	*n*	%
Pre-AB 705						
Asian	725	91.7	66	8.3	791	100.0
Black/African American	410	87.2	60	12.8	470	100.0
Hawaiian/Pacific Islander	19	86.4	3	13.6	22	100.0
Latina/o/x	3,277	87.4	471	12.6	3,748	100.0
Native American	12	92.3	1	7.7	13	100.0
Two or more races	156	88.6	20	11.4	176	100.0
Unknown	86	90.5	9	9.5	95	100.0
White	924	90.7	95	9.3	1,019	100.0
Total	5,609	88.6	725	11.4	6,334	100.0
Post-AB 705						
Asian	337	95.5	16	4.5	353	100.0
Black/African American	197	92.9	15	7.1	212	100.0
Hawaiian/Pacific Islander	5	100.0	0	0.0	5	100.0
Latina/o/x	1,913	95.3	94	4.7	2,007	100.0
Native American	4	100.0	0	0.0	4	100.0
Two or more races	73	96.1	3	3.9	76	100.0
Unknown	81	100.0	0	0.0	81	100.0
White	506	95.1	26	4.9	532	100.0
Total	3,116	95.3	154	4.7	3,270	100.0

Furthermore, students with STEM-declared majors completed transfer-level math within their first year at a higher proportion than their non-STEM peers in both pre- and post-AB 705 cohorts. Table 14 displays transfer-level math attempts and completion by non-STEM and STEM majors. Almost 9% of non-STEM majors in the pre-AB 705 cohorts completed transfer-level math within their first year, compared with almost 22% of STEM majors. The proportion of students who completed transfer-level math increased for both non-STEM and STEM majors in the post-AB 705 cohorts. Almost 18% of non-STEM majors in the post-AB 705 cohorts completed transfer-level math within their first year, compared with almost 31% of STEM majors. The proportion of non-STEM majors who completed transfer-level math increased by 9.3 percentage points from the pre-AB 705 cohorts (8.6%) to the post-AB 705 cohorts (17.9%), compared with an increase of 8.9 percentage points for STEM majors (21.9% to 30.8%).

Table 14

Transfer-Level Math Attempts and Completion Within the First Year by Non-STEM and STEM Majors

	Attempted transfer-level math				Completed transfer-level math			
	No		Yes		No		Yes	
Cohort	*n*	%	*n*	%	*n*	%	*n*	%
Pre-AB 705								
Non-STEM major	65,229	86.7	9,998	13.3	68,768	91.4	6,459	8.6
STEM major	4,303	67.9	2,031	32.1	4,944	78.1	1,390	21.9
Total	69,532	85.3	12,029	14.7	73,712	90.4	7,849	9.6
Post-AB 705								
Non-STEM major	14,001	65.2	7,471	34.8	17,621	82.1	3,851	17.9
STEM major	1,546	47.3	1,724	52.7	2,263	69.2	1,007	30.8
Total	15,547	62.8	9,195	37.2	19,884	80.4	4,858	19.6

College

The rates of first-time students attempting transfer-level math varied by college. In the pre-AB 705 cohorts, College 7 had the lowest proportion of students attempting transfer-level math, at 4.5%, and College 5 had the highest proportion of students attempting transfer-level math, at 19.5%. Although the proportions of students attempting transfer-level math increased for all colleges post-AB 705, College 7 continued to have the lowest proportion of students attempting transfer-level math, at 11.6%, and College 5 continued to have the highest proportion of students attempting transfer-level math, at 52.9%.

In regards to completing transfer-level math, College 7 also had the lowest proportion of students completing transfer-level math, at 5.9%, and College 5 had the highest proportion of students completing transfer-level math, at 13.4% pre-AB 705. The proportions of students completing transfer-level math also increased for all colleges post-AB 705. However, College 7 continued to have the lowest proportion of students completing transfer-level math, at 5.3%, and College 5 continued to have the highest proportion of students completing transfer-level math, at 32.5%. Some colleges had similar proportions of students completing transfer-level math post-AB 705 as colleges pre-AB 705. For example, 12% of students in College 9 completed transfer-level math post-AB 705, which is similar to College 3 (13%) and College 5 (13.4%) pre-AB 705. Table 15 shows transfer-level math attempts and completions by college.

Table 15

Transfer-Level Math Attempts and Completion Within the First Year by College

Cohort	Attempted transfer-level math				Completed transfer-level math			
	No		Yes		No		Yes	
	n	%	*n*	%	*n*	%	*n*	%
Pre-AB 705								
1	7,777	87.7	1,092	12.3	8,167	92.1	702	7.9
2	13,480	85.0	2,388	15.0	14,206	89.5	1,662	10.5
3	5,940	81.2	1,372	18.8	6,365	87.0	947	13.0
4	5,492	83.0	1,126	17.0	5,979	90.3	639	9.7
5	11,331	80.5	2,745	19.5	12,189	86.6	1,887	13.4
6	3,361	91.1	329	8.9	3,472	94.1	218	5.9
7	6,793	95.5	323	4.5	6,922	97.3	194	2.7
8	8,759	82.7	1,838	17.3	9,510	89.7	1,087	10.3
9	6,599	89.0	816	11.0	6,902	93.1	513	6.9
Total	69,532	85.3	12,029	14.7	73,712	90.4	7,849	9.6
Post-AB 705								
1	1,495	64.9	807	35.1	1,860	80.8	442	19.2
2	3,448	67.6	1,656	32.4	4,256	83.4	848	16.6
3	1,041	55.6	832	44.4	1,450	77.4	423	22.6
4	1,169	58.4	832	41.6	1,680	84.0	321	16.0
5	2,095	47.1	2,350	52.9	3,002	67.5	1,443	32.5
6	770	70.3	326	29.7	926	84.5	170	15.5
7	2,065	88.4	270	11.6	2,212	94.7	123	5.3
8	1,788	54.1	1,520	45.9	2,494	75.4	814	24.6
9	1,676	73.6	602	26.4	2,004	88.0	274	12.0
Total	15,547	62.8	9,195	37.2	19,884	80.4	4,858	19.6

Furthermore, Table 16 details the proportions of first-time students who completed transfer-level math within their first year by entry cohort and college. Although the proportion of completion generally increased over time for all colleges, the range of proportions in completing transfer-level math remained wide. For example, in 2020, 37.6% of first-time students from College 5 completed transfer-level math within the first year, compared with 4.8% of students from College 7.

Table 16

Proportion of First-Time Students Who Completed Transfer-Level Math Within the First Year by Entry Cohort and College

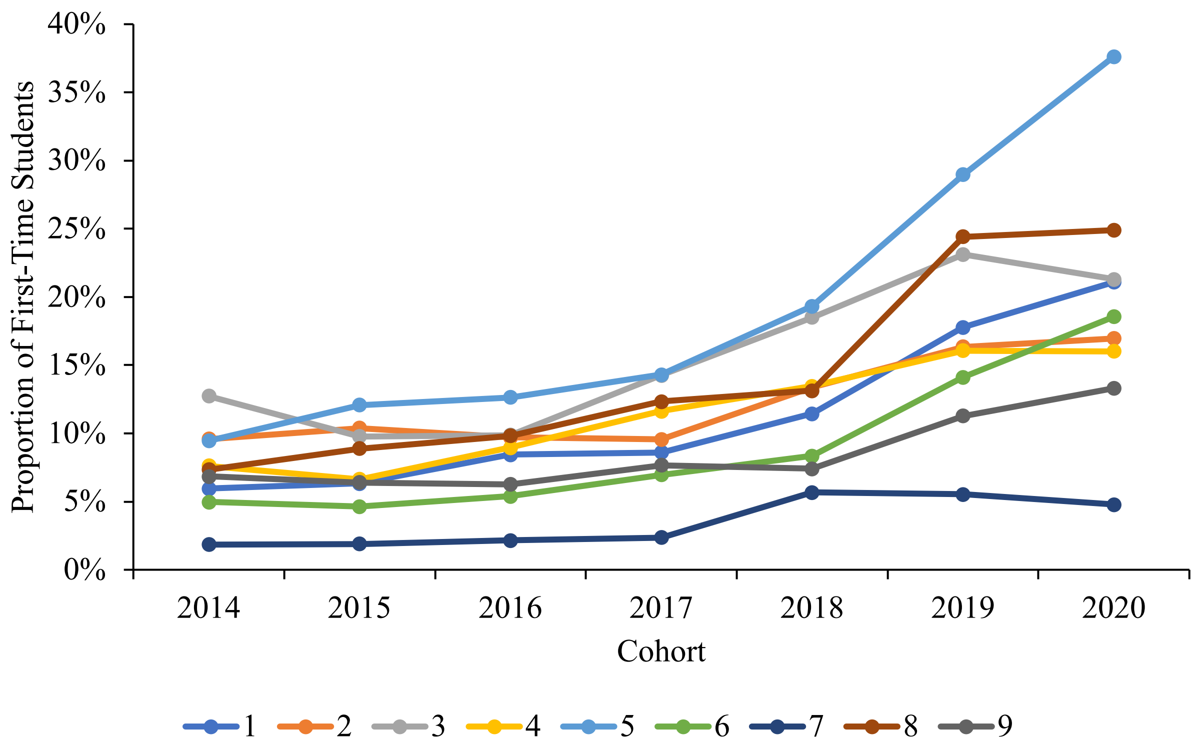
Cohort	1	2	3	4	5	6	7	8	9
2014	6.0	9.6	12.7	7.6	9.5	5.0	1.8	7.3	6.9
2015	6.3	10.4	9.8	6.6	12.1	4.6	1.9	8.9	6.4
2016	8.4	9.7	9.9	8.9	12.6	5.4	2.2	9.8	6.3
2017	8.6	9.6	14.3	11.6	14.3	7.0	2.4	12.3	7.7
2018	11.5	13.4	18.5	13.5	19.3	8.3	5.7	13.1	7.4
2019	17.8	16.3	23.1	16.1	29.0	14.1	5.5	24.4	11.3
2020	21.1	17.0	21.3	16.0	37.6	18.6	4.8	24.9	13.3

Figure 1 displays the proportions of first-time students who completed transfer-level math within their first year by entry cohort and college. The proportion of students completing transfer-level math generally increased over time, especially from 2018 to 2019, which was the first year of AB 705 implementation. From 2018 to 2019, the completion of transfer-level math increased by 6.3 percentage points in College 1, 3 percentage points in College 2, 4.6 percentage points in College 3, 2.6 percentage points in College 4, 9.6 percentage points in College 5, 5.8 percentage points in College 6, 11.3 percentage points in College 8, and 3.9 percentage points in

College 9. Only College 7 experienced a slight decrease in the proportion of students completing transfer-level math, from 5.7% in 2018 to 5.5% in 2019. In summary, the completion of transfer-level math increased and varied by college.

Figure 1

Proportion of First-Time Students Who Completed Transfer-Level Math Within the First Year by Entry Cohort and College



Logistic Regression Analyses

I used the analysis from the contingency tables to build up to the regression models. Because contingency tables do not account for changes in demographics over time and do not control for student characteristics, I used regression models to determine the effect of variables on the completion of transfer-level math. The dependent variable was the completion of transfer-level math within the first year. The independent variables included race/ethnicity, gender, income status, full-time status, major, cohort pre- and post-AB 705, and college. Regression models allowed for several predictor variables and interaction variables to be evaluated simultaneously. I investigated a series of seven multiple logistic regression models to determine the effect of each set of predictors on the completion of transfer-level math within students' first year. A different set of predictors was added to each model from Model 2 to Model 7. This helped evaluate the contribution of those predictors independent of other predictors. During this process, I examined the residual deviance, degrees of freedom, -2x Log-Likelihood, and R^2 value of each model to determine how additional predictors affected the ability to improve prediction. I also conducted likelihood ratio tests to compare models, examine the differences between the models, and determine the fit of the models. The analysis resulted in using Model 7 as the final model to predict completion of transfer-level math within the first year for different student profiles.

The baseline model is represented by Model 1 in Table 17 and includes only the post-AB 705 cohort variable, the college variable, and an interaction variable between post-AB 705 cohort and college. The interaction between college and year accommodates trends in the transfer-level completion by college in pre- and post-AB 705 years. In other words, the interaction variable accounts for the effect of AB 705 on the completion of transfer-level math changes, depending on college. Addressing the variability allows for the examination of student characteristics (e.g., race/ethnicity) and their association with completing transfer-level math, controlling for differences by year and college. Model 1 had a -2x Log-Likelihood of 74138 and Tjur R^2 value of 0.038.

Model 2 built upon the baseline model and added the race/ethnicity variables. With this set of predictors included, the coefficient of determination (Tjur R^2) increased from 0.038 to

0.062. Table 18 includes the test statistic as well as the *p* values to evaluate the addition of each set of predictor variables and determine if the predictors offered a significant improvement in fit. Comparing Model 2 to Model 1 using the likelihood-ratio test showed that race/ethnicity offered a significantly better fit.

Model 3 is the baseline model with the addition of gender variables. The coefficient of determination (Tjur R^2) in Model 3 was 0.038, which is the same as Model 1. However, comparing Model 3 to Model 1 using the likelihood-ratio test showed that gender offered a significantly better fit.

Model 4 is the baseline model with the addition of the full-time variable. The coefficient of determination (Tjur R^2) in Model 4 increased to 0.009. Comparing Model 4 to Model 1 using the likelihood-ratio test showed that full-time status offered a significantly better fit.

In Model 5, the low-income variable was included. The coefficient of determination (Tjur R^2) in Model 5 remained the same, 0.038, as the baseline model. Comparing Model 5 to Model 1 using the likelihood-ratio test showed that full-time status offered a significantly better fit.

Model 6 included the STEM major variable. The coefficient of determination (Tjur R^2) in Model 6 increased to 0.051. Comparing Model 6 to Model 1 using the likelihood-ratio test showed that full-time status offered a significantly better fit.

Model 7 represents the final model, which includes the variables in the baseline model and each set of predictors from Models 2 through 6. Model 7 was used to estimate the predicted probabilities of completing transfer-level math for hypothetical students. The coefficient of determination (Tjur R^2) in Model 7 increased to 0.134. Comparing Model 7 to Model 1 using the likelihood-ratio test showed that full-time status offered a significantly better fit.

Table 17

Summary of Logistic Regression Models

	Models						
	1	2	3	4	5	6	7
Predictors in model							
AB 705 cohort	x	x	x	x	x	x	x
College	x	x	x	x	x	x	x
AB 705 cohort*college	x	x	x	x	x	x	x
Race/ethnicity		x					x
Gender			x				x
Full-time status				x			x
Income status					x		x
STEM major						x	x
Number of predictors	17	24	20	18	18	18	30
Residual deviance	74138	72002	74097	68904	74111	72996	66160
Degrees of freedom	106281	106274	106278	106280	106280	106280	106268
-2x Log-Likelihood	74138	72002	74097	68904	74111	72996	66160
Tjur R^2	0.038	0.062	0.038	0.099	0.038	0.051	0.134

Note. All students in the sample (n = 106,303) were included in the logistic regression models, whether they attempted math or not.

Table 18

Comparison of Logistic Regression Models

	Models compared					
	2 vs 1	3 vs 1	4 vs 1	5 vs 1	6 vs 1	7 vs 1
LRT	2136.1	40.5	5233.3	27.0	1141.7	7978.0
p-value	<.001	<.001	<.001	<.001	<.001	<.001

Note. Likelihood-ratio test (LRT) is the chi-square test statistic for the difference in -2x log-likelihood between models.

The final logistic regression model was used to examine the effect of certain variables on the completion of transfer-level math within students' first year of college. The final model is presented as follows:

$$log\left(\frac{P_{TLM\_Success}}{1-P_{TLM\_Success}}\right) = \beta_0 + \beta_{AB705\_cohort} \times X_{AB705\_cohort} + \beta_{college} \times X_{college}$$

$$+ \beta_{AB705\_cohort*college} \times X_{AB705\_cohort} \times X_{college} + \beta_{race} \times X_{race} + \beta_{gender} \times X_{gender}$$

$$+ \beta_{full\_time} \times X_{full\_time} + \beta_{income} \times X_{income} + \beta_{stem} \times X_{stem},$$

where $P_{TLM\_Success}$ is the probability of successfully completing transfer-level math within the first year; X_{AB705_cohort} is a variable indicating 1 if entry term is 2019 or 2020 and 0 if entry term is between 2014 and 2018; $X_{college}$ is a variable indicating each of the nine colleges; X_{race} is a set of dummy variables indicating 1 or 0 for each racial/ethnic category; X_{gender} is a set of dummy variables indicating 1 or 0 for each gender category; X_{full_time} is a variable indicating 1 if units attempted in the entry term were 12 or more and 0 if units attempted in the entry term were fewer than 12; X_{income} is a variable using the California Promise Grant as a proxy for low-income where 1 indicates receiving the grant and 0 indicates not receiving the grant; X_{stem} is a variable indicating 1 if students' major was in STEM during their entry term and 0 if it was not; β_{AB705_cohort}, $\beta_{college}$, β_{race}, β_{gender}, β_{full_time}, β_{income}, and β_{stem} are slope coefficients for the various predictor variables; $\beta_{AB705\_cohort*college}$ is a slope intercept for the interaction between the post-AB 705 variable and the college variable; and β_0 is the model intercept. Table 19 contains the results from the logistic regression model.

Research Question 2 Findings

AB 705 Cohort

The logistic regression analysis showed the log odds and expected probabilities for completing transfer-level math within the first year holding certain student characteristics constant. See Table 19 for the logistic regression findings. The logistic regression produced a coefficient of 1.025 for the AB 705 cohort variable. In other words, being in a post-AB 705 cohort versus a pre-AB 705 cohort was associated with a log odds of completing transfer-level math of 1.025 ($e^b = 2.787$, $p < .001$). The expected probability of completing transfer-level math is higher for any comparison of hypothetical students post-AB 705. The expected probability of completing transfer-level math within the first year at the biggest college holding all other variables in the model constant to typical values post-AB 705 is 7.5%, compared with 4.5% pre-AB 705. Typical values for the variables in the model account for students who are low-income, Latina/o/x, female, full-time, and non-STEM majors.

Table 19

Logistic Regression Findings: Completion of Transfer-Level Math Within the First Year

Variable name	*b*	SE*(b)*	*p*	exp*(b)*
Intercept (constant)	-3.677	0.399	< .001	0.025
AB 705 cohort	1.025	0.070	< .001	2.787
College (reference = 1)				
2	0.377	0.050	< .001	1.458
3	0.477	0.055	< .001	1.611
4	0.536	0.060	< .001	1.710
5	0.513	0.049	< .001	1.671
6	0.146	0.085	.082	1.157
7	-0.917	0.085	< .001	0.400
8	0.309	0.053	< .001	1.362
9	-0.069	0.063	.251	0.934
Low-income	-0.011	0.021	.558	0.989
Race/ethnicity (reference = unknown)				
Asian	0.808	0.074	< .001	2.243
Black/African American	-0.596	0.082	< .001	0.551
Hawaiian/Pacific Islander	-0.470	0.229	.048	0.625
Latina/o/x	-0.323	0.071	< .001	0.724
Native American	-0.509	0.330	.122	0.601
Two or more races	-0.142	0.093	.131	0.868
White	0.279	0.073	< .001	1.322
Gender (reference = unknown)				
Female	0.574	0.397	.152	1.776
Male	0.600	0.397	.134	1.821
Non-binary	1.179	0.665	.077	3.253
Full-time status	1.416	0.021	< .001	4.120
STEM major	0.884	0.028	< .001	2.421
Post-AB 705 cohort*college (reference = Post-AB 705 cohort*1)				
Post-AB 705 cohort*2	-0.472	0.085	<.001	0.624
Post-AB 705 cohort*3	-0.264	0.099	.007	0.768
Post-AB 705 cohort*4	-0.616	0.104	<.001	0.540
Post-AB 705 cohort*5	0.102	0.082	.213	1.108
Post-AB 705 cohort*6	0.103	0.133	.441	1.109
Post-AB 705 cohort*7	-0.306	0.139	.028	0.736
Post-AB 705 cohort*8	-0.076	0.089	.401	0.926
Post-AB 705 cohort*9	-0.380	0.108	<.001	0.684

Note. *b* is the expected change in the log odds of completion of transfer-level math within the first year given a unit change in the predictor and holding other predictors constant. SE(*b*) is the standard error of the estimated slope (b). *p* is the *p* value for a test of the slope. *p* values less than 0.05 are significant. Exp(*b*) is the expected change in the odds of completion of transfer-level math given a unit change in the predictor and holding other predictors constant.

College

The logistic regression analysis revealed significant variation in the log odds of completing transfer-level math across colleges. Students in College 7 ($e^b = .400$, $p < .001$) are less likely to complete transfer-level math compared with students in College 1, fixing for other predictors. Holding all variables constant to typical values, the expected probability of completing transfer-level math within the first year post-AB 705 varied across the colleges and ranged from 2.6% to 14.2%. Typical values for the variables in the model account for students who are low-income, Latina/o/x, female, full-time, and non-STEM majors. Holding all variables in the model constant to typical values post-AB 705, students in College 5 had a 14.2% expected probability of completing transfer-level math, compared with 10.3% at College 6, 10.2% at College 8, 10% at College 3, 8.2% at College 1, 7.7% at College 4, 7.5% at College 1, 5.4% at College 9, and 2.6% at College 7.

Low-Income

Students who are considered low-income are less likely to complete transfer-level math than those students who are not considered low-income. However, the difference is not statistically significant ($e^b = .989$, $p = .558$). Holding all variables in the model constant to typical values post-AB 705, low-income and non-low-income students had similar expected probabilities of completing transfer-level math, 7.5% and 7.6%, respectively. Typical values for the variables in the model accounted for students who are at the biggest college, Latina/o/x, female, part-time, and non-STEM majors. The expected probability is very similar for low-income and non-low-income students within the same college post-AB 705. Holding all variables constant to typical values, the expected probability of completing transfer-level math within the first year post-AB 705 across the colleges ranged from 2.6% to 14.4%.

Race/Ethnicity

The logistic regression analysis indicated significant increases in the probability of completing transfer-level math for Asian ($e^b = 2.243$, $p < .001$), Black ($e^b =.551$, $p < .001$), Latina/o/x ($e^b = 0.724$, $p < .001$), and White ($e^b = 1.322$, $p < .001$) student groups. The expected probability more than doubled for these student groups post-AB 705. Holding all variables in the model constant, Asian students had a 20.2% expected probability of completing transfer-level math within their first year post-AB 705, compared with a 12.7% expected probability pre-AB 705. Black students had a 5.8% expected probability of completing transfer-level math within their first year post-AB 705, compared with a 3.4% expected probability pre-AB 705. Latina/o/x students had a 7.5% expected probability of completing transfer-level math within their first year post-AB 705, compared with a 4.5% expected probability pre-AB 705. White students had a 13% expected probability of completing transfer-level math within their first year post-AB 705, compared with a 7.9% expected probability pre-AB 705. Typical values for the variables in the model accounted for students who are at the largest college, female, part-time, low-income, and non-STEM majors. Although it increased for these racial/ethnic groups, there was wide variation of the expected probability by racial group. For example, the expected probability for Black students was lower post-AB 705 than for Asian students pre-AB 705. The analysis also found wide variation by college, where a few colleges had consistently higher expected probabilities for all racial/ethnic groups, while others had consistently low expected probabilities for all racial/ethnic groups.

Gender

Female students compared with students with unknown genders was associated with a log odds of completing transfer-level math of 0.574 ($e^b = 1.776$, $p = .152$). Male students compared with students with unknown genders was associated with a log odds of completing transfer-level of 0.600 (574 ($e^b = 1.821$, $p = .134$). Both are not statistically significant. There were not major differences in the expected probabilities by gender, as well as by gender and racial/ethnic groups. For example, female Latina students had a 7.5% expected probability of completing transfer-level math within their first year post-AB 705, compared with 4.5% pre-AB 705. Male Asian students had similar expected probabilities of completing transfer-level math as their female Asian peers, which was 7.7% post-AB 705 compared with 4.6% pre-AB 705. These expected probabilities are values for students who were non-STEM, low-income, part-time, female, and attended the largest college.

Full-Time Status

Being a full-time student was associated with a log odd of completing transfer-level math of 1.416 ($e^b = 1.416$, $p < .001$). Full-time students had a 25.25% expected probability of completing transfer-level math post-AB 705, compared with a 16.20% expected probability pre-AB 705. On the other hand, part-time students had a 7.5% expected probability of completing transfer-level math, compared with a 4.5% expected probability post-AB 705. These expected probabilities are specific to students who were non-STEM, low-income, part-time, female, Latina, and attended the largest college. It is important to note that the expected probability is higher (16.20%) for full-time students pre-AB 705 than for part-time students (7.5%) post-AB 705. Lastly, full-time status almost doubled the expected probabilities for each racial group post-AB 705.

STEM Major

Unless otherwise indicated, the examples of the expected probabilities described in this section fix for variables in the model based on the reference college in the model, STEM major, part-time status because the majority of the sample was part time, and low-income status. However, low-income was not found to be statistically significant in the model.

Female Asian students with STEM majors had a 40.2% expected probability of completing transfer-level math within their first year post-AB 705, compared with 19.4% pre-AB 705. These expected probabilities were fixed on the criteria described previously. Male Asian students with STEM majors had similar expected probabilities of completing transfer-level math as their female Asian peers, which was 40.8% post-AB 705 compared with 19.8% pre-AB 705. The expected probabilities were slightly lower for both female (38.0%) and male (38.6%) Asian students, when accounting for the largest college in the sample. The expected probabilities of completing transfer-level math for STEM Asian students varied by college post-AB 705 from 56.0% to 16.5%.

Female Black students with STEM majors had a 14.2% expected probability of completing transfer-level math within their first year post-AB 705, compared with 5.6% pre-AB 705. These expected probabilities were fixed on the criteria described previously. Male Black students with STEM majors had similar expected probabilities of completing transfer-level math as their female Black peers, which was 14.5% post-AB 705 compared with 5.7% pre-AB 705. The expected probabilities of completing transfer-level math for STEM Black students varied by college post-AB 705 from 23.9% to 5%. The expected completion probability for Black STEM major students doubled when they were full-time students.

Female Latina students with STEM majors had an 18.2% expected probability of completing transfer-level math within their first year post-AB 705, compared with 7.2% pre-AB 705. These expected probabilities were fixed on the criteria described previously. Male Latino students with STEM majors had similar expected probabilities of completing transfer-level math as their female Latina peers. The expected probabilities of completing transfer-level math for STEM Latina/o/x students varied by college post-AB 705 from 29.1% to 6%. The expected probability of completing transfer-level math for Latina/o/x students more than doubled when they were full-time students.

Female White students with STEM majors had a 28.4% expected probability of completing transfer-level math within their first year post-AB 705, compared with 12.4% pre-AB 705. These expected probabilities were fixed on the criteria described previously. Male White students with STEM majors had similar expected probabilities of completing transfer-level math as their female White peers. The expected probabilities of completing transfer-level math for STEM Latina/o/x students varied by college post-AB 705 from 75.6% to 11%. The expected probability of completing transfer-level math for White students more than doubled when they were full-time students.

The logistic regression analysis indicated significant increases in the probability of completing transfer-level math for Asian, Black, Latina/o/x, and White student groups. The expected probabilities of completing transfer-level math for these racial/ethnic groups was higher for STEM majors than non-STEM majors. The expected probability more than doubled for these student groups post-AB 705. Although it increased for these racial/ethnic groups, there was wide variation of the expected probability by racial group. The analysis also found wide variation by college, where a few colleges had consistently higher expected probabilities for all racial/ethnic groups, while others had consistently low expected probabilities for all racial/ethnic groups. Lastly, full-time status almost doubled the expected probabilities for each racial group.

Conclusion

The analysis found that AB 705 helped all racial groups complete transfer-level math at higher proportions. However, there continued to be differences in transfer-level math completion when comparing different racial/ethnic groups. Testing various student characteristics found significant effects for the racial/ethnicity set of predictors, as well as full-time status. Furthermore, being a STEM major significantly increased the completion of transfer-level math within the first year. The proportion of Black and Latina/o/x students switching away from STEM majors decreased post-AB 705, but these two groups continued to be the groups with the highest number of STEM major switches within the first year.

CHAPTER FIVE: DISCUSSION

This research study examined the proportions of students enrolling in and completing transfer-level math pre- and post-AB 705, as well as different predictors affecting the completion of transfer-level math within the first year. The study drew attention to the relationship between students' race/ethnicity and the completion of transfer-level math given the implementation of AB 705. The study addressed the racial equity gaps in math completion and examined the potential impact AB 705 may have on STEM. The research site for this study was a large community college district in Southern California. The study analyzed seven cohorts of first-time students who entered in the fall of 2014 to 2020. Because AB 705 was fully implemented in fall 2019, analyzing 5 years prior to implementation identified trends pre-AB 705. This study confirms existing research on equity gaps surrounding the completion of transfer-level math, as well as early research on the impact of AB 705. This study also adds to the limited research on the role of math in promoting STEM at the community college level for Students of Color. This chapter summarizes key findings, discusses implications of the study, identifies limitations of the study, and provides recommendations for future research.

Summary of Findings

Although the proportion of first-year students attempting any math within their first year decreased in 2019 and 2020, the proportion of students attempting transfer-level math increased and the number of students attempting transfer-level math almost doubled from 3,188 students in 2018 to 5,667 students in 2019, the first year of AB 705. The analysis found that AB 705 helped all racial groups complete transfer-level math at higher proportions. The expected probability more than doubled for Asian, Black, Latina/o/x, and White student groups post-AB 705. However, there continue to be differences in transfer-level math completion when comparing different racial/ethnic groups. The expected probability for each racial group varied widely. For example, the expected probability for Black students was lower post-AB 705 than for Asian students pre-AB 705. Full-time status almost doubled the expected probabilities for each racial group. Furthermore, being a STEM major significantly increased the completion of transfer-level math within the first year. The proportion of Black and Latina/o/x students switching away from STEM majors decreased post-AB 705, but these two groups continued to have the highest number of STEM major switches within the first year.

The analysis also found wide variation by college, where a few colleges had consistently higher expected probabilities for all racial/ethnic groups, while others had consistently low expected probabilities for all racial/ethnic groups. One of the main takeaways is that even for the same hypothetical students at different colleges, students had fairly different expected probabilities of completing transfer-level math within their first year.

Significance of Findings

The recent implementation of AB 705 opened an opportunity to address racial equity gaps in math completion and overall college completion. Research has shown that students who do enroll in developmental courses are less likely to graduate than those students who begin taking transfer-level courses (Logue et al., 2019). Given the systemic increase in access to transfer-level math post-AB 705, transfer and graduation rates are expected to increase. Because the long-term impacts of the bill cannot be analyzed yet and there was only 1 year of AB 705 implementation before the COVID-19 pandemic, it is important to continue monitoring its short-term impact.

Furthermore, AB 705 has the potential to rectify the harms of developmental education on Students of Color and increase STEM participation. Research has shown that California

Community Colleges have an unmet potential in preparing students to pursue STEM majors (Bahr et al., 2017). This study showed that having a STEM major significantly increases the completion of transfer-level math within the first year. The proportion of Black and Latina/o/x students switching away from STEM majors decreased post-AB 705. Community college students with STEM-aspiring majors depend on the timely entry and completion of transfer-level math courses (Park et al., 2020). Because AB 705 has opened access to transfer-level math courses, it provides an opportunity to ensure STEM-aspiring students take the math courses needed to continue the STEM pathway.

Implications and Recommendations for Practice

A new follow-up bill to AB 705, Assembly Bill 1705 (AB 1705), was introduced in early 2022. At the time of this writing, the bill has not passed and is being discussed at the state legislature (California Legislative Information, 2022). AB 1705 is a continuation of AB 705 and would require colleges to place and enroll all students in transfer-level English and math by July 1, 2023. Given the changing landscape in California Community Colleges, this study has the potential to inform both practitioners and policy makers. Specifically, this study infers significant differences in the completion of transfer-level math by college and racial/ethnic groups. Although there were increases in the completion of transfer-level math within students' first year for every sub-group post-AB 705, the overall completion rates remain low. AB 705 may be a step in the right direction to increase transfer-level math completions, but it is not enough. Therefore, this study may be used to help policy makers make informed decisions regarding AB 1705 and help colleges implement AB 1705 successfully if the law were to pass. Whether the law passes or not, colleges should continue exploring and implementing effective practices and practices to increase transfer-level math completion. That way, transfer-level math completion can continue increasing at higher rates, especially for colleges that have very low completion rates.

The new performance-based funding formula financially incentivizes districts to increase transfer-level math completions. Therefore, colleges are financially encouraged to increase the number of students who complete transfer-level math within their first year. The findings revealed that a higher proportion of first-year students are attempting and completing transfer-level math. The findings also revealed remaining equity gaps in the probability of completing transfer-level math; specifically, some racial/ethnic groups have a lower expected probability of completing transfer-level math within their first year. Therefore, it is recommended that colleges focus on these students and provide the necessary ongoing support for them to attempt and complete transfer-level math.

Furthermore, full-time status doubles the expected probability of completing transfer-level math. However, two thirds of the community college population in the district is not full time. It is recommended that colleges help students enroll full time. That way, students have more opportunity to attempt and complete transfer-level math, as well as other graduation and transfer requirements. Many times, students are not enrolled full time due to financial reasons or work obligations. Colleges are encouraged to help students find on-campus employment and remove barriers that prevent students from enrolling in college full time.

Recommendations for Future Research

Future research should continue assessing the impact of AB 705, especially if AB 1705 passes. Specifically, additional recent cohorts should be analyzed, including the most recent cohort, which started in fall 2021. Also, future research should extend the timeframe of the study from 1 year to 2 years, and possibly longer. This would allow the researcher to examine cohorts for a longer period of time and better assess the impact of AB 705 on students' college completion goals. Moreover, the study focused on the completion of transfer-level math as the outcome variable, which was measured by grades. However, completion might not equate to learning. A future study may focus on learning as the outcome variable to assess the impact of AB 705 and better understand math learning in the context of AB 705.

In this study, first college was defined as the student's entry college. However, students may take classes at multiple colleges simultaneously within the same term or term to term. Therefore, future research could redefine college as the college in which the student took the most units or enrolled in the longest. This way, college is defined as where the student spent the most time and likely was most influenced by the environment.

Other predictor variables should be considered for the logistic regression, including an entry term predictor. For example, future research could examine the impact of AB 705 and any differences based on the start term of new students. Communication and onboarding activities may differ term to term. For example, there may be more counseling outreach during the summer time as seniors graduate from high school than in the winter intersession. In other words, the experience of students may differ based on the term in which they start. A first-generation predictor variable is also recommended to investigate. Community colleges serve as an entryway to higher education for first-generation college students. It would be interesting to analyze the impact of first-generation status on the completion of transfer-level math. Other sets of predictor variables might also include participation in special groups such as diversability support services or other student characteristics such as veteran status. Math courses were also switched to an online remote environment due to the COVID-19 pandemic. A future study could further investigate the impact of course modality on the completion of transfer-level math. Lastly, the completion of transfer-level math may also be investigated by full-time and part-time professors and their demographics. This set of predictors may also have an impact on the completion of transfer-level math, especially for Students of Color.

Furthermore, the study found that there are indeed differences between the colleges that could be further investigated to understand the sources. Perhaps there are other variables that were not accounted for in the models, which could explain the differences. Multi-level regression models to test colleges as a random effect instead of a fixed effect might be a method that a future study could use. The college environment might have different effects on certain students. This method might also be used to draw conclusions that are generalizable to the California Community College system.

Limitations of the Study

One of the study's limitations was the lack of depth in the analysis, results, and interpretation. Because the study was strictly quantitative, the results did not answer "why" race/ethnicity influences particular math course enrollments and why students switch majors. An additional component of the study that focused on qualitative methods would provide a depth of knowledge as to why students choose to enroll in a certain math course sequence and subsequently complete transfer-level math. The current study did not dig deep into understanding students' feelings, perceptions, and experiences. It also did not address processes or how students obtain information that influences their decisions to enroll in certain math classes. Therefore, a future study with a mixed-methods approach would allow for both breadth and depth of this study's findings.

Another potential limitation was the lack of standardization of math classes across the colleges within the district. Math classes are titled and numbered differently across all colleges within the district. Because students enroll in multiple colleges, this might affect students' choice of math courses. The size of the colleges also varies. The largest college serves about 60,000 students each year, while the smallest college serves about 10,000 students each year. This might affect how students receive information to enroll in their math classes and their experiences in general. The urban location and student diversity of the district might not allow the study to be generalizable to other college districts in rural areas with mono-ethnic student populations.

Many departments also changed their curriculum in response to AB 705 and added credit corequisite support classes to complement the transfer-level math course (Research & Planning Group, 2020a). The comparisons that were made throughout the study pre- and post-AB 705 did not account for differences in the curriculum or changes to the courses. This might be a limitation of the study that could be further explored by adding a set of predictors to control for the effect of changes in the curriculum. The additional support classes that were implemented post-AB 705 may have led to higher success and completion rates. This was not explicitly examined in this study.

Lastly, the pandemic affected enrollments, services, learning, and teaching. Classes were quickly moved online in the middle of the spring 2020 semester. While AB 705 was implemented in fall 2019, the 2019–2020 and 2020–2021 academic years were not typical. Fall 2019 and winter 2020 were the only terms with data post-AB 705 and pre-pandemic. The study consisted of five cohorts pre-AB 705 and two cohorts post-AB 705, one of which was a pandemic cohort. This means that only one cohort was post-AB 705 without the pandemic, which has limits in itself because colleges were transitioning and exploring approaches to be compliant with AB 705. The study's results may have been influenced by both AB 705 and the pandemic, and it will not be possible to differentiate those influences.

Conclusion

Although AB 705 has increased access to transfer-level math and English, the data showed that more than 60% of first-year students are not enrolling in transfer-level math during their first year. Also, there is a wide variation on the completion of transfer-level math among colleges and racial/ethnic groups. Even though the proportion of completing transfer-level math increased for all students in the post-AB 705 cohorts, the rate remains relatively low. In additional to institutional barriers students may face, lack of information and fear of math might be reasons affecting transfer-level math attempts. Students' environment may also play a role in the decision to attempt a transfer-level math course. Furthermore, stereotypes, stereotype threat, deficit practice, and internalized beliefs may also be affecting the completion of transfer-level math. The combination of these factors may be contributing to the persistent equity gaps in math completion among Students of Color. This new era of policy reform is promising in helping decrease persistent equity gaps.

APPENDIX A: Math Courses and Sequence Crosswalk

Course	Course Title	Units	TOP Code	Transfer Level	Course Sequence
ACAD PR 011CE	MATHEMATICS: WHOLE NUMBERS AND DECIMALS	0	170100	No	
ACAD PR 012CE	MATHEMATICS: FRACTIONS	0	170100	No	
ACAD PR 014CE	MATHEMATICS: RATIO, PROPORTION, AND PERCENT	0	170100	No	
ACAD PR 027CE	STATISTICS SKILLS AND PREPARATION I	0	170100	No	
ACAD PR 028CE	STATISTICS SKILLS AND PREPARATION II	0	170100	No	
ACAD PR 112CE	PRE-ALGEBRA	0	170100	No	
ACAD PR 115CE	ELEMENTARY ALGEBRA	0	170100	No	
ACAD PR 125CE	INTERMEDIATE ALGEBRA	0	170100	No	
ACAD PR 240CE	TRIGONOMETRY FUNDAMENTALS	0	170100	No	
ACAD PR 245CE	COLLEGE ALGEBRA FUNDAMENTALS	0	170100	No	
BSICSKL 028CE	BASIC SKILLS PRE-ALGEBRA	0	170100	No	
BSICSKL 030CE	BASIC SKILLS GEOMETRY	0	170100	No	
BSICSKL 031CE	BASIC SKILLS ALGEBRA II	0	170100	No	
BSICSKL 032CE	BASIC SKILLS TRIGONOMETRY/PRECALCULUS PREPARATION	0	170100	No	
BSICSKL 033CE	DEVELOPING MATHEMATICAL THINKING	0	170100	No	
BSICSKL 035CE	BASIC MATH SKILLS	0	170100	No	
BSICSKL 036CE	PATHWAY MATH	0	170100	No	
BUS 015	BUSINESS STATISTICS	3	050500	Yes	BSTEM
CO SCI 942	DISCRETE STRUCTURE	3	070600	Yes	BSTEM
CS 131	DISCRETE STRUCTURES FOR COMPUTER SCIENCE	3	070600	Yes	BSTEM
ENG GEN 121	PROGRAMMING FOR ENGINEERS: C++	3	090100	Yes	BSTEM
ENG GEN 121	PROGRAMMING FOR ENGINEERS: C++	4	090100	Yes	BSTEM
ENG GEN 221	ENGINEERING PROBABILITY AND STATISTICS	3	090100	Yes	BSTEM
FINANCE 008	PERSONAL FINANCE AND INVESTMENTS	3	050400	Yes	SLAM
LRNSKIL 010A	MATHEMATICS FUNDAMENTALS	1	170100	No	

Course	Course Title	Units	TOP Code	Transfer Level	Course Sequence
LRNSKIL 010B	MATHEMATICS FUNDAMENTALS	1	170100	No	
LRNSKIL 010C	MATHEMATICS FUNDAMENTALS	1	170100	No	
LRNSKIL 011A	ELEMENTARY ALGEBRA	1	170100	No	
LRNSKIL 011B	ELEMENTARY ALGEBRA	1	170100	No	
LRNSKIL 011C	ELEMENTARY ALGEBRA	1	170100	No	
LRNSKIL 011D	ELEMENTARY ALGEBRA	1	170100	No	
LRNSKIL 011E	ELEMENTARY ALGEBRA	1	170100	No	
LRNSKIL 017A	INDIVIDUALIZED INTERMEDIATE ALGEBRA A	1	170100	No	
MATH 100	MATHEMATICS WORKSHOP	1	170100	No	
MATH 105	ARITHMETIC	3	170100	No	
MATH 110	INTRODUCTION TO ALGEBRAIC CONCEPTS	5	170100	No	
MATH 112	PRE-ALGEBRA	3	170100	No	
MATH 113	ELEMENTARY ALGEBRA A	3	170100	No	
MATH 114	ELEMENTARY ALGEBRA B	3	170100	No	
MATH 115	ELEMENTARY ALGEBRA	5	170100	No	
MATH 120	PLANE GEOMETRY	5	170100	No	
MATH 121	ELEMENTARY GEOMETRY FOR COLLEGE STUDENTS	3	170100	No	
MATH 121	ESSENTIALS OF PLANE GEOMETRY	3	170100	No	
MATH 122	INTERMEDIATE ALGEBRA FOR STATISTICS	5	170100	No	
MATH 123A	ELEMENTARY AND INTERMEDIATE ALGEBRA I	4	170100	No	
MATH 123B	ELEMENTARY AND INTERMEDIATE ALGEBRA II	4	170100	No	
MATH 123C	ELEMENTARY AND INTERMEDIATE ALGEBRA III	4	170100	No	
MATH 124A	INTERMEDIATE ALGEBRA A	2.5	170100	No	
MATH 124A	INTERMEDIATE ALGEBRA A	3	170100	No	
MATH 124B	INTERMEDIATE ALGEBRA B	2.5	170100	No	
MATH 124B	INTERMEDIATE ALGEBRA B	3	170100	No	
MATH 125	INTERMEDIATE ALGEBRA	5	170100	No	
MATH 125S	INTERMEDIATE ALGEBRA WITH SUPPORT	5	170100	No	

Course	Course Title	Units	TOP Code	Transfer Level	Course Sequence
MATH 127	BASIC INTERMEDIATE ALGEBRA I	5	170100	No	
MATH 129A	PRE-COLLEGE MATH I	6	170100	No	
MATH 129B	PRE-COLLEGE MATH II	5	170100	No	
MATH 134	ACCELERATED ELEMENTARY AND INTERMEDIATE ALGEBRA	6	170100	No	
MATH 137	PRE-STATISTICS ALGEBRA	5	170100	No	
MATH 167	PRE-STATISTICS	5	170100	No	
MATH 173	OBJECT-ORIENTED PROGRAMMING AND DESIGN	4	170100	Yes	
MATH 185	DIRECTED STUDY – MATHEMATICS	1	170100	Yes	
MATH 192	GRAPHING CALCULATOR	1	170100	Yes	
MATH 202	MATHEMATICS WORKSHOP	1	170100	Yes	
MATH 215	PRINCIPLES OF MATHEMATICS I	3	170100	Yes	SLAM
MATH 216	PRINCIPLES OF MATHEMATICS II	3	170100	Yes	
MATH 225	INTRODUCTORY STATISTICS	3	170100	Yes	SLAM
MATH 227	STATISTICS	4	170100	Yes	SLAM
MATH 227A	STATISTICS I	2	170100	Yes	SLAM
MATH 227B	STATISTICS II	2	170100	Yes	SLAM
MATH 227S	STATISTICS WITH SUPPORT	4	170100	Yes	SLAM
MATH 228A	STATISTICS PATHWAY PART I	5	170100	No	
MATH 228B	STATISTICS PATHWAY PART II	5	170100	Yes	SLAM
MATH 230	MATHEMATICS FOR LIBERAL ARTS STUDENTS	3	170100	Yes	SLAM
MATH 234	COLLEGE LEVEL ALGEBRA	4	170100	Yes	BSTEM
MATH 235	FINITE MATHEMATICS	5	170100	Yes	BSTEM
MATH 236	CALCULUS FOR BUSINESS AND SOCIAL SCIENCE	5	170100	Yes	BSTEM
MATH 236L	SUPPORT COMPONENT FOR CALCULUS FOR BUSINESS AND SOCIAL SCIENCE	0.5	170100	No	
MATH 238	CALCULUS FOR BUSINESS AND SOCIAL SCIENCE I	5	170100	Yes	BSTEM
MATH 240	TRIGONOMETRY	3	170100	Yes	BSTEM

Course	Course Title	Units	TOP Code	Transfer Level	Course Sequence
MATH 240S	TRIGONOMETRY WITH SUPPORT	4	170100	Yes	BSTEM
MATH 241	TRIGONOMETRY WITH VECTORS	4	170100	Yes	BSTEM
MATH 241S	TRIGONOMETRY WITH VECTORS WITH SUPPORT	4	170100	Yes	BSTEM
MATH 245	COLLEGE ALGEBRA	3	170100	Yes	BSTEM
MATH 245C	COLLEGE ALGEBRA WITH COREQUISITE	3	170100	Yes	BSTEM
MATH 258	GEOMETRY AND TRIGONOMETRY	5	170100	Yes	BSTEM
MATH 259	PRECALCULUS WITH TRIGONOMETRY	6	170100	Yes	BSTEM
MATH 260	PRECALCULUS	5	170100	Yes	BSTEM
MATH 260S	PRECALCULUS WITH SUPPORT	6	170100	Yes	BSTEM
MATH 261	CALCULUS I	5	170100	Yes	BSTEM
MATH 262	CALCULUS II	5	170100	Yes	BSTEM
MATH 263	CALCULUS III	5	170100	Yes	BSTEM
MATH 265	CALCULUS WITH ANALYTIC GEOMETRY I	5	170100	Yes	BSTEM
MATH 266	CALCULUS WITH ANALYTIC GEOMETRY II	5	170100	Yes	BSTEM
MATH 267	CALCULUS WITH ANALYTIC GEOMETRY III	5	170100	Yes	BSTEM
MATH 270	LINEAR ALGEBRA	3	170100	Yes	BSTEM
MATH 272	METHODS OF DISCRETE MATHEMATICS	5	170100	Yes	BSTEM
MATH 273	INTRODUCTION TO DATA STRUCTURES AND ALGORITHMS	4	170100	Yes	
MATH 275	ORDINARY DIFFERENTIAL EQUATIONS	3	170100	Yes	BSTEM
MATH 385	DIRECTED STUDY - MATHEMATICS	3	170100	Yes	
PSYCH 091	STATISTICS FOR PSYCHOLOGY	4	179900	Yes	SLAM
PSYCH 091	STATISTICS FOR THE SOCIAL AND BEHAVIORAL SCIENCES	4	179900	Yes	SLAM
PSYCH 093	MULTIVARIATE STATISTICAL ANALYSIS FOR THE SOCIAL AND BEHAVIORAL SCIENCES	3	200100	Yes	SLAM
STAT 001	ELEMENTARY STATISTICS I FOR THE SOCIAL SCIENCES	3	170100	Yes	SLAM

Course	Course Title	Units	TOP Code	Transfer Level	Course Sequence
STAT 001	ELEMENTARY STATISTICS I FOR THE SOCIAL SCIENCES	3	179900	Yes	SLAM
STAT 100	FOUNDATIONS OF STATISTICAL REASONING	4	170100	No	
STAT 101	STATISTICS FOR THE SOCIAL SCIENCES	4	170100	Yes	SLAM
STAT 101	STATISTICS FOR THE SOCIAL SCIENCES	4	179900	Yes	SLAM

Note. Some courses are repeated because components of the courses such as title, units, or TOP code vary by college.

APPENDIX B: STEM Programs

TOP Code	TOP Title	Similar CIP	CIP Title	*n*	%
040100	Biology, General	260101	Biology/Biological Sciences, General	2461	25.62
490200	Biological and Physical Sciences (and Mathematics)	300101	Biological and Physical Sciences	2201	22.92
090100	Engineering, General (requires Calculus Transfer)	140101	Engineering, General	1346	14.01
170100	Mathematics, General	270101	Mathematics, General	934	9.73
070710	Computer Programming	110201	Computer Programming/Programmer, General	491	5.11
070600	Computer Science (Transfer)	110101	Computer and Information Sciences, General	406	4.23
020100	Architecture and Architectural Technology	040200	Pre-Architecture Studies	402	4.19
190500	Chemistry, General	400501	Chemistry, General	401	4.18
092400	Engineering Technology, General (requires Trigonometry)	140103	Applied Engineering	260	2.71
190200	Physics, General	400801	Physics, General	188	1.96
093400	Electronics and Electric Technology	144701	Electrical and Computer Engineering	183	1.91
030100	Environmental Science	030104	Environmental Science	63	0.66
043000	Biotechnology and Biomedical Technology	150401	Biomedical Technology/Technician	63	0.66
093430	Telecommunications Technology	150305	Telecommunications Technology/Technician	45	0.47
190100	Physical Sciences, General	400101	Physical Sciences, General	33	0.34
095500	Laboratory Science Technology	410101	Biology/Biotechnology Technology/Technician	25	0.26
191400	Geology	400601	Geology/Earth Science, General	25	0.26
220600	Geography	304101	Environmental Geosciences	20	0.21
099900	Other Engineering and Related Industrial Technologies	150699	Industrial Production Technologies/Technicians, Other	18	0.19

TOP Code	TOP Title	Similar CIP	CIP Title	*n*	%
070100	Information Technology, General	110101	Computer and Information Sciences, General	14	0.15
094610	Energy Systems Technology	144801	Energy Systems Engineering, General	<10	<0.10
093470	Electron Microscopy	150404	Instrumentation Technology/Technician	<10	<0.10
070730	Computer Systems Analysis	110501	Computer Systems Analysis/Analyst	<10	<0.10
029900	Other Architecture and Environmental Design	040299	Architecture, Other	<10	<0.10
095400	Chemical Technology	410301	Chemical Technology/Technician	<10	<0.10
070700	Computer Software Development	110201	Computer Programming/Programmer, General	<10	<0.10
193000	Earth Science	303801	Earth Systems Science	<10	<0.10

Note. 9,604 students, or 9% of the sample, had an entry major linked to a STEM Taxonomy of Program (TOP) code. The table is sorted in descending order of size. Numbers less than 10 students are suppressed for confidentiality purposes. Classification of Instructional Programs (CIP) codes and titles are included. CIPs are a national coding system.

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