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"We Have the Potential"––Math as a Racialized Barrier: Counter-Narratives of Black and Latinx Working-Class California Community College STEM Students

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by

Erika Knox

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ABSTRACT

"*We Have the Potential"*—Math as a Racialized Barrier: Counter-Narratives of Black and Latinx Working-Class California Community College STEM Students

by

Erika Knox

Within the CCC system, mathematics has been identified as the most considerable barrier to persistence, transfer, and degree completion (Cooper et al., 2022). Recent research corroborated the notion that mathematics serves as a gatekeeper for Black and Latinx students; historically, this subject has impeded students of color from accessing educational opportunities in science, technology, engineering, and math (STEM; Joseph et al., 2021). Consequently, mathematics has evolved into a racialized impediment for students and, by extension, STEM graduates. Recognizing mathematics' critical role in shaping students' future prospects, the state legislature introduced *California Assembly Bill 705* (AB 705; California Assembly Bill 705 [AB 705], 2017) to provide an intervention implemented in the fall of 2019. The purpose of this study was to examine how Black and Latinx working-class STEM students interpret and derive meaning from their mathematics trajectories, as well as the strategies they develop to navigate transfer-level mathematics environments in post-AB 705 (2017) contexts. Utilizing critical race theory (CRT) as a framework, the research documented students' counter-narratives with the aim of enhancing transfer rates and STEM transfer readiness for students of color in STEM fields. Additionally, the study established connections between the policy and existing research on STEM momentum and transfer success through the voices of students of color.

Five self-identified Black and Latinx students who enrolled at a CCC in the fall of 2019 or later and transferred to either a UC or CSU in the fall of 2023 as a STEM major were interviewed. Additionally, all participating students received the California Promise Grant (California Community Colleges Chancellor's Office, 2017) at some point in their CCC careers, which served as a proxy for their socioeconomic status. To further provide context, one STEM counselor and one CCC math instructor with at least 5 years of experience supporting Black and Latinx working-class STEM students were interviewed. The counter-narratives reveal systemic flaws in the education system, from secondary education through community college. Their stories identified systemic barriers primarily in secondary education that hinder the recognition and development of working-class Black and Latinx students' potential. Additionally, as the student participants transitioned to college, structural racism and classism continued to create barriers to success in transfer-level math courses in community colleges. Concurrently, student narratives highlighted the pivotal aspects at community colleges that contribute to their success, including supportive academic environments, culturally responsive teaching, and inclusive communities, thereby highlighting the barriers and challenges that arise when such aspects are absent in transfer-level math and the STEM pipeline.

CHAPTER 1

INTRODUCTION

With almost 2 million students enrolling in a California community college (CCC) every year, the CCC system is the country's most extensive higher education system (Boland et al., 2018; Brint & Karabel, 1989; California Community Colleges Chancellor's Office, 2022). According to the California Community Colleges Chancellor's Office (2022), at the time of this study, there were 116 colleges enrolling 1.8 million students, and almost 70% of the student population was from diverse ethnic backgrounds. Since their inception, community colleges have primarily educated underserved and marginalized communities (Bernstein, 1986; Boland et al., 2018; Moore & Shulock, 2010). In fact, a 2018 study found that 88 CCCs were minority-serving institutions (Boland et al., 2018). While the community college system aims to provide students with an opportunity to advance their educational and career aspirations, many students of color, nontraditional, and students from historically marginalized communities continue to face barriers to success (Fong et al., 2016). For example, working-class students of color are 50% more likely to stop out of school than their White counterparts (Purnell & Blank, 2004).[1] At the time of this study, although Black and Latinx students combined made up the largest minoritized group in the CCC, they did not progress at the rates of other minoritized groups and showed declining enrollment when compared to their White and Asian American counterparts (Contreras & Contreras, 2015; Flores & Park, 2013; Fong et al., 2016; Johnson & Mejia, 2020).

[1] There are debates about whether students are dropping out, stopping out, or being pushed out. Because community college student journeys are not always linear and traditional, students' nonparticipation in a community college does not guarantee that a student is dropping out of college. It is common for community college students to return later in life to complete their academic goals (Bonham, & Luckie, 1993).

While students attend a community college for various reasons, a 2020 study found that more than 75% of CCC students declare transferring to a 4-year university and receiving a degree as an academic goal. However, about 19% transferred to a university within 4 years, and 28% transferred within 6 years. Although Black and Latinx students were as likely to declare transfer as a goal as White and Asian American students, there was a significant equity gap in the number of students who completed the courses required and transferred (Johnson & Mejia). Over 10 years ago, a report found that "about 23% of degree seekers transferred to a university, and Latino students were only half as likely as White students to transfer (14% vs. 29%)" (Moore & Shulock, 2010, p. ii). Additionally, African American students have historically transferred from community colleges to 4-year universities at lower rates than any other group (Budd & Stowers, 2015; Johnson & Mejia, 2020). In the most recent study, researchers reported that 9% of African American and 10% of Latinx students versus 17% of White students and 24% of Asian American students transferred within 4 years (Johnson & Mejia, 2020). While success and transfer can be difficult for all students, African American and Latinx students have faced persistent equity issues.

Statement of the Problem

Within the CCC system, mathematics has been identified as the most considerable barrier to persistence, transfer, and degree completion (Cooper et al., 2022). Recent research corroborated the notion that mathematics serves as a gatekeeper for Black and Latinx students; historically, this subject has impeded students of color from accessing educational opportunities in science, technology, engineering, and math (STEM; Joseph et al., 2021). Consequently, mathematics has evolved into a racialized impediment for students and, by extension, STEM

graduates. Recognizing mathematics' critical role in shaping students' future prospects, the state legislature introduced *California Assembly Bill 705* (AB 705; California Assembly Bill 705 [AB 705], 2017) to provide an intervention implemented in the fall of 2019.

Before 2019, math placement practices in CCCs significantly hindered students' ability to complete their academic goals. Across the state, students' math placement was mainly determined through an assessment test taken upon entrance, regardless of a student's math history in high school or otherwise. In many cases, although students had taken higher levels of mathematics in high school, the assessment test placed students in lower levels of math. In fact, studies revealed that more than 80% of students were enrolling in one or more non-transferable math courses while attending a CCC (Henson & Hern, 2019; Johnson & Mejia, 2020). Many students had to take four math courses before beginning their transferable math course, potentially completing five or more math courses (regardless of their major) before entering a 4-year university. This disservice was amplified for Black and Latinx students. For example, Purnell and Burdman (2021) explained that, through assessment testing methods in California, 85% of African American and Latinx students were placed in remedial math courses compared to 72% of White students. The additional required math courses significantly impacted a student's college trajectory. Studies have showed that enrolling students in non-transferable math courses hinders their ability to complete their academic goals, as this process could take eight semesters or more to complete, leading to additional time to graduation or transfer (Bailey et al., 2010; Henson & Hern, 2019; Johnson & Mejia, 2020; Kelliher, 2022; Melguizo et al., 2014; Park & Ngo, 2021; Trinidad, 2022).

To ameliorate the negative impact of mathematics placement on CCC students, beginning in the fall of 2019, CCCs were required to implement AB 705 (2017) and use one or more of the following methods to place students in the appropriate math course: (a) high school coursework, (b) high school grades, and (c) high school grade point average. To date, these new placement methods have statistically proven to be successful. In a recent pilot study, "one-year completion of transfer-level courses increased from . . . 26 percent to 50 percent in mathematics, from fall 2015 to fall 2019" (California Assembly Bill 1705 [AB 1705], 2022). While AB 705 (2017) has improved success rates, it has not closed equity gaps. According to the California Community Colleges Chancellor's Office (2022), in the 2020–2021 academic year, 40% of Black and 46% of Latinx students completed a transfer-level math course in 1 year compared to 62% of White and 73% of Asian students. Thus far, AB 705 (2017) has succeeded in increasing the number of completed transfer-level math courses in a 1-year timeframe. However, equity gaps persist for Black and Latinx students.

Research Questions

Against the backdrop of AB 705 (2017) and the COVID-19 global pandemic, this study aimed to understand how working-class Black and Latinx STEM students described and experienced their mathematics trajectories through the CCC system after the implementation of AB 705 (2017). One overarching research question followed by three sub-questions guided the study:

> How do working-class Black and Latinx STEM students author themselves into the narrative of mathematics and the STEM pipeline in California community colleges?

1. How do working-class Black and Latinx STEM students describe their academic preparation in mathematics before entering the California community college system?
2. How do working-class Black and Latinx STEM students perceive and make meaning of contributors and barriers to transfer-level math success in the California community college system?
3. How can the perceptions and understandings of working-class Black and Latinx STEM students inform recommendations for successful transfer rates and transfer readiness to baccalaureate degrees in STEM?

Purpose of the Study

The purpose of this study was to examine how Black and Latinx STEM students interpret and derive meaning from their mathematics trajectories, as well as the strategies they develop to navigate transfer-level mathematics environments in post-AB 705 (2017) contexts. Utilizing critical race theory (CRT) as a framework, the research documented students' counter-narratives with the aim of enhancing transfer rates and STEM transfer readiness for students of color in STEM fields. Also, in analyzing Black and Latinx student counter-narratives, the study established connections between the policy and existing research on STEM momentum and transfer success through the voices of students of color. Ultimately, the research sought to identify potential leading indicators of transfer readiness, offering valuable insights into the efficacy and limitations of policy interventions designed to promote upward STEM transfer for students of color.

Significance of the Study

For years, students of color have faced hurdles in mathematics, a critical gateway to careers in STEM. To ensure Latinx and Black students have equal opportunities in STEM education, experts have agreed that equity in math is essential. California's community colleges have long seen math as a gatekeeper to student persistence, transfer, and degree completion (Cooper et al., 2022). However, the enactment and implementation of AB 705 (2017) ushered in a new era of opportunity to augment the number of students obtaining bachelor's degrees in STEM fields. Given that AB 705 (2017) has been in effect for only 4 years, and the goal of closing equity gaps drove its adoption, the present study is poised at a time when much can be learned from students' experiences in mathematics.

This study's significance stemmed from two areas. First, it centered youth voices to inform policy implementation. Historically and contemporarily, few formal spaces have elevated student voice research in educational policy. In response, this study opened up new areas for investigation, especially connections between theory and practice specific to students' voice in the implementation of educational policy, as well as presented political realities and tensions that emerged when students' voice was centered in assessing policies like AB705 (2017). Second, this research examined the intersectionality between race and class in terms of mathematics coursework. Research focusing on a single dimension of identity risks homogenizing group experiences and overlooking within-group differences for negotiating mathematics trajectories. To disrupt discourses of STEM underachievement and underrepresentation associated with Black and Latinx students, this study aimed to qualitatively unpack their strategies of resilience and persistence in STEM higher education at the intersections of race and class.

Theoretical Framework

This study was grounded in CRT for education, which was used as the foundation to collect, analyze, and present the data obtained. Critical race theory has been used to center race and racism in research while challenging traditional data collection methods and acknowledging how race, gender, and class intersect and impact communities of color. Going further, studies grounded in CRT have highlighted the experiences of People of Color and offered a counter-narrative that uplifts the voice of communities of color (Solórzano et al., 2000; Solórzano, 1997; Solórzano & Yosso, 2002). Critical race theorists have identified five tenets that can be used to analyze and identify the role of race within education:

- First is the intersectionality of race and racism with other forms of subordination of People of Color, such as that based on gender, sexual orientation, socioeconomic status, disability, or other identities. For this study, the intersectionality of race and socioeconomic status was at the forefront.
- Second is the challenge to the dominant ideology of Black and Latinx working-class STEM students.
- Third is the commitment to social justice to understand how White supremacy is embedded in social structures. For this study, CRT helped to explore how math and the community college STEM pipeline embed White supremacy. Critical race theory shed light and publicized the existing paradigms and acted toward eliminating racism and White supremacy within the community college system and mathematics.
- Fourth is the centrality of experiential knowledge, which is focused on centering and legitimizing the experiences of communities of color and linking traditional forms of

data collection and research to the history of colonization and racism. This study documented Black and Latinx students' voices through counter-narratives, which were often absent in prior policy development and frequently not considered in policy implementation at the campus level.

- Finally, the interdisciplinary perspective, CRT for education, has been connected to other disciplines to understand how race, racism, and White supremacy have historically (and currently) shaped education (and math) and opportunities provides for students of color (Carbado et al., 2013; Crenshaw, 1988; Irby et al., 2012; Jain et al., 2011; Ladson-Billings, 1998, 2005; Ladson-Billings & Tate, 1995; Solórzano et al., 2000; Solórzano, 1997; Solórzano & Yosso, 2002; Yosso et al., 2022).

Research Design and Methodology

This study sought to understand the persistent equity gap in the number of Black and Latinx STEM students completing transfer-level math and transferring to 4-year universities. I used critical race methodology (CRM; Solórzano & Yosso, 2002), informed by CRT, as a framework to collect, analyze, and present data. A critical method employed in this study was counter-storytelling, which amplified the voices and experiences of historically marginalized groups. Through in-depth interviews, I presented the counter-narratives of five Black and Latinx STEM students who enrolled in a community college in the fall of 2019 or later and planned to transfer to a University of California (UC) or California State University (CSU) campus in the fall of 2023. Additionally, all student participants received the California Promise Grant (California Community Colleges Chancellor's Office, 2017), which served as a proxy for their socioeconomic status. To further triangulate the data, I interviewed one STEM counselor and one

math instructor with at least 5 years of experience in their roles. These professionals began their careers prior to the implementation of AB 705 (2017).

Limitations, Delimitations, and Assumptions

This study had two main limitations. First, traditionally, information on transfer rates has been gathered at the 2-year, 4-year, and 6-year mark. While AB 705 (2017) passed 5 years ago, spring 2023 marks exactly 4 academic years since the law's implementation. Furthermore, since the implementation of AB 705 (2017), the world experienced a global pandemic in the spring of 2020, which altered the face of the K–12 and higher education systems. As a result of the COVID-19 global pandemic, multiple factors affected the data examined herein.

Secondly, the sample size for the qualitative portion was not relative to the number of students enrolled in the CCC system. However, the counter-stories presented through personal stories or narratives the stakeholders provided held information that could not have been extrapolated from quantitative data (Solórzano & Yosso, 2002).

There was one main delimitation to this study: AB 705 was enacted in 2017 to help CCC students complete transfer-level English and math. Both subjects were determined to be the gatekeepers to student success. This study only focused on math for three reasons. First, math has been identified as a gatekeeper subject that most often hinders students' access to post-secondary education. Second, while the minimum requirement to transfer to a California public university was completing one transfer-level math course, many majors and universities required students to take more than one math course to graduate. For example, STEM majors must have taken multiple levels of calculus before transferring to the university. Therefore, while AB 705 (2017) might have eliminated non-transferable courses, many students would still have needed to

complete multiple math courses in their college careers. Third, while gaps exist in the percentage of students who complete English transfer-level courses, the number of students who completed a transfer-level English course in 1 year was greater than that of students who completed a transfer-level math course in 1 year. For example, while 68% of students completed a transfer-level English course in the 2019–2020 academic year, only 51% completed a transfer-level math course in the same year (California Community Colleges Chancellor's Office, n.d.-a).

Positionality

I am a first-generation Chicana who attended a CCC for 3 years and transferred to the University of California, Los Angeles (UCLA). Eight years after completing my bachelor's degree, I received a master's degree from Loyola Marymount University. As a community college student, I took a math assessment at my CCC and placed in pre-algebra. I was a non-STEM major, and like many students, I took four math courses before transferring to the university (three were not transferrable). After completing my master's degree, I became an adjunct counselor at two community colleges in Southern California. As a counselor, I met with students one-on-one and discussed various topics, including mental health, financial insecurities, and academic and career goals. When I was not meeting with students, one of my roles was to increase the number of students who transferred to a 4-year university. I created and implemented events and strategies to help disseminate information and prepare students to transfer. While I had a personal and professional connection to the topic, in this study, I positioned myself as a Loyola Marymount University student conducting research for dissertation purposes.

Definitions of Key Terms

This study used the following terms:

- CCC. California community college
- STEM. An acronym for science, technology, engineering, and math majors or careers.
- Transfer. The process students go through when moving from a community college to a 4-year institution
- Transferable. Usually referring to a course that will transfer to a 4-year institution for credit
- Working-class. Students who received or were eligible for the California Promise Grant (California Community Colleges Chancellor's Office, 2017) at some point in their CCC careers.

Organization of Dissertation Proposal

Chapter 1 introduced the study, which focused on the lived experiences of Black and Latinx working-class STEM students in math courses post-AB 705 (2017) implementations. The study's purpose and significance were described and grounded in CRT. It explained the research design and methodology grounded in CRM (Solórzano & Yosso, 2002). Lastly, the chapter described the study's limitations and delimitations. Chapter 2 presents a synthesis and critical analysis of the relevant literature to the research topic. Chapter 3 describes the research design and methodology. It also provides recruitment strategies, sample research questions, data collection, and analysis. Chapter 4 presents student portraits and the findings of the participant's experiences in secondary school. Chapter 5 presents the findings of the participants' experiences

in community college. Finally, Chapter 6 provides the discussion and implications of the study as well as the recommendations for practice, policy and research.

CHAPTER 2

LITERATURE REVIEW

Every year, almost 2 million students have enrolled in a CCC (California Community Colleges Chancellor's Office, 2022). At the time of this study, the CCC system was one of the largest systems in the country and a leader among community college systems (Brint & Karabel, 1989). However, retention and success have been a longtime issue. This literature review will cover a brief history of the community college system in the United States, the CCC system's mission, and the students it serves. It will also provide a brief history of math in higher education, highlighting previous math completion rates, transfer rates, and the inequities resulting from the previous math placement policies. Lastly, this chapter will cover the most current policy, AB 705 (2017), as it pertains to math placement, math completion, the stakeholders, the implications, and the current outcomes of AB 705 (2017).

History and Mission of the Community College

Historically, many have viewed education as the vehicle for economic and social mobility in the United States. This concept began emerging in the late 1800s and was well established in the early to mid-1900s as inequality, the opportunity for mobility, and the wealth gap in America were increasingly widening (Brint & Karabel, 1989). As a way to remedy social and economic inequality, the community college system (commonly termed junior college at the time) was established in Chicago, Illinois, in 1901 with the proposition that students would complete 2 years at a junior college and later transfer to a university to complete the remaining 2 years of the 4-year bachelor's degree (Bernstein, 1986; Brint & Karabel, 1989; Galizio, 2019; Grubbs, 2020).

Initially, community colleges were created as an alternative to secondary school and trade schooling. Most community colleges were connected to local high schools as an extension of secondary school. Although the idea that community colleges could provide people with the skills to advance their economic and social mobility remained, the system was not truly designed as a pathway for students to gain access to 4-year universities or bachelor's degrees. Instead, the focus was to train the public to be local workers in the community (Brint & Karabel, 1989; Grubbs, 2020; Karabel, 1986). In fact, when establishing the first community college, proponents of the idea projected that students would conveniently stop after completing junior college, gaining an associate degree, and would opt not to pursue education further. This would allow the universities to focus on research and training the "intellectual elite." In essence, this was a tactic that universities used to weed out the applicant pool and "increase their standards," creating a contradiction in its foundation. (Bernstein, 1986; Brint & Karabel, 1989; Grubbs, 2020).

In 1920, the American Association of Community Colleges was formed and officially sought to design the community college system for vocational and semiprofessional careers (Grubbs, 2020). While still offering the opportunity to move toward a 4-year university but focusing primarily on vocational careers, "the junior college was located at the very point where the aspirations generated by American democracy clashed head-on with the realities of its class structure" (Brint & Karabel, 1989, p. 9). However, despite their contradictory founding, community colleges have played a significant role in developing much of the American technical workforce and advancing the American higher education system (Karabel, 1986).

Many scholars have argued that the move toward a vocational focus propelled the community college system and expanded higher education (Brint & Karabel, 1989; Grubbs,

2020; Karabel, 1986). In 1947, President Harry Truman validated the existence and contributions of the community college system by expressing its importance in creating social and economic mobility. Even further, in the President's Commission on Higher Education (1947) report, he stated that "[community colleges] remove geographic and economic barriers to educational opportunity and discover and develop individual talents at low cost and easy access…[and] attempt to meet the total post-high school needs of its community" (pp. 67–68). Forty years later, Brint and Karabel (1989) described the impact of the creation of the community college system by noting that "the junior college came to play an increasingly pivotal role in the transformation of the nation's system of colleges and universities . . . [and became] the most successful institutional innovation in twentieth-century American higher education" (p. 6).

The California Community College

The CCC system was established in 1910 in Fresno, California. Like other community colleges in the United States, the college was established in connection to the local high school and later developed into Fresno Community College (Galizio, 2019). The UC initiated and supported the CCC system under the perception that it would allow students who were not initially accepted to a 4-year university to transfer. However, resembling other community colleges in the country, it was essentially intended to weed out students in hopes of creating an elite class (Brint & Karabel, 1989). Alexis Lange, the dean of the school of education at the UC, stated,

> The work of the first 2 years [of university education], as a matter of history and fact, is all of a piece with secondary education and should, therefore, be relegated as soon and as far as practicable to secondary school. . . . The upward extension of the high school

> [would be] in the educational interests of the great mass of high school graduates who cannot, will not, should not, become university students. (Lange, 1915, p.119 as cited in Brint & Karabel, 1989, p. 24)

In 1960, steps were taken to remedy the inequality and misalignment that resulted from the previous community college structure, and the California Master Plan was created (Boland et al., 2018; Callan, 2009,; Leveille, 2012). The California Master Plan for Higher Education was a legislative document that united and dictated the goals of the three public higher education systems in California: the UC, the CSU, and the CCC (Boland et al., 2018; Callan, 2009; Leveille, 2012; University of California Office of the President, n.d.). Among those goals was

> The transfer function . . . an essential component of the commitment to access. UC and CSU are to establish a lower division to upper division ratio of 40:60 to provide transfer opportunities to the upper division for Community College students, and eligible California Community College transfer students are to be given priority in the admissions process (University of California Office of the President, n.d., para. 13).

Due to the stipulations in The California Master Plan for Higher Education (University of California Office of the President, n.d.), the UC system "aims to enroll one new California resident transfer student for every two new California resident freshmen" (University of California, n.d.). This commitment is commonly referred to as the 2:1 ratio.

Quickly, CCCs became the country's most extensive higher education system. According to the California Community Colleges Chancellor's Office (2022), at the time of this study, the system's 116 college enrolled 1.8 million students, and almost 70% of students were from diverse ethnic backgrounds. Per Galizio (2019),

> The junior college may have started in Illinois, but California provided the leadership for its expansion. Visionaries in California laid much of the groundwork for what would become the largest sector of public higher education in California and throughout the nation—the community college. (para. 5)

As early as the 1970s, California was named the most intricate network of community colleges (Callan, 2009; Karabel, 1986).

Students and Equity in the Community College

Since their inception, community colleges have primarily educated underserved and marginalized communities (Bernstein, 1986; Boland et al., 2018; Moore & Shulock, 2010). In fact, in 2018, a study found that 88 of 116 CCCs were minority-serving institutions (Boland et al., 2018). While the community college system aimed to provide students with an opportunity to advance their educational and career aspirations, many students of color, nontraditional, and students from historically marginalized communities have continued to face barriers to success (Fong et al., 2016). For example, Purnell and Blank (2004) found that working-class students of color were 50% more likely to stop out of school than their White counterparts.

In the CCC system, at the time of this writing, although Latinx students were the largest minoritized group seeking higher education, they did not progress at the rates of other minoritized groups and evidenced declining enrollment when compared to their White counterparts (Contreras & Contreras, 2015; Flores & Park, 2013; Fong et al., 2016). Additionally, Black and Latinx students tended to be nontraditional, often older, first-generation, and part-time. These nontraditional factors put them at risk of leaving school and created barriers to success (Núñez et al., 2011). Furthermore, African American students transferred from

community colleges to 4-year universities at lower rates than any other group (Budd & Stowers, 2015; Johnson & Mejia, 2020).

While students have attended community colleges for various reasons, a 2020 study found that more than 75% of CCC students declared transferring to a 4-year university and receiving a degree as an academic goal. Nonetheless, only about 19% transferred within 4 years, and 28% transferred within 6 years. While Black and Latinx students were as likely to declare transfer as a goal as White and Asian American students, there was a significant equity gap in terms of meeting requirements and actually transferring. The study's authors reported that 9% of African American and 10% of Latinx students versus 17% of White students and 24% of Asian American students transferred within 4 years. While success and transfer could be difficult for all students, challenges have been compounded for African American and Latinx students in community colleges (Johnson & Mejia, 2020).

The Vision for Success

The California Community Colleges Chancellor's Office (2022) explained that the goal of the CCC system was to provide opportunities for students and break down systematic barriers and inequities in education. To realize this concept and increase equity, in 2017, the CCC system created the "Vision for Success" (Reyna, 2020). The "Vision for Success" (California Community Colleges Chancellor's Office , 2017) consists of six goals to address equity gaps and improve student outcomes:

- Increase by at least 20% the number of CCC students annually who acquire associate degrees, credentials, certificates, or specific skill sets that prepare them for an in-demand job.

- Increase by 35% the number of CCC students systemwide transferring annually to a UC or CSU.
- Decrease the average number of units accumulated by CCC students earning associate degrees, from approximately 87 total units (the most recent systemwide average) to 79 total units—the average among the quintile of colleges showing the strongest performance on this measure.
- Increase the percentage of exiting CTE students who report being employed in their field of study from the most recent statewide average of 60% to an improved rate of 69%.
- Reduce equity gaps across the above measures through faster improvements among traditionally underrepresented student groups, with the goal of cutting achievement gaps by 40% within 5 years and fully closing those achievement gaps for good within 10 years.
- Reduce regional achievement gaps across all of the above measures through faster improvements among colleges located in regions with the lowest educational attainment of adults, with the ultimate goal of closing regional achievement gaps for good within 10 years. (California Community Colleges Chancellor's Office , 2017, p. 2)

While ambitious, the "Vision for Success" (California Community Colleges Chancellor's Office, 2017) set forth the goal of achieving equity in the CCC system by 2024. Implementing the "Vision for Success" led to reforms to accomplish this vision; among them was the reconstruction of math (Johnson & Mejia, 2020).

Math as a Racialized Barrier

Several authors have stated that one of the most noted barriers in education for Black and Latinx students is the subject of mathematics. In the CCC system, math has posed the most significant barrier to persistence, transfer, and degree completion (Cooper et al., 2022). While recent research has supported the idea of math as a gatekeeper for Black and Latinx students, historically, math has been a gatekeeper for students of color, and educators have struggled to bring equity to the subject of mathematics and, by extension, the STEM fields (Joseph et al., 2021).

From assessment and placement to instruction and completion, the field of mathematics has marginalized students of color for years. The literature on course placement in community colleges has demonstrated an overrepresentation of historically marginalized students in the lowest levels of non-transferable courses (Bahr et al., 2017). For example, in California, 85% of African American and Latinx students in higher education were placed in remedial math courses through assessment testing methods compared to 72% of White students (Purnell & Burdman, 2021). Further, studies found that students who began in the lowest courses were less likely to advance in their STEM courses than those who placed one level above the lowest non-transferable course (Bahr et al., 2017). In a recent study on CCC students, Johnson and Mejia (2020) found that "transfer rates are higher for students who successfully complete gateway transfer-level math (51 percent within four years)" (p. 3). A similar study, focusing specifically on African American/Black CCC students, found that students who completed a transfer-level math class within their 1st year of college transferred at a higher rate than those who did not. The study found that when Black community college students completed a transfer-level math course

in their 1st year, they were 160% more likely to become eligible for transfer. Although this report found that completion of transfer-level math within the 1st year significantly impacted Black students, it also revealed an equity gap in student completion of transfer-level math overall. Completing a transfer-level math course within the 1st year had a more significant positive impact on non-Black students (Cooper et al., 2022).

Additionally, community college placement via assessment testing has often placed students below their capabilities. Misplacement has been an issue because STEM progression often relied on the completion and progress of math coursework (Bahr et al., 2017; Park & Ngo, 2021). Because math placement has directly affected when and if a student completed transfer-level math courses and ultimately met their transfer goal, this section will discuss math as a gatekeeper for Black and Latinx students due to a combination of systemic, institutional, and psychosocial factors that have created and perpetuated racial disparities in math education and achievement.

Pre-College Experiences for Black and Latinx Students: Systemic and Institutional Factors

Systemic factors, such as disparities in educational resources and opportunities, have too often disproportionately affected Black and Latinx students. Schools in low-income and racially segregated areas lack funding and resources to provide high-quality math education, including access to experienced teachers, advanced courses, and extracurricular programs. The lack of adequate preparation in math at the high school level has led to lower performance on standardized tests, which often have played a significant role in college admissions and scholarship opportunities.

Prior research has found that enrolling in more advanced math courses in high school increases the likelihood of following a STEM trajectory in college and having STEM career interests (Barton, 2003; Chang et al., 2014; Crisp & Nora, 2012). Despite the significance of math course-taking patterns, differences in access to advanced and quality math courses for Black and Latinx compared to their White and Asian peers have persisted. National and international studies have documented inequities in learning opportunities, showing how academic tracking disadvantages students by race/ethnicity and social class (Van de Werfhorst, 2018). In math classes, lower-level courses perpetuate these inequities, as they are associated with low teacher expectations, poor quality curriculum, and fewer resources for learning math (e.g., equipment, textbooks, computers, and programs to supplement learning). However, once students are tracked, limited advancement to higher-level courses has created a mobility trap significantly linked to race/ethnicity (Anfuso et al., 2022; Crisp & Nora, 2012; Ngo & Velasquez, 2020; Young, 2005).

Community College Experiences for Black and Latinx Students: Systemic and Institutional Factors

Research has found that institutional factors, including implicit bias and stereotype threat, can lead to negative experiences for students of color in math classrooms. These institutional factors can range from campus-wide microaggressions to teacher bias and stereotypes. For example, one study found that even before students began taking courses at a community college, they regarded math placement exams as microaggressions and, therefore, viewed their low placement as the first "microinvalidation of their ability in mathematics" (Ngo & Velasquez, 2020, p. 24). Furthermore, research has found that teachers may hold lower expectations for

students of color or interact differently with them, which can adversely affect student performance and engagement, especially in STEM courses (Ramsay-Jordan, 2020). In fact, in 1982, Hall and Sandler coined the term "chilly" when referring to the climate women experience in STEM (p. 3). Additionally, a 2011 qualitative study of community college women of color who transferred to a university as STEM majors revealed both the demoralizing impacts of the weeding-out process and the regularity with which they experienced microaggressions and felt ignored and diminished by interactions with their professors (Reyes, 2011). Much research has classified the STEM climate in education as unfriendly, difficult to navigate, regularly discouraging, and contentious. This climate resulted from a few factors, including stereotyping of expectations based on a student's race and sex, microaggressions, the weeding-out mentality, and the competitive atmosphere stemming from promoting and celebrating individualism in STEM fields (Camacho & Lord, 2013; Crisp et al., 2009; Hall & Sandler, 1982; Reyes, 2011; Villa et al., 2020).

While in some cases, campus-wide policies like assessment tests and teacher interactions were associated with lower completion rates (Berhane et al., 2023; Crisp & Nora, 2012), studies have found that positive teacher interactions, engagement in on- and off-campus activities, and overall support from faculty and staff have been instrumental in student success (Berhane et al., 2023; Ramsay-Jordan, 2020; Tovar, 2015; Villa et al., 2020). For example, students who participated in STEM programs or experiences in college were more likely to complete a STEM degree (Berhane et al., 2023; Crisp & Nora, 2012). A community college study found that interactions with faculty outside the classroom significantly improved students' grade point averages (Tovar, 2015). While teacher interactions have been reported to increase completion for

all students, for students of color, these interactions have not always been associated with higher completion rates.

Although the number of Latinx students entering college interested in STEM fields has increased, once enrolled in college, many students have either changed their major to a non-STEM major, gotten stuck in (what has been referred to as) the math trap, or left school completely (Ackert et al., 2021; Crisp & Nora, 2012; Crisp et al., 2009; Ngo & Velasquez, 2020). In fact, according to Ngo and Velasquez (2020), Black and Latinx students "have higher probabilities of being trapped in chronic math tracking sequences" (p. 24). Thus, research has indicated that teacher interactions and activities are insufficient for student success in STEM. There are also psychosocial dimensions that have not yet been considered.

Psychosocial Dimensions of Experiences

Prior research has found that psychosocial factors, such as a diminished sense of belonging, self-confidence, and self-efficacy, have also contributed to math being a gatekeeper for students of color. The experience of racial and cultural isolation in predominantly White academic settings can lead to feelings of self-doubt, anxiety, and disengagement. For example, Boettcher et al. (2022) studied how Black and Latinx students in a rural college navigated their higher education pathway. Students reported "feeling a sense of disconnection with the campus community because it did not reflect the racial demographics of their home communities . . . [and] often were the only Black or Latinx student in a space" (p. 9). The study found that students who participated in programs that contributed to their community cultural wealth and, in turn, their sense of belonging successfully navigated the college experience despite feeling

disconnected from the campus because the racial demographics did not match their own (Boettcher et al., 2022).

Similarly, studies on the impact of support programs such as peer supplemental instruction (SI) have noted that the support, connection, and community building that occurs between peers in SI programs contributes to a sense of belonging and has proven to contribute to African American and Latinx students' academic success rates in STEM courses (Anfuso et al., 2022b; Ingram, 2018). Additionally, research has found that Black and Latinx students have a stronger sense of belonging when they feel welcomed by the faculty. Moreover, "when faculty create conditions where students feel welcome to engage inside and outside of the classroom. . . . African American men were more likely to engage with faculty members" (Ingram, 2018, p. 5). While engagement with faculty contributes to students' sense of belonging in community college overall, the research has found that Black students are less likely to engage with faculty in or out of the classroom, as previous experiences in predominantly White academic settings can lead to feelings of self-doubt, anxiety, and disengagement (Ingram, 2018).

Furthermore, the internalization of negative stereotypes about the math abilities of certain racial or ethnic groups can erode self-confidence and self-efficacy, ultimately hindering academic performance. Research has revealed that the strongest predictor of majoring in a STEM field is a student's self-efficacy and self-confidence in the field of mathematics (Buenaflor, 2023; Crisp & Nora, 2012; Kwon et al., 2019; Sax et al., 2015; Villa et al., 2020). Going further, recent research on self-efficacy and STEM has demonstrated a strong relationship between students' self-efficacy and their overall academic performance (Kwon et al., 2019). Bandura (1994) defined self-efficacy "as people's beliefs about their capabilities to produce designated levels of

performance that exercise influence over events that affect their lives" (p. 1). In other words, students believe they will succeed academically based on their past academic experiences. Historically, minoritized students have reported lower levels of self-efficacy in education (Buenaflor, 2023; Crisp & Nora, 2012; Villa et al., 2020).

However, recent research found that a student's attitude toward mathematics can be changed at any point in their academic trajectory (Di Martino & Zan, 2010). In fact, Di Martino and Zan's study revealed a connection between students' emotional disposition toward math, their vision of math, and their perceived competence in math. The study found that students with low perceived competence also had an instrumental vision of math. This low perceived competence is "reinforced by repeated experiences, perceived as failures" (Di Martino & Zan, 2010, p. 45). Thus, students develop what the authors called a fatalist attitude and giving-up thinking. Therefore, the authors stated that the possibility of success and control is crucial for perceived competence in the future. Students need to experience and identify success in math so they can see that achievement is possible. The research suggested that "teachers need to learn how to deal with students' emotions, vision of mathematics, and perceived competence" (Di Martino & Zan, 2010, p. 46). Because students' emotions, vision of math, and perceived competence are all interconnected, working on one will affect the other.

Mathematics and the California Community College

While research has found that the number of Latinx students who enroll in STEM majors in college has increased, the number of Latinx students who receive a degree or certificate in a STEM field is disproportionately lower than their White and Asian American counterparts (Chang et al., 2014; Crisp & Nora, 2012; Young, 2005). Moreover, Black students comprise only

4% of the total number of Bachelor of Science degrees in engineering, which has decreased in the last several years. While the number of women and Latinx students earning a Bachelor of Science degree in engineering has increased, it is not proportional to White male students (Berhane et al., 2023). The research found that at least half of Black and Latinx students who earn a bachelor's degree in STEM majors begin their education at a community college (Berhane et al., 2023; Park et al., 2020).

Recent studies revealed that Black and Latinx community college students struggle to transfer to 4-year universities as STEM majors because of the lack of a structured and well-scaffolded sequenced STEM pathway (Wang, 2016, 2021). In fact, a recent mixed-methods study of over 1,600 students suggested that STEM pathways do not exist for community college students. The current transfer process for STEM students is filled with structural obstacles, and students persevere because of their own agency, resilience, and tenacity versus a system that lends itself to an equitable transfer pathway (Wang, 2021). Because math courses are considered gatekeeper courses and are an integral part of any STEM pathway, more research on math in community colleges is necessary to equitize STEM (Berhane et al., 2023; Park et al., 2020; Wang, 2021).

The literature has demonstrated the barriers and equity gaps for Black and Latinx students in education, particularly in STEM fields, and as previously stated, many of those barriers begin with math. Therefore, math has become a racialized barrier for community college students and, by extension, STEM graduates. The CCC system recognized the importance of math and its significance in the future of all students, STEM and otherwise, and proposed AB 705 (2017) as the intervention effective in the fall of 2019.

Math Placement Prior to 2019

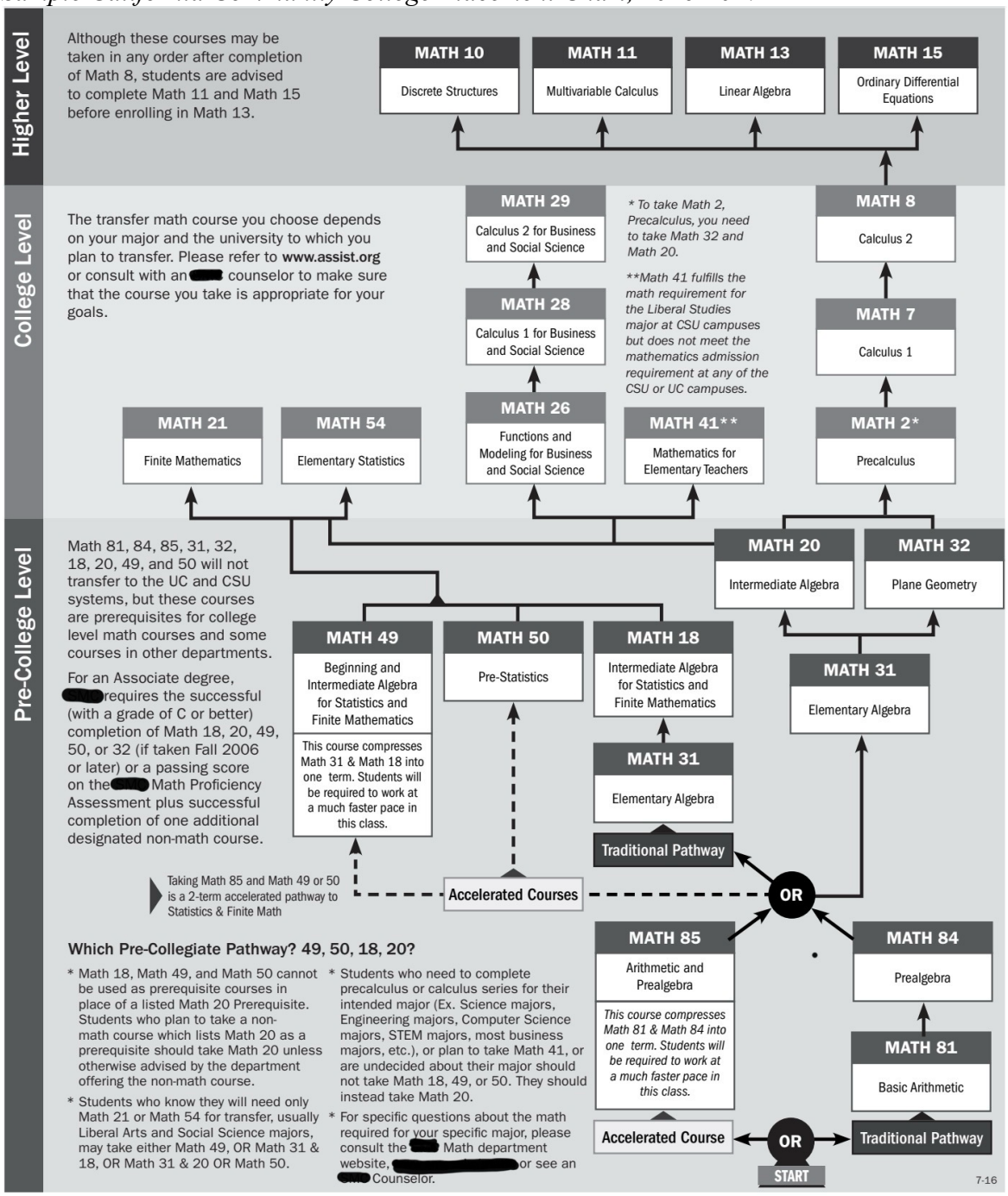
Prior to 2019, students entering the CCC system were placed in math courses based on an assessment test taken upon entrance, regardless of a student's math history in high school or otherwise (Henson & Hern, 2019; Melguizo et al., 2014; Trinidad, 2022). While most CCCs utilized a test titled Accuplacer, each CCC varied in its determining score for placement. For example, the score needed to enter intermediate algebra could vary between 60 and 80 depending on the college where the student took the test. All students took the same math placement test regardless of major. Immediately following the exam, students were placed in one of three areas: developmental math, degree-applicable math, or transferable math (Bailey et al., 2010; Melguizo et al., 2014; Park & Ngo, 2021). Developmental math refers to math not deemed college-level, such as basic arithmetic, pre-algebra, and elementary algebra (Bailey et al., 2010; Park & Ngo, 2021). Degree-applicable math refers to math deemed appropriate to meet associate degree math requirements stipulated by the college, such as intermediate algebra, geometry, or a higher-level math course (Bailey et al., 2010; Park & Ngo, 2021).

In California, the two public university systems, the CSU and the UC, determine transferable math or transfer-level math. Both systems review and determine course articulation for all 116 of the state's community colleges. Generally, courses that meet the definition of transferable math are college algebra, statistics, pre-calculus, and higher levels of math. Once placed in a math class, students must complete a series of math courses to reach their desired goal. Each subsequent math course has a pre-requisite course that must be completed to move forward (Bailey et al., 2010; Park & Ngo, 2021). In many cases, CCC students would need to take four math courses before beginning their transferable math course, potentially completing

five or more math courses (regardless of their major) before entering a 4-year university (Bailey et al., 2010; Johnson & Mejia, 2020; Melguizo et al., 2014; Park & Ngo, 2021). More than 80% of students enrolled in one or more non-transferable math courses while attending a CCC. Enrolling students in non-transferable math reduces their ability to complete their academic goals, as completing the courses can take eight semesters or more, adding time to graduation or transfer (see Figure 1; Henson & Hern, 2019; Kelliher, 2022; Park & Ngo, 2021; Trinidad, 2022).

Figure 1

Sample California Community College Placement Chart, 2016-2017



Note: Figure 1 is a math placement chart from a CCC pre- AB 705. After completing the math placement exam at this college, students were placed into one of the courses listed on this chart and were required to complete the math sequence based on their academic goals. Mathematics Placement Chart from Sun Community College | CA, 2016-2017, Used with permission.

One study found that the closer a student was to the transfer-level math cutoff, the greater a deterrent that placement was to math progression and STEM participation. In other words, the closer the student was to the mark, the more it impacted their STEM trajectory (Park & Ngo, 2021). This finding aligns with the findings on placement tests and microaggressions previously mentioned. As previously stated, students regard math placement exams as microaggressions and, therefore, view their low placement as the first "microinvalidation of their ability in mathematics" (Ngo & Velasquez, 2020, p. 24).

Interestingly, studies have shown that assessments and testing are not the best predictors of success in college. Per prior work, grades in previous coursework and grade point averages are better predictors of future course outcomes (Bastedo et al., 2018; Melguizo et al., 2014). Additionally, students are two to three times more likely to complete transfer-level math when they start directly in transferable courses (Henson & Hern, 2019; RP Group, 2018). Moreover, research has shown that the longer a student is enrolled in college, the less likely they are to complete their academic goals (Henson & Hern, 2019; Melguizo et al., 2014; Park et al., 2020). Henson and Hern (2019) explained,

> When incoming community college students are designated prepared for college-level work in English and math, they go on to complete degrees, certificates, and transfer-related outcomes at a rate of 71% within 6 years. For students designated as unprepared and required to enroll in developmental courses, that figure is just 41%. (California Community Colleges Chancellor's Office, 2017, p. 1, as cited in Henson & Hern, 2019)

In other words, students enrolling directly in transferable math courses were 30 % more likely to complete their academic goals than those enrolled initially in developmental courses. For STEM

students, the research found that students are more successful in transferring if they complete a higher number of STEM units in their 1st year, and completing at least one transferable STEM course in their first semester is linked to success in transfer (Bicak et al., 2023; Park et al., 2020; Wang, 2016). This gap in placement was even wider when disaggregating the data by ethnicity.

California community colleges have not facilitated the same completion rate of math for Latinx and African American students as for their White student counterparts (Henson & Hern, 2019; Hern & Snell, 2014). When assessment tests determined course placement, African American and Latinx students were disproportionately placed into non-transferable or developmental math courses at higher rates than White students. African American and Latinx students took at least three additional math courses compared to their White counterparts (Henson & Hern, 2019; Kelliher, 2022). One dataset found that, "Black and Latinx students were twice as likely to have to take three or more developmental courses than White students were (43% of Black and Latinx students vs. 22% of White students; Witham et al., 2015, as cited in Henson & Hern, 2019, p. 3).

Furthermore, men, older students, African American students, and part-time students were less likely to advance through their full math sequences (Bailey et al., 2010). These placements significantly decreased African American and Latinx students' likelihood of transferring to a 4-year university (Henson & Hern, 2019; Trinidad, 2022). Additionally, findings from a 2020 study suggested that "the overreliance on the placement test may have especially hindered STEM-aspiring" underrepresented minorities from pursuing STEM majors (Park et al., 2020, p. 425). To realize the vision of breaking down inequities for students of color in education, the state legislature passed Assembly Bill 705 in 2017.

AB 705: The Proposed Intervention

According to the California Community Colleges Chancellor's Office (n.d.-b), AB 705 (2017) "requires that a community college district, or a college, maximize the probability that a student will enter and complete transfer-level coursework in English and math within a one year timeframe" (p. 1). Beginning in the fall of 2019, community colleges must use one or more of the following: high school coursework, high school grades, and high school grade point average to place students in the appropriate math courses. This process is also called multiple measures (see Figure 2; AB 705, 2017).

Figure 2

Sample California Community College Math Placement Chart, 2022

AB 705 Placement Levels- HS GPAs are UNWEIGHTED- Students receive an English, GE Math, and BSTEM Clearance Level (Effective: Summer 2022)

English	GE Math**	BSTEM Math***				
HS GPA Only **E**	**HS GPA Only** **G**	**Did not pass Algebra 2#** **N**	**HS GPA & C or better in Algebra 2#** **A**	**HS GPA & C or better in HS Trigonometry†** **T**	**HS GPA & C or better in HS Precalculus†** **P**	**HS GPA & C or better in HS Calculus** **C**
GPA [2.60, 4.00] English 1A LEUN	**GPA [3.00, 4.00]** Math 110 Math 115 Math 120 Math 140 Math 150 LGUN	**GPA [3.40, 4.00]** Math 130 + 130S Math 170 + 170S LNUS	**GPA [3.40, 4.00]** Math 130 Math 170 LAUN	**GPA [3.50, 4.00]** Math 165 Math 190 LTUN	**GPA [3.10, 4.00]** Math 165 Math 190 LPUN	**GPA [2.60, 4.00]** Math 165 Math 190 LCUN
	GPA [2.30, 2.99] Math 110 Math 115 Math 120 + 120S Math 140 Math 150 + 150S LGMS	**GPA [2.60, 3.39]** Math 130 + 130S Math 170 + 170S LNMS	**GPA [2.60, 3.39]** Math 130 + 130S Math 170 + 170S LAMS	**GPA [2.60, 3.49]** Math 130 Math 170 Math 180 LTMN	**GPA [2.30, 3.09]** Math 130 Math 170 Math 180 LPMN	
GPA [1.90, 2.59] English 1A + 1AS LEMS		**GPA [0.00, 2.59]** **or no GPA**	**GPA [0.00, 2.59]**	**GPA [0.00, 2.59]**		**GPA [1.90, 2.59]** Math 130 Math 170 Math 180 LCMN
GPA [0.00, 1.89] **or no GPA** English 1A + 1AS LELS	**GPA [0.00, 2.29]** **or no GPA** Math 110 Math 115 Math 120 + 120S Math 140 Math 150 + 150S LGLS	Math 130 + 130S Math 170 + 170S LNLS	Math 130 + 130S Math 170 + 170S LALS	Math 130 + 130S Math 170 + 170S Math 180 + 180S LTLS	**GPA [0.00, 2.29]** Math 130 + 130S Math 170 + 170S Math 180 + 180S LPLS	**GPA [0.00, 1.89]** Math 130 + 130S Math 170 + 170S Math 180 + 180S LCLS

Blue shading indicates that a support course is required.

**All students may enroll in MATH 110, 115, 120, and 140. ***All students majoring in BSTEM may start in Math 130 or Math 170. Combined courses, e.g., Trig/Precalculus or Precalculus/Calculus or Functions/Trigonometry/Statistics can be used in these columns, but HS Statistics should not be used. #Completing Integrated Math 1, 2, and 3 is equivalent to completing Algebra 1, Geometry, Algebra 2. †Currently, still check the Geometry prerequisite for Math 170 and the Trigonometry prerequisite for Math 180. A C in HS Trigonometry serves as a check for the Geometry prerequisite for Math 170. A C in HS Precalculus serves as a check for the Trigonometry prerequisite for Math 180.

Updated: February 2, 2022

Note. Figure 2 is a post- AB 705 math placement chart using multiple measures from Bay Community College. Students' placements are based on their high school GPAs and the last math course they completed. Sample California Community College Math Placement Chart from Bay Community College | CA, 2022, Used with permission.

Research has indicated that when using multiple measures to place students into transferable math courses, students can complete their academic goals at a higher rate. The research demonstrated that high school GPAs and direct placement with support through corequisite are better predictors of success than a placement exam and prerequisites. Additionally, data reports revealed that multiple measures significantly reduce equity gaps in completing transfer-level courses (Henson & Hern, 2019; Trinidad, 2022). In a pilot study, "one-

year completion of transfer-level courses increased from . . . 26 percent to 50 percent in mathematics, from fall 2015 to fall 2019" (AB 1705, 2022). Thus far, AB 705 (2017) has succeeded in increasing the number of completed transfer-level math courses in a 1-year timeframe, but equity gaps persist. While the decision to pass and implement AB 705 (2017) was grounded in research-based evidence, many faculty and administrators doubted the effectiveness of the policy. They expressed concern over students' ability to succeed in transfer-level courses, particularly Black students, as they see developmental education as a way to prepare underprepared students for college-level courses (Park & Ngo, 2021; Sims, 2020; Trinidad, 2022).

Critical Race Theory

This study explored student experiences since the implementation of AB 705 (2017) in California community colleges to support increased transfer rates and STEM transfer readiness for STEM students of color. Specifically, through the lens of CRT, the study explored how STEM Black and Latinx working-class students described and made meaning of their social, cultural, emotional, and academic experiences and the development of strategies to navigate transfer-level math environments post-AB 705 (2017). Analysis of student counter-narratives connects the policy to the existing research on STEM momentum and transfer success. Ultimately, this study sought to identify potential leading indicators of transfer readiness, providing much-needed documentation and guidance on the efficacy and limitations of policy interventions to improve upward STEM transfer for students of color.

As many scholars of race have indicated, race is a reality of everyday life and permeates throughout society both as an ideological construct and a physical construct (Ladson-Billings,

1998; Ladson-Billings & Tate, 1995; Solórzano et al., 2000; Solórzano, 1997; Yosso et al., 2022). Discussions on the success of Black and Latinx students in math and the community college transfer pathway must consider race and the impact it has on society at large but specifically on students of color both at the institutional and the individual level (Ladson-Billings, 1998; Ladson-Billings & Tate, 1995; Yosso et al., 2022). For this reason, this dissertation applied CRT for education as the framework to analyze and present the data obtained.

Critical race theory was first imagined in the 1970s by a group of legal scholars investigating how the law has played a role in the perpetuation of White supremacy in society (Ladson-Billings, 1998; Yosso et al., 2022). According to Delgado (2013),

> Derrick Bell (an African American) and Alan Freeman (a white), . . . were deeply distressed over the slow pace of racial reform in the United States. It seemed to them—and they were quickly joined by others—that the civil rights movement of the 1960s had stalled and indeed that many of its gains were being rolled back. (p. 2)

Race is so deeply embedded in the structure of society that one movement alone is not enough to make real progress; rather, there is a need to overhaul how societal structures are viewed (Crenshaw, 1988; Delgado & Stefancic, 2013). Since its inception, CRT has evolved in many disciplines, including sociology, women's studies, and education (Solórzano et al., 2000). Ladson-Billings (1998) explained that CRT can be used as an instrument for deconstructing, reconstructing, and constructing societal structures, particularly in education. According to Solórzano et al. (2000),

> The critical race theory framework for education is different from other CRT frameworks because it simultaneously attempts to foreground race and racism in the research as well as challenge the traditional paradigms, methods, texts, and separate discourse on race, gender, and class by showing how these social constructs intersect to impact on communities of color (p. 63).

Additionally, CRT highlights the experiences of People of Color and offers a counter-narrative that uplifts the voice of communities of color. Five CRT tenets can be used to analyze and identify the role of race within education.

- The first tenet is the intersectionality of race and racism with other forms of subordination of People of Color, such as gender, sexual orientation, socioeconomic status, disability, etc. . . . Intersectionality acknowledges that People of Color are multi-faceted and therefore affected by social structures on more than one level. Intersectionality looks at the overlapping ways social structures marginalize and subordinate People of Color while shedding light on hidden multidimensional forms of subordination and oppression (Carbado et al., 2013; Solórzano et al., 2000; Yosso et al., 2022).
- The second tenet is the challenge to the dominant ideology. Critical race theory challenges claims of color blindness and meritocracy and calls out race lighting, as these arguments are to serve the interest of the dominant groups in power. CRT for education sheds light on the existence of interest convergence, White supremacy, and the logic that guides it—racism (Crenshaw, 1988; Irby et al., 2012; Ladson-Billings, 1998; Solórzano, 1997; Yosso et al., 2022).

- The third tenet is the commitment to social justice. Critical race theory seeks to understand how White supremacy is embedded in social structures and to shed light and publicize the existing paradigms and act toward eliminating racism and White supremacy (Ladson-Billings, 2005; Solórzano, 1997; Yosso et al., 2022). Critical race theory notes that this work, revolving around concepts of race, is activist by nature (Irby et al., 2012). Critical race theory's broader and primary goal is to end racial subordination and all other forms of subordination.
- The fourth tenet is the centrality of experiential knowledge. Critical race theory for education focuses on centering and legitimizing the experiences of communities of color and linking traditional forms of data collection and research to the history of colonization and racism. CRT scrutinizes the traditional forms of storytelling and recognizes that rather than maintaining "neutrality," they are political expressions of power dynamics (Irby et al., 2012; Ladson-Billings, 1998; Solórzano, 1997; Yosso et al., 2022).
- And finally, the fifth tenet is the interdisciplinary perspective. Critical race theory for education connects to other disciplines to understand how race, racism, and White supremacy have historically (and currently) shaped education and the opportunities it provides to students of color. (Jain et al., 2011; Ladson-Billings, 1998; Solórzano et al., 2000; Yosso et al., 2022).

As noted above, race permeates all aspects of life, including math and community college policies like AB 705 (2017). Education in the United States is not a constitutional right; therefore, education is primarily constructed, influenced, and modified through state legislation

(Ladson-Billings, 1998). Throughout American history, students of color have fought to gain equal access to education, but equal access is not enough. As long as White supremacy exists and racism is the guiding logic for institutions of power, equality in education (in instruction, curriculum, facilities, and funding) does not exist (Ladson-Billings, 1998). According to Ladson-Billings (1998), critical race theorists explain that students of color, specifically African American students, are viewed as deficient, and institutions and educators use the language of failure when describing students of color. This language leads educators to race-neutral or color-blind forms of education and inevitably places the responsibility of educating students of color on the student rather than the institution (Campbell, 2012; Kohli & Solórzano, 2012; Ladson-Billings, 1998; Leonardo, 2013).

An example of the effects of color-blind education is intelligence testing, more commonly known today as standardized testing and assessments. Using science as the pretense, intelligence testing, and assessments were designed to legitimize the subordination of People of Color (Bastedo et al., 2018; Gentry et al., 2021; Ladson-Billings, 1998). Intelligence testing has perpetuated the idea that People of Color are less than, and the effects of the intelligence movement are present today.

Conclusion

Since 2017, the "Vision for Success" (California Community Colleges Chancellor's Office , 2017) and AB 705 (2017) have made strides in moving the CCC system toward equitable progress in the completion of math (RP Group, 2018; Henson & Hern, 2019; Trinidad, 2022; California Community Colleges Chancellor's Office, n.d.-a). However, as this legislation has just passed, minimal research has been done on the effects this legislation has had on the

number of Black and Latinx working-class students transferring from a CCC to a 4-year institution. As it stands, limited research has examined the community college transfer process (Schwehm, 2017). Using CRT as the guiding framework for this research, this study explored how Black and Latinx working-class students describe and experience the role of mathematics in the community college transfer process since the passing of AB 705 (2017). Additionally, this research explored how counseling and instructional community college faculty describe the student experience in the completion of math.

CHAPTER 3

METHODOLOGY AND RESEARCH DESIGN

Historically, math has been a gatekeeper for students of color, and educators have struggled to bring equity to the subject of mathematics (Joseph et al., 2021). The CCC system has been no exception to this trend. Math has been a consistent barrier for students of color in completing an associate degree and transferring to a 4-year institution. Specifically, CCCs have failed to help Black and Latinx students succeed in degree attainment at the rates of their White counterparts (Henson & Hern, 2019; RP Group, 2022). The passage of AB 705 (2017) was meant to reduce equity gaps in math and higher education.

AB 705 (2017) required all California community colleges to maximize the probability that students will complete a transfer-level math course in a 1-year timeframe. Prior to AB 705 (2017), students were required to take an assessment test called Accuplacer (Melguizo et al., 2014) upon entry and placed into a corresponding math course regardless of their previous coursework. In many cases, CCC students would take four to five math courses before entering a 4-year university (Bailey et al., 2010; Johnson & Mejia, 2020; Melguizo et al., 2014). Enrolling students in non-transferable math courses lowers their ability to meet their academic goals, as completing the requirements to transfer could take students eight semesters or more (Henson & Hern, 2019; Kelliher, 2022; Park & Ngo, 2021; Trinidad, 2022). African American and Latinx students took at least three additional math courses compared to their White counterparts, decreasing their likelihood of transferring to a 4-year institution (Henson & Hern, 2019; Kelliher, 2022; Trinidad, 2022; RP Group, 2022).

To understand the impact of AB 705 (2017) on closing the equity gap for working-class Black and Latinx working-class STEM community college students, this study explored such students' experiences to support increased transfer rates for STEM students of color. Through the lens of CRT, the study explored how STEM Black and Latinx working-class students described and made meaning of their social, cultural, emotional, and academic experiences and the development of strategies to navigate transfer-level math environments post-AB 705 (2017). Analysis of student counter-narratives connects the policy to the existing research on STEM momentum and transfer success. Ultimately, this study identified potential leading indicators of transfer readiness, providing much-needed documentation and guidance on the efficacy and limitations of policy interventions to improve upward STEM transfer for students of color.

This chapter outlines the study's methodology and rationale for using counter-narratives. This chapter will also provide the study's research questions and describe the study's context, qualitative data collection procedures, and the approaches used to analyze the data (including interviews and coding). Finally, the chapter will discuss the study's limitations, delimitations, and timeline.

Methodology

This study examined the experiences of STEM Black and Latinx working-class students who narrated their perspectives on mathematics and the STEM pipeline in CCCs. Accordingly, the study used CRM, a qualitative approach rooted in CRT, to critically analyze and understand the complex ways race and racism operate in educational settings (Solórzano & Yosso, 2002). Critical race methodology (Solórzano & Yosso, 2002) allowed for examining the deeply entrenched, systemic nature of racial inequality and the role of power dynamics in perpetuating

disparities. By centering the experiences and voices of marginalized racial and ethnic groups, CRM (Solórzano & Yosso, 2002) exposes the subtle and overt forms of racism present in various social institutions, policies, and practices.

This study used CRM (Solórzano & Yosso, 2002) because it centers race and racism in research while challenging traditional data collection methods and acknowledging how race and class intersect and impact communities of color. Critical race methodology (Solórzano & Yosso, 2002) explains that the ways in which data is collected are informed by theories around race. Five CRT tenets were used to analyze and identify the role of race within education and math: (a) intersectionality, (b) the challenge to the dominant ideology, (c) commitment to social justice, (d) experiential knowledge, and (e) the interdisciplinary perspective (Carbado et al., 2013; Crenshaw, 1988; Irby et al., 2012; Jain et al., 2011; Ladson-Billings, 1998; Solórzano et al., 2000; Solórzano, 1997; Solórzano & Yosso, 2002; Yosso et al., 2022). One critical method of CRM (Solórzano & Yosso, 2002) data collection is counter-narratives (Solórzano & Yosso, 2002). This study was anchored on Black and Latinx working-class STEM students and their counter-narratives.

Rationale for Counter-Narratives as Method

In this study, counter-narratives were employed as the primary data collection method to capture the unique perspectives and experiences of Black and Latinx STEM transfer students. Critical race methodology (Solórzano & Yosso, 2002) utilizes counter-narratives to shed light on White supremacy and counter the narrative put forth by the dominant culture. By employing counter-narratives, the study delved deeper into the lived experiences of students of color by focusing on their personal stories, emotions, and perspectives regarding the STEM pipeline that

may not be adequately captured or represented in mainstream discourses. By giving voice to these participants, the counter-narratives offered a more intimate and authentic understanding of their realities, uncovering the complexities and subtleties of their experiences in mathematics and the STEM pipeline in CCCs (Solórzano & Yosso, 2002).

Counter-narratives are a critical tool used in the field of education to challenge dominant narratives and offer alternative perspectives on societal issues. They emerge from the experiences and voices of marginalized or underrepresented groups, providing a platform for their narratives to be heard and acknowledged. By centering these alternative perspectives, counter-narratives aim to expose and disrupt the power dynamics that perpetuate inequalities and social injustices, thus advocating for a more equitable and inclusive understanding of the world.

In this study, counter-narratives served multiple functions. Firstly, they acted as a means of resistance, empowering Black and Latinx students to reclaim their agency and assert their own experiences in the face of dominant narratives that might otherwise silence or marginalize them. Secondly, counter-stories contribute to knowledge production by offering rich, contextualized insights that challenge conventional wisdom and prompt reevaluation of existing theories and paradigms. In this way, counter-stories promote social justice and inclusivity as well as enrich and diversify academic discourse, ultimately fostering a more nuanced and robust understanding of the educational experiences of students of color (Delgado, 1989; Solórzano & Yosso, 2002).

Research Questions

Against the backdrop of AB 705 (2017) and the COVID-19 global pandemic, this study aimed to understand how working-class Black and Latinx STEM students described and experienced their mathematics trajectories through the CCC system after the implementation of

AB 705 (2017). One overarching research question followed by three sub-questions guided the study:

How do working-class Black and Latinx STEM students author themselves into the narrative of mathematics and the STEM pipeline in California community colleges?

1. How do working-class Black and Latinx STEM students describe their academic preparation in mathematics before entering the California community college system?
2. How do working-class Black and Latinx STEM students perceive and make meaning of contributors and barriers to transfer-level math success in the California community college system?
3. How can the perceptions and understandings of working-class Black and Latinx STEM students inform recommendations for successful transfer rates and transfer readiness to baccalaureate degrees in STEM?

Context

The study took place in Southern California. There are 116 colleges across the state and 1.8 million students in the CCC system. Almost 70% of the CCC student population is from a diverse ethnic background, with African American students making up almost 6% (or 108,000) and Latinx students making up roughly 46% (or 828,000) of the student population (California Community Colleges Chancellor's Office, 2022). Additionally, about 45% (or 810,000) of students qualify for the California College Promise Grant (California Community Colleges Chancellor's Office, 2017), which is a form of state aid that pays for student tuition fees, and eligibility is determined by the student's financial need (California Community Colleges Chancellor's Office, n.d.-c).

The CCC system commits to offering an open-access education to all students, providing opportunities for students, and breaking down systematic barriers and inequities in education (Brint & Karabel, 1989; Callan, 2009). A primary function of the CCC system is to allow students to transfer to a 4-year university. The CCC system strongly partners with the two public university systems in California: the UC and the CSU. Most students who transfer to a university will transfer to one of these two systems. One non-negotiable requirement to transfer to the UC and CSU systems is to complete a transferable math course. As noted above, math has historically been a racialized barrier for students of color.

The recent passing of AB 705 (2017) was created to close equity gaps and has shifted how students experience math and the transfer process. The state has instructed all CCCs to change their math placement processes to allow students to complete a transfer-level math course within a 1-year time frame. While AB 705 (2017) was passed in October 2017, schools were to implement these changes by the fall of 2019. According to the California Community Colleges Chancellor's Office (n.d.-a) and The RP Group (2021), there has been an almost 20% increase in the number of students who complete a transfer-level math course within 1 year, and while equity gaps have decreased, they persist. Prior research has examined the number of students completing a transfer-level math course within a 1-year time frame, but little is known of the effects AB 705 (2017) has had on the student transfer process. The following sections provide details about the participants, setting, data collection, and analysis plan.

Participants

The study participants were five self-identified Black and Latinx students who enrolled at a CCC in the fall of 2019 or later and transferred to either a UC or CSU in the fall of 2023 as a

STEM major. Additionally, all participating students received the California Promise Grant (California Community Colleges Chancellor's Office, 2017) at some point in their CCC careers, which served as a proxy for their socioeconomic status. To further triangulate the data, I also interviewed one STEM counselor and one CCC math instructor with at least 5 years of experience supporting Black and Latinx working-class STEM students. These professionals began their careers prior to the implementation of AB 705 (2017) and self-identified as either Black or Latinx.

Sampling and Recruitment

I selected participants through purposive sampling. Purposive sampling is a technique that enables the researcher to choose individuals and sites that "purposefully inform an understanding of the research question and central phenomenon of the study" (Creswell, 2007, p. 125). Through purposive sampling, participants were not randomly assigned or selected but were chosen intentionally to maximize the depth of understanding surrounding the research questions. Although this sampling method may limit the generalizability of findings to the larger population, it is particularly useful for exploring under-researched topics, such as working-class Black and Latinx experiences in mathematics and the STEM pipeline.

For participant recruitment, I initially contacted my network of counseling faculty and STEM program leaders at CCCs, UCs, and CSUs all of whom work with diverse students in or from CCCs. I posted a recruitment message on a public listserv for CCC faculty describing the study and asking for the counselors to recommend former students who meet the student criteria. Additionally, I posted a student recruitment flyer in professional social media spaces meant for counseling and instructional professionals in the CCC system. Faculty participants were also

selected through purposive sampling. I contacted my network of counseling faculty, describing the study and asking for recommendations of participants who meet the faculty criteria.

I sent a recruitment email to all prospective participants, presenting myself, outlining the research project and methodology, and supplying contact details. Participants interested in being interviewed were scheduled virtually at a convenient time via Zoom (www.zoom.us). To adhere to the principles of voluntary participation, I notified all potential participants that their involvement was not obligatory and that they could opt-out at any time. I distributed informed consent forms to all participants to ensure they comprehended the study's objectives and consented to take part.

Data Collection Methods

This exploratory study, focusing on working-class Black and Latinx student experiences related to math and the community college STEM pipeline, employed two sequential stages of data collection. In the first stage, semi-structured interviews were conducted with Black and Latinx students using Seidman's (2019) three-interview series. The three-interview series is an interviewing structure that allowed the interviewer and participant to dive deep into the experience while placing it into context (Seidman, 2019). Within the three-interview series, each interview had a specific focus. The first interview set the stage by examining the context of the participant's experience. This included understanding their background, educational journey, and other factors that may have influenced their perspective on mathematics and STEM aspirations.

In the second interview, participants were asked to reconstruct the details of their experiences within the context in which they occurred. This involved discussing specific challenges they faced, the support they received, and any pivotal moments that shaped their

educational trajectory. Finally, the third interview encouraged participants to reflect on the meaning of their experiences. This involved examining how their experiences in mathematics and the STEM pipeline in CCCs have impacted their personal and academic growth and how they perceived their future STEM selves. Table 1 presents the alignment of research questions with the three-interview series protocol and sample interview questions. See Appendix for the complete interview protocol.

Table 1

Relation of Three-Interview Series Protocol to Research Questions and Interview Questions

Research Questions	Three-interview series	Sample interview questions
How do working-class Black and Latinx STEM students describe their academic preparation in mathematics before entering the California community college system?	Focused Life History: Examine the context of the participant's lived experiences, including an understanding of their background, educational journey, and other factors that may influence their perspective on mathematics and STEM aspirations.	What were your secondary education experiences with math like? How did these experiences shape your attitude toward pursuing a STEM field? Can you share any role models, teachers, or mentors who have influenced your decision to pursue a STEM major? What impact did they have on your educational journey?

Table 1 (continued)

Relation of Three-Interview Series Protocol to Research Questions and Interview Questions

Research Questions	Three-interview series	Sample interview questions
How do working-class Black and Latinx STEM students perceive and make meaning of contributors and barriers to transfer-level math success in the California community college system?	Detail of Experience: Participants recall and reconstruct specific details of their racialized and classed lived experiences in math and the STEM pipeline in the California community college system.	Can you discuss any specific challenges or barriers you have faced in your math courses at the community college? How did you overcome them? Describe the support systems available to you during your time at the community college, such as tutoring, counseling, or peer networks. How have these resources impacted your experience in math courses? Can you recall any pivotal moments or turning points in your educational journey that have influenced your commitment to pursuing a STEM major? Please describe the details and context of these moments.
How do working-class Black and Latinx STEM students perceive and make meaning of contributors to successful transfer rates and transfer readiness to baccalaureate degrees in STEM?	Reflection on Meaning: The third interview will prompt participants to reflect on the significance of their experience and how it relates to their understanding transfer readiness to baccalaureate degrees in STEM?	How do you believe your experiences in math at the community college have influenced your personal and academic aspirations in STEM? Reflecting on your journey so far, what advice would you give to other Black or Latinx students entering community college with an interest in pursuing a STEM major?

Note: Adapted from (2019). *Interviewing as Qualitative Research: A Guide for Researchers in Education and the Social Sciences*, 2019, by I. Seidman, Teachers College Press, copyright 2019 by Teachers College Press.

The second data collection phase involved semi-structured interviews with two counseling and instructional faculty. I invited participants to participate in 1-hour interviews over Zoom. Interview questions prompted them to discuss perceptions of students' experiences in secondary school and in math since the passing of AB 705 (2017). Based on their experience

with students, faculty were asked to speak on what they believed were the contributors and barriers to closing the equity gap in math for Black and Latinx working-class community college STEM students.

Data Analysis

Braun and Clarke's (2006) six-phase thematic analysis guided the thematic analysis. This process allowed for describing emergent themes from participants' stories, uncovering nuances about their experiences, noting similarities and differences across participants, and providing an interpretation in light of the literature and this study's conceptual framework. Below is a description of how I conducted the thematic analysis.

- Familiarization with the data: I immersed myself in the data by reviewing the questionnaire responses, listening to the recordings, and reading and re-reading the transcripts to develop a comprehensive understanding of the participants' experiences.
- Coding: I completed the coding process through deductive and inductive coding. I began by conducting a preliminary review of the transcripts to familiarize myself with the data. I then manually coded the transcripts using the research questions as a guide for overarching themes in identifying passages that directly answered the research questions. I highlighted relevant passages and began creating codes based on the research questions. After passages were selected and codes were created, I began inductive coding to allow the salient themes to emerge from data and understand the key aspects of the participants' experiences. These segments were assigned descriptive codes and labels, which helped to organize the data (Saldaña, 2016). The coding process specifically looked for examples in

which the participants defined and made meaning of mathematics and the STEM pipeline in community college settings.

- Interpretation: An iterative process of moving between the whole and the parts of the text is applied during this phase. I engaged in a continuous, reflexive dialogue with the data as I interpreted and reinterpreted the meanings within the context of the participants' lived experiences.
- Identification of themes: I manually analyzed the coded data to identify patterns, connections, and emerging themes that capture the essence of the phenomenon under investigation. I paid particular attention to finding similarities, differences, frequency of shared practices, and comments within each code.
- Member checking: Since a vital component of counter-narratives is capturing authentic responses that describe an individual's unique perspective and lived experience, I utilized member checking, in which each participant received a copy of their responses to the questionnaire to verify that preliminary findings were in line with their intended meaning during the interview. Participants could edit, redact, or add to any information gathered.
- Integration and synthesis: I synthesized the identified themes, offering a comprehensive understanding of the phenomenon. The synthesis involved integrating the themes with relevant literature and the theoretical framework, CRT.
- Final write-up: This process involves selecting "vivid, compelling extract examples, [the] final analysis of selected extracts, relating back the analysis to the research question and literature, [and] producing a scholarly report of the analysis" (Braun & Clarke, 2006, p. 87).

Credibility and Trustworthiness

To uphold the credibility and trustworthiness of the analysis in this qualitative study, I employed three validation strategies:

- Member checking: Member checking involves the process of seeking feedback from participants to confirm the accuracy of the data interpretation. As a validation strategy, member checking ensures that the participant's accounts are accurately represented in the analysis (Birt et al., 2016).
- Peer debriefing: Peer debriefing involves sharing the research process and findings with my dissertation chair and committee to receive feedback and challenge assumptions. This strategy helped reduce potential bias and enhanced the rigor of the analysis through the incorporation of diverse perspectives (Spall, 1998).
- Reflexivity through audit trails: To ensure credibility, dependability, and confirmability, an audit trail in the form of a reflexive journal was used to document the decisions and choices made throughout the study, including daily logistics, methodological decisions, and personal reflections.

Limitations

Traditionally, information on transfer rates is gathered at the 2-year, 4-year, and 6-year mark. While AB 705 (2017) passed 5 years ago, spring 2023 will mark exactly 4 academic years since the law's implementation. Furthermore, since the implementation of AB 705 (2017), the world experienced a global pandemic in the spring of 2020, which has altered the face of the education system both in K–12 and higher education (Avidov-Ungar et al., 2022; Treve, 2021).

As a result of the COVID-19 global pandemic, the data for this study has been impacted by multiple factors.

Additionally, the sample size for the qualitative portion is not relative to the number of students enrolled in the CCC system, but the counter-stories presented through personal stories or narratives the stakeholders provided hold information that cannot be extrapolated from quantitative data (Solórzano & Yosso, 2002).

Delimitations

Assembly Bill 705 was created in 2017 to help CCC students complete transfer-level English and math. Both subjects were determined to be the "gatekeepers" to student success. This study only focused on math for the following reasons:

1. Math has been identified as a gatekeeper subject that most often hinders students' access to post-secondary education.
2. While the minimum requirement to transfer to a California public university is completing one transfer-level math course, many majors and universities require students to take more than one math course to graduate. STEM majors must take multiple levels of calculus before transferring to the university. Therefore, while AB 705 (2017) may eliminate non-transferable courses, many students will still need to complete multiple math courses in their college careers.
3. While gaps exist in the percentage of students who complete English transfer-level courses, the number of students who complete a transfer-level English course in 1 year is greater than that of students who complete a transfer-level math course in 1 year. For example, while 68% of students completed a transfer-level English course

in the 2019-2020 academic year, only 51% completed a transfer-level math course in the same year (California Community Colleges Chancellor's Office, n.d.-a).

Positionality

I am a first-generation Chicana who attended a CCC for 3 years and transferred to the University of California, Los Angeles (UCLA). Eight years after completing my bachelor's degree, I received a master's degree from Loyola Marymount University. As a community college student, I took a math assessment at my CCC and placed in pre-algebra. I was a non-STEM major, and like many students, I took four math courses before transferring to the university (three were not transferrable). After completing my master's degree, I became an adjunct counselor at two community colleges in Southern California. As a counselor, I met with students one-on-one and discussed various topics, including mental health, financial insecurities, and academic and career goals. When I was not meeting with students, one of my roles was to increase the number of students who transferred to a 4-year university. I created and implemented events and strategies to help disseminate information and prepare students to transfer. While I had a personal and professional connection to the topic, in this study, I positioned myself as a Loyola Marymount University student conducting research for dissertation purposes.

Timeline

As a doctoral student within an Educational Leadership for Social Justice program, my proposal defense took place in May of 2023, with Institutional Research Board (IRB) submission and approval in August 2023. Upon IRB approval, data collection took place between September and December 2023. Data analysis occurred between September 2023 and January 2024, with a

draft of the findings in dissertation form submitted to my doctoral chair and committee by April 2024. The defense of the study took place in April 2024.

CHAPTER 4

FINDINGS OF SECONDARY EDUCATION

This study examined how Black and Latinx STEM students interpreted and derived meaning from their mathematics trajectories, as well as the strategies they developed to navigate transfer-level mathematics environments in the post-AB 705 (2017) contexts. Historically and contemporarily, there have been limited formal spaces that elevate student voice research in educational policy and practice. Because of this, this study centered student voices to inform how students experience and understand their math and STEM trajectories. Additionally, this study examined the intersectionality between race and class in terms of mathematics coursework and STEM trajectories. Research focusing on a single dimension of identity risks homogenizing group experiences and overlooks within-group differences for negotiating mathematics trajectories. To disrupt discourses of STEM underachievement and underrepresentation associated with Black and Latinx students, this study aimed to qualitatively unpack their strategies of resilience and persistence in STEM higher education at the intersections of race and class. Before presenting the thematic findings that emerged from the qualitative data, this chapter begins by detailing the research questions and methodology that guide the study. Second, the chapter provides portraits of the student participants and the findings of the first sub-research question, focusing on the students' secondary experiences before entering the CCC system.

Restatement of the Research Questions and Methodology

Against the backdrop of AB 705 (2017) and the COVID-19 global pandemic, this study aimed to understand how working-class Black and Latinx STEM students described and experienced their mathematics trajectories through the CCC system after the implementation of

AB 705 (2017). One overarching research question followed by three sub-questions guided the study:

How do working-class Black and Latinx STEM students author themselves into the narrative of mathematics and the STEM pipeline in California community colleges?

1. How do working-class Black and Latinx STEM students describe their academic preparation in mathematics before entering the California community college system?
2. How do working-class Black and Latinx STEM students perceive and make meaning of contributors and barriers to transfer-level math success in the California community college system?
3. How can the perceptions and understandings of working-class Black and Latinx STEM students inform recommendations for successful transfer rates and transfer readiness to baccalaureate degrees in STEM?

Informed by CRT, this study utilized CRM (Solórzano & Yosso, 2002), and a critical method in this study was counter-storytelling. Through in-depth interviews, I examined the counter-narratives of five Black and Latinx STEM students who started or resumed their CCC journey in the fall of 2019 or later and transferred to a UC or CSU campus in the fall of 2023. Additionally, all participating students received the California Promise Grant (California Community Colleges Chancellor's Office, 2017), which serves as a proxy for their socioeconomic status. To further contextualize the data, I interviewed one STEM counselor and one math instructor with at least 5 years of experience in their roles. These professionals began their careers prior to the implementation of AB 705 (2017).

Counter-narratives were employed as the primary data collection method to capture the unique perspectives and experiences of Black and Latinx STEM transfer students. Critical race methodology (Solórzano & Yosso, 2002) utilizes counter-narratives to shed light on White supremacy and counter the narrative put forth by the dominant culture. By employing counter-narratives, the study delved deeper into the lived experiences of students of color by focusing on their personal stories, emotions, and perspectives regarding the STEM pipeline that may not be adequately captured or represented in mainstream discourses. By giving voice to these participants, the counter-narratives offered a more intimate and authentic understanding of their realities, uncovering the complexities and subtleties of their experiences in the mathematics and STEM pipeline at CCCs (Solórzano & Yosso, 2002).

In this study, counter-narratives were a means of resistance, empowering the participants to reclaim their agency and assert their experiences in contrast with dominant narratives. Secondly, counter-stories contributed to prior research via rich, contextualized insights that challenge conventional wisdom and aid in reevaluating theories and paradigms. Ultimately, the counter-stories fostered a more nuanced and robust understanding of the educational experiences of students of color (Delgado, 1989; Solórzano & Yosso, 2002).

This study employed two sequential stages of data collection. In the first stage, semi-structured interviews were conducted with Black and Latinx students using Seidman's (2019) three-interview series. The three-interview series is an interviewing structure that allows the interviewer and participant to dive deep into the experience while placing it into context (Seidman, 2019). In the three-interview series, each interview had a specific focus. The first interview included an understanding of their secondary schooling background, educational

journey, and other factors that may have influenced their perspective on mathematics and STEM aspirations. In the second interview, participants discussed specific barriers they faced, the support they received, and any pivotal moments that shaped their educational trajectory in the CCC system. Finally, the third interview asked students to examine how their experiences in mathematics and the STEM pipeline in CCCs have impacted their personal and academic growth and how they perceive their future STEM selves.

Student Portraits

Before delving into the empirical data, the following sections present portraits of the student participants. The purpose of these was to provide a deeper understanding of the students' lived experiences and context for their personal, cultural, and social backgrounds. Additionally, my aim was to humanize the data and reinforce the importance of understanding that the participants in this study were complex individuals and not mere data points. Their voices and contributions to the research were not isolated in a vacuum but inseparable from their identities and experiences and, therefore, should be ethically and respectfully represented as such.

The student portraits detailed significant experiences of students navigating their mathematics education within broader racioeconomic educational contexts. Challenges such as difficulties with public transportation affecting grade outcomes in secondary school or disparities in STEM opportunities and preparation highlight the broader systemic barriers that can impact students' academic success. This has been particularly true in STEM fields, where access to quality education and resources is crucial for preparation and success in STEM. The portraits of five Black and Latinx working-class STEM students who transferred from a community college in Southern California to a UC or CSU are detailed below.

Maribel

While in high school, Maribel did well and applied to several UC and CSU campuses. She was admitted to a few schools but was not accepted at her top-choice campus. She was unsure about her major, so she attended a community college to save money. Maribel described her secondary experience in high school and the impact of her socioeconomic status on her secondary education. She did not live near her high school and took public transportation to commute to school. Maribel explained the academic effects of this commute:

> In my 10th grade year, I lived kind of far away from my high school, and I would have to transport by bus, and my math class was early in the morning. So even though my school started at 8:00 in the morning, I would get there at 8:50 or 8:40, so I would miss a big portion of it. . . . Yeah, I would have to take public transportation since, then, my mom was working, and my sisters were also going to school, so I would take the bus. Even though I'd wake up early enough . . . since a lot of people do take the bus, it would always skip my stop since it was already full. That's why I would come late. . . . That was all of high school, really. All of my first periods, I would miss a big portion of it. In 10th grade, I had my math class first period, which was geometry. Because I was decent at math, I was able to pass it, but barely with a C because I would do okay on the tests.

Maribel explained that even in high school, she understood the value of majoring in a STEM field for a person of color and similar background:

> I wanted to be able to do something like that because I know not that many people are able to get a higher education, but having the opportunity, I wanted to be able to do something like that. . . . I guess once I met my teacher [in high school], my engineering

> teacher, and he would talk about his other students majoring in engineering and STEM and stuff like that. Well, it was something that . . . it's fascinating, really, to see someone do that, especially if they're a minority.

Maribel was one of three children and a first-generation college student. Her eldest sister also attended a university and was of great support and motivation to her throughout her educational journey.

When interviewed, Maribel was in her early 20s and began her community college journey in the fall of 2020 in Southern California. She attended her community college for 3 years before transferring to the CSU system as a computer science major. As a student in the community college system, Maribel worked for the last year and a half as a student tutor on campus.

Katherine

Katherine was a first-generation undocumented college student who immigrated to the United States when she was 2 years old and was placed in English as a second language (ESL) classes in school. As a result, she always felt that numbers made more sense than language.

> I loved [math], I think, because again, as an undocumented student when I came, my English wasn't so good, and my English is still not that great. . . . I need a shirt that says English is my second language, so it'll give me excuses, but I think that's why I love math because I had such a hard time with English and expressing myself with English than with math. It was like, I don't have to talk.

Katherine attended a high school that offered limited resources in a large metropolitan area. When asked to describe her secondary school, she explained,

> It was busy, and we were split up a lot. And then it wasn't . . . it's so unfortunate. I think back, and I'm like, man, because these other schools have such nicer classrooms, more funding, and technology and stuff. And so, they had all the new computers and stuff. . . . And so, I was like, man, I really missed out. So, my own school, I would say, did not really have [STEM] programs until my senior year. Then again, I wasn't part of them because they had to split up. So, they were there, but they were limited, and they were not easily accessible. And yeah, it's unfortunate because I think it would have been fun to start off super early with [STEM].

Although Katherine was frustrated with the resources and STEM exposure available to her, she described her high school math experience as a positive one. The highest math class she took in secondary school was Advanced Placement (AP) Calculus.

When interviewed, Katherine was in her 30s and began her community college education in the fall of 2008 but stopped-out in the fall of 2012 and re-enrolled at a different community college in the fall of 2019. Both community colleges were in Southern California. She was enrolled at her last community college for 4 years before transferring to a UC campus as a computer science major. As a student in the community college system, Katherine worked all 4 years.

Rico

Rico attended a high school in a large metropolitan area located within walking distance of his house. According to Rico, most of the school's population was socioeconomically disadvantaged:

> Most of the students were Hispanic/Latinx and African American. There were few people of Asian descent and even fewer White people. . . . When it comes to class, my best answer is that most students lived in poverty. A lot of students qualified for free lunch and breakfast, including myself. Additionally, [my high school] is located in a community that isn't known for having the same amount of resources as wealthier neighborhoods.

Overall, Rico enjoyed his secondary experience and had a deep passion for mathematics, but he was frustrated with the lack of math preparation his school provided. After enrolling in college, he noticed the discrepancy in preparation and spent much time making sure that his sisters learned and understood the math material that would be expected of them in higher education:

> I've made my sisters go through hell because I've complained to them about how easy math is in the K–12 system, and they don't make it any harder. . . . I asked them, "Do you know why they tell you y = mx+b?" They only tell you to remember it. . . . Even though that isn't the most generic form of the equation, . . . I don't know if it's miscommunication between student and teacher, but it's just that the teachers don't know how to explain it, so to say . . . they were going over some graphs, [and] I guess she had a question, but the professor was just like, "Look at the domain. Look at the domain. Look at the domain." That was all he said. But my sister didn't understand. And so, she couldn't really come to some solution, or she couldn't really make sense of anything he was saying or connect that to a solution.

Rico played the role of older brother, tutor, mentor, and motivator for his sister and friends. He saw the importance of passing on the knowledge he gained as the first person in his family to go to college and paying it forward to his family and his CCC community.

> You just got to reciprocate the love for things that have taken care of you. That's how I just am. It's like, This has taken care of me. This has allowed me to get to this point in life. I got to show it some love.

When interviewed, Rico was in his early 20s and began his community college journey in the fall of 2019 at a community college in Southern California. He attended his community college for 4 years before transferring to a CSU campus as a computer engineering major. Rico is a first-generation college student but received much support and connection from his cousin, who was also a STEM major at a university in California. Rico did not work during his time as a community college student.

Esteban

Esteban grew up in El Salvador in a town with limited resources and access to technology and, therefore, limited opportunities for exposure to STEM careers and subjects:

> Just because, as a country, we don't have the resources to fully develop anything that has to do with research or anything that goes into STEM… But the thing is, in El Salvador, or at least where I grew up, we didn't even have computers. In my head, from reading books and stuff like that, I knew that I liked computers, but I just didn't have the resources to explore them.

Esteban emigrated with his family from El Salvador to the United States in 2017, and when he arrived, he had the understanding that he would enter a charter school with his cousins, but was directed to another school:

> I initially was going to go to a charter high school because that's where my cousins went. I went there, and they told me, "Oh, we don't have any resources that can really help you. We recommend you go to your local district." They sent me back. Okay, so I'm from a [working-class community]. That, too. . . . They sent me back to the district, . . . and the nearest high school that I had at that time was [working-class high school] . . . it's not a shocker. . . . We don't have resources.

Esteban entered his junior year in high school with the expectation that he would complete coursework for all 4 years of high school in two years without support from the institution:

> They don't really support students. Now, it's a bit better, but when I first got there in 2017, they didn't even have anyone to translate anything for me. It was just me against the odds and just trying to make it out of there. . . . I was placed as a junior, but taking classes from ninth grade mixed with junior classes and just getting through my education during high school. . . . Whenever they would see you coming from abroad or being an ESL student, it would be like putting a stamp on you or putting a label. We don't really care about you as long as you get it done; we're chilling and nothing else outside of high school education.

When Esteban was in community college, in addition to working as a student worker, he was tasked with driving his mother to work. That gave him exposure to a university but added to his list of responsibilities:

> My last 2 years of community college, my mom got hired for housing at a UC. My mom doesn't know how to drive, so I would be driving from [our neighborhood] to the UC, driving my mom and then going back to my community college for classes, going back to pick up my mom. Or I would just go and be on campus at the UC just because my mom works there, so let me just use their resources, library, and everything.

When interviewed, Esteban was in his 20s and began his community college education in Southern California in the fall of 2019. He was enrolled at his community college for 4 years before transferring to the UC as a computer science major. Esteban is a first-generation student, and as a student in the community college system, he worked on campus all 4 years.

Imani

Imani spent her early childhood in Florida and was placed in a gifted program that focused on STEM from first grade to sixth grade. At the age of 12, she moved to Texas and completed her secondary schooling there. In middle school, she was recommended for a selective high school's special STEM program and was admitted:

> We were selected in middle school. In eighth grade, the teachers that you had in eighth grade would basically send recommendations to the high school, . . . and then you just get a letter in the mail saying you've been selected to participate in the academy, but you don't just immediately go in. You have to take your PSAT. They do an interview with you and your parents. Like, I got interviewed, and my mother got interviewed. Then you have to write. . . . You have to get two letters of recommendation, and you have to write a resume, and complete an application. They're preparing you for upper-level stuff anyway. When you go to college, and you are expected to have a letter of

> recommendation and all these things for when you're doing research projects and going into other programs, it's like preparing you for that, but you're 12, and they're preparing you for that for high school. . . . Looking back as an adult, I'm like, Wow! What was that? It didn't feel like that. I just felt like a lot of like, . . . I mean, I needed to dress up because it was an interview. You can go and pick out your stuff. It was a lot for . . . I think I was, like, what, 13, 14.

While in the high school academy, Imani was immersed in STEM and prepared to go into the medical field. Imani took AP statistics and AP calculus in high school. Imani's school was a school within a school. The academy was a subsection of a larger school. While Imani's school was diverse, her STEM academy was not. Imani describes her school setting:

> The school, in general, I would say, was a good mix of everything as far as income level, race. …There were a lot of people of color at my school, but in my classes in particular, there were very few people who were lower income, a very few number of people who were people of color. Because I took the AP courses outside of my little block, there were maybe three other Black girls, maybe three. And then, in my graduating class, within my block, there were, I want to say, four or five of us, a very small amount of. . . . Actually, no, girls, I think there was one other. Just a very small group of people. . . . My school had a lot of people who were Black, a lot of people who were Hispanic, and then a good number of people who were White. But I would say it was mostly Black and Hispanic at my school. Then, my particular academy block was the complete opposite. People who were in the upper-level classes were not people who looked like me.

Imani attended the STEM school, was in the top 11%, and was fully involved, but she was not interested in higher education at the time and suffered from depression. She applied to a school in New York as a pre-law major and then returned to Texas after a year. Imani details her experience:

> I've suffered with depression since I was 12, but never did anything about it. After I was in my junior and senior year of high school, they were asking, "Let's register for schools, and you need to start applying." A lot of my friends, because they were in that block with all the AP classes and everything else, they were all top 10 percenters. Most people that I knew were top 10 %. I was friends with the valedictorian and then the ones that were right below the valedictorian. It was a very competitive thing. I was like, I'm not into all this competition. I was in the top 11%, just shy of the 10%, but I was not trying to do anything. I told all of my teachers senior year, "I'm going to drop out."
>
> My plan was to just do nothing. Then I graduated, and I went to school for pre-law instead because I said I don't really care about anything. I don't really have a path I want to do anymore. I have been on the STEM track, but instead of doing the STEM thing like I had planned, I just went completely left field and was like, "I'm going to do law." I went to school in New York after being in Texas because I was like, "How far away can I get from Texas?" So, I just went to school in New York. It wasn't like, Okay, you've been preparing, and preparing, and then you got to the STEM thing. I just was like, No, I'm not doing any of that. So. I did the stuff for pre-law then. . . . I brought up the depression because I was actually discharged from that school. They were like, "You

need to take a medical leave of absence, get your mind right," because I was so depressed. My grades were great, but they were like, "You are not okay mentally, so you should go back home in return when you get some therapy." Instead of doing the great mental health part and going back and taking care of myself, I just went back home and was like, I don't know what I'm going to do with my life.

Imani lived in Texas for a few more years before moving to California with her husband. In 2021, she learned she was pregnant with her first child at the same time as she had decided to quit her job and dedicate herself to school. Throughout her CCC career, Imani was a parent. As she transferred and transitioned to the UC, she learned she was pregnant with her second child. At the time of her interview, she was in her second trimester.

When interviewed, Imani was in her 30s and began her higher education journey in the fall of 2012 at a university in New York, but she stopped-out in the spring of 2013 and re-enrolled in two other community colleges in Texas in the fall of 2013. Imani took another break from school and began her CCC journey in the fall of 2019 at a community college in Southern California. She was enrolled at her last community college for 4 years before transferring to the UC as a biology major. As a student in the community college system, Imani worked on and off during her 4 years. Both of Imani's parents hold bachelor's and master's degrees in business from an HBCU. Imani's mother also holds a master's degree in education.

Findings

The findings of this study are presented in three chapters through a thematic analysis informed by the research questions. This section details the findings of the first sub-research question and ends with a summary of the findings of the students' experiences in secondary

education. The second sub-research question is presented in Chapter 5, and the third sub-research question and discussion is addressed in Chapter 6.

The main finding of this section was that secondary schools failed to meet students' potential. This is demonstrated in the misalignments in students' high levels of competency, their self-perceptions in math, and the inconsistency in the educational offerings and support students received in secondary school.

Academic Preparation in Mathematics Before Entering the California Community College System: "I Feel Like It Could Have Been More Rigorous."

The mathematics preparation provided to the study participants in secondary school failed to match their full potential despite all students highlighting their high achievement and strong interest in the subject. To begin, the students interviewed shared their experiences with mathematics in secondary school, emphasizing their high achievement and strong interest in the subject. Despite receiving high grades and demonstrating a strong interest in mathematics, the student's potential was not fully recognized by secondary institutions. These schools fell short in several areas, including restricted educational offerings, tracking systems, and limited support for STEM subjects.

When discussing their experiences with math in secondary school, every student interviewed excelled in their math courses and proved to demonstrate a high level of competency and interest in math, but there was variability in the courses students had access to, which influenced their self-perception in math. Maribel took honors math courses and did well. She enjoyed math and was "decent at it," but she did not perceive herself to have strong math abilities because she did not take high levels of calculus in secondary school. Maribel shared a

pivotal experience that solidified her interest in the STEM pathway and expressed her level of confidence in math:

> But something that influenced me to pursue the STEM field, I guess, was when I asked my counselor to change my math class so I could join the soccer team. . . . I was enrolled in honors math, but then she put me in a normal math class. I remember that I felt like it wasn't challenging enough. I went back to her, and I asked her, "Can I go back to the Honors Math?" Even though I wasn't good at it, this makes me sound like I was really good at math. I wasn't. But it's just that I wanted more of a challenge. . . . I was still taking pre-calculus in my 12th-grade year, which goes to show that I wasn't that good at math.

While doing well in math and showing an interest in the subject, Maribel's secondary school failed to place her in higher levels of calculus, which influenced her self-perception in math. Similarly, Esteban discussed his feelings regarding his math abilities and the exemplary grades he received in math. Despite his success in his math courses, his secondary mathematics experiences influenced how he viewed his math abilities and led to anxiety in the subject. Esteban discussed his feelings regarding math and his grades:

> In math, in particular, in my life, I think I get done what I need to get done when it comes to math. Am I good at it? I wouldn't say so, but I'll get it done. I'll get my As, but it's not like . . . I don't know if that makes any sense, but I'm just going to get it done. . . . Growing up, as part of my secondary education, I was really scared of math. . . . I didn't know that I was dealing with anxiety, so I would even bite my pencils, and it was so bad. I was really scared of math. I hated it.

Conversely, Imani expressed confidence in her math abilities due to the ease she felt in class. Imani's experience in her math courses is not aligned with traditional educational success markers, yet while all other courses added stress to her life, math became a comforting subject:

> Because I did sleep a lot in this class, I would get called out by other students. Like, "Imani is sleeping." "Well, Imani is getting an A, so you don't have to worry about what Imani is doing." I'm like, oh, well, that's good to know that even if I don't really try, I can still figure it out on my own. I didn't really get nervous about the math portion. I decided, like, okay, cool, at least I can do that. If I can't study for biology or whatever other course I need to take, I'm like, "At least I've got math under my belt. I can do math." Because I just remember people being like, "Oh, she's got it." That's nice.

Imani did well in her math courses, which contributed to her confidence in math, but rather than further realize her math potential, her math teachers allowed her to sleep in class. Some students shared positive feelings toward math and confidence in their math abilities despite their school's inability to provide adequate exposure to AP math or STEM pathways in secondary school. For example, Katherine shared confident feelings about math:

> I did really well in middle school and high school. It was always a positive experience because it just came easy to me. In high school, I went on to do trigonometry, pre-calculus, and then calculus. . . . But because I've enjoyed it so long, and it was always like, I don't know, I want to keep doing this. I thought it made sense. It was straightforward, and it was logic, and I loved it!

Rico shared a similar passion for math and confidence in his math abilities and potential:

> I've always believed I was good at math, and I've always wanted to go against the narrative that was commonplace throughout the time that math is hard and that not many people understand it. And to me, that was nonsense because it's very easy to understand if you have the intuition for it. And if you can understand it at a very intimate level, the concepts and the ideas, then you'd be fine. And I've wanted to convince myself of my own claims, basically.

Despite receiving high grades and demonstrating a strong interest in mathematics, secondary institutions did not fully recognize the students' potential. These schools fell short in several areas, including restricted educational offerings, tracking systems, and limited support for STEM subjects.

Restricted Educational Offerings and Tracking

When students described the courses they were enrolled in and the availability of math or STEM programs offered, they had varying responses. Two of the five participants were involved in STEM programs and tracked for STEM careers. Some STEM programs were more robust than others, but the students nonetheless reported taking courses that fed their interest in STEM. Although Maribel did not take high levels of calculus in high school, she was placed on a STEM track that offered courses related to careers in STEM and fueled her interests:

> I did the engineering route, which offered engineering classes for all 4 years. I learned the different types of engineers that there are, how to build things, and how to use the computer to make stuff. Like, make models and stuff like that.

Additionally, Maribel was given the opportunity to take math college courses while in high school, and that prepared her for her first math course as a college student:

> I took [pre-calculus] one summer while I was still in high school, . . . [the] summer before entering 12th grade. I remember I had to withdraw, but then, after high school, I retook it again. . . . It was fast-paced and really challenging, but not that challenging. . . . Well, it was really challenging. Yeah, it was challenging, but since I already took pre-calculus in 12th grade, it helped. So, I was able to pass that with a B.

At an early age, Imani was tracked to go into a STEM career and received rigorous math preparation. Imani described her pre-high school experiences and then discussed her experience in the high school STEM academy:

> So, I was always in the gifted programs. . . . Even before I was in high school, they did a lot of math and science gifted [lessons] first, and then they would do language arts and everything else. So that definitely shaped part of becoming who I am.

> [In the academy,] I had to take an extra science or math course elective every year. Usually, you just take one or two. You have to take an advanced math already, and then you took an upper-level science, and then you took another additional science or math course. That prepared me for this. . . . Not only are they saying like, "Oh, are you interested in STEM?" They're just like, "You're interested in STEM, and we're going to make this happen for you."

As previously mentioned, although all students reported strong grades in secondary math courses, not all were tracked and prepared for higher levels of math. In some cases, they reported deliberately being excluded from entering STEM tracks or taking adequate math courses. For example, Esteban emigrated from El Salvador to the United States while in high school. He

shared his experience as an English learner and a new student in the United States. Although his math teacher recognized his strong math abilities, the school would not place him in AP courses or high levels of math:

> My counselors were like, "Oh, no, you're taking ESL classes, so you can't take any AP courses at the moment." That was my experience during that time. I didn't get to take any advanced math courses like Calculus 1 or 2, which my professor at that time wanted me to take. But because XYZ reason, counselors didn't want to fix my schedule. They just decided to sweep it under the rug and just let it be like that. I ended up taking Algebra 1 my first year here. Then, my second year, I did half of geometry during the summer, and then the rest I did at a continuation high school.

This early educational setback had lasting impacts, as he later encountered challenges in community college, where he felt outpaced and underprepared compared to peers who had benefited from more rigorous math backgrounds:

> You have that mixture of backgrounds [in community college]. I was coming from the hood area, so I didn't have access to any resources and then going into STEM. . . . A lot of these kids were in high school doing dual enrollment, already taking the class that I was barely getting to after my 3 rd year at my community college, so that made me feel like, Am I not smart enough? Am I not? . . . Or am I just dumb at this point? I don't know how they get it.

Additionally, students recounted the school system's failure to recognize strong math students and place them in STEM academies. Katherine and Rico both shared their enthusiasm for math and expressed frustration upon discovering that they had not been placed in their school's STEM

academy. Katherine was particularly disappointed to learn in her final year of high school that a STEM track existed, regretting that she had not been guided into this pathway earlier:

> My high school was divided into these things called academies, and each academy was focused on different fields. One was more of a theater academy, one was more of a medical nursing academy, and one was more like a STEM one. I did not know that there was a STEM one, and so, our school just got split up into different academies, and I was in the theater one. . . . Freshman year, you get placed in these different fields. Again, I didn't know about STEM, so I just picked whatever. And it wasn't until my senior year that . . . I happened to take that class. I was like, "Oh, well, I'm in the wrong part of the school"… I've always wanted to do a career that paid well and that I was doing something that I loved and enjoyed and was good at… I think that's why it took until my senior year when I took that Intro to Engineering course, and I was like, "Oh, wait, this is actually a field that I can go into, and these are classes I can take to learn more about it?" It was a rough start because I hear from other students who are like, "I knew ever since I was little [that] I wanted to do this." I'm like, I didn't know until the last year, the last semester of my high school experience. I just knew I liked math. I want to do math. This is a field of math. But besides that, I don't know. I'm surprised I'm still here.

Rico firmly stated his view that high schools fall short in preparing students for college, noting his own high school math preparation as inadequate and overly simplistic. He also shared his experience of being excluded from the STEM track, regretfully attributing this oversight to himself:

> I'm going to raise a lot of complaints here, and it's not because I struggled. I'm going to complain because I feel like it could have been more rigorous, in my opinion. Okay. So during my time in middle school and even leading up to high school, much of the math that I've learned, well, I wouldn't say I've learned because I already knew it, but it would be reused and reused, and I'd see . . . the same stuff over and over again. And so, that's really the complaint I've had throughout my time in secondary school. Not to mention that they're just handing you the ideas without really proving anything. It never intellectually stimulates you. You're just like, yes, I know. . . . At the time, I was really driven to want to understand everything that I was presented. And so, I felt that . . . they should just prove things and not have us wondering why they're teaching it to us in the first place.

> I believe that they weren't really schools meant for people who were looking into STEM. . . . I believe it's my fault. It's my fault for not choosing a STEM route along the way. So, I could have done better. But those were just miscalculations on my part because in high school, I did want to join a magnet [school], but I was turned down.

Uneven STEM Support in Secondary Schooling

Regarding the educational support they received for math, students reported mixed experiences with STEM support in secondary school, encompassing school staff, external organizations, and after-school programs. Importantly, none mentioned receiving formal after-school academic support in math or additional content support from their schools.

Imani described her experiences with teachers as a positive one. She details the additional effort as one of above and beyond. Teachers went out of their way to take an interest in her future and kept her accountable:

> My teacher, Mrs. S., was extremely influential. Even if I didn't want to be doing anything because sometimes I just took the classes because I thought they were fun, and I didn't want to pursue anything post-high school. She was the one that sat me down [and asked], "What do you want to do, and why do you want to do it? And like, This is the path you need to take. Don't just sit here and be in this class because you're supposed to be in this class. Let's learn, and let's figure out what we're going to do for your future." She was great with grabbing other people and pulling them in and saying, "This is what you need to do." She was extremely influential. . . . I had a math teacher named Mrs. T. She was awesome. I had a math teacher, Mrs. M. She was great. Just a bunch of . . . Actually, they're all women now thinking back. A lot of women that helped say, this is what we're going to do, and this is what YOU'RE going to do, and this is why. And even if I didn't want to do it, they held me to it.

Similarly, Esteban had teachers who went out of their way to provide advice, support, and encouragement. Despite the structural barriers and lack of official guidance, he had a few teachers who took an interest in his future.

> Then, I was lucky enough that at least my Algebra 1 teacher, he was Mexican American. He had also emigrated from Mexico. We had that connection, and he saw that I was really wanting, . . . that I was different in a sense. He was the first person that was like, I think you should consider going to college. Mind you, I spent my entire first year at that

> high school, and counselors were non-existent. . . . He made me realize that I could do math, but in the states specifically. Like, oh, no, there's a potential route that you could take to further your education. Just because you're probably not proficient [in the] language right now, it's not going to determine where you're going to end up in life. If you just continue doing what you're doing, you're going to do well. And so, I did. Then I had him, and I also had a few other teachers that were really rooting for me to be placed in AP courses.

Maribel also described a positive experience with a teacher she was able to have for 3 years in high school. This teacher was in the field she was interested in pursuing, and he gave her insight into STEM:

> I would say my high school teacher, he was my teacher for ninth, 11th, and 12th grade, so for 3 years. He was an engineer himself, . . . and it was honestly really nice to have a teacher like him to introduce computer science. And it wasn't something that I'd ever been introduced to before. I've heard of computer science from my older sister, my oldest sister. But other than that, my parents know nothing about computer science.

Katherine explained that she did not receive any STEM or math-related teacher support, but teacher support nonetheless. Although she had supportive teachers, she described negative experiences with her high school counselors:

> I had teachers that worked, that were good, but not specifically STEM-related teachers. I had counselors who were fine but were definitely not supportive, so not that. I think to further talk about that, about the counselors, there was an incident. I am undocumented, so when I was applying for college and stuff, I had a counselor who told me that it was

> going to be really tough. It was going to be extra tough for myself as an undocumented student. I'm sure it was meant to come off as realistic, but it felt more like a downer. So, that didn't feel supportive. . . . So, absolutely no support for STEM, unfortunately… It was mostly from the instructor. They gave me the office hours kind of support… I think if [math] would have come hard, I think it would have been hard to find support in terms of tutoring and all these other things.

Rico recounted receiving no staff or teacher support during his secondary education, and as a result, he relied on himself for guidance:

> I'm the type of person who doesn't really go around asking for help. I prefer to figure it out on my own. If there's something I can't do, I'd go out of the way to figure it out and take my time to really understand it. Yes, there will be points where I will ask for help, but I'll first watch YouTube, maybe. I'll probably read some books, and if that isn't helpful, then at that point, I will go around asking for help. But it never got to that point during my time. It never really got to that point because the concepts weren't too hard to understand. They weren't really that hard to understand. And so, I never really had trouble. And, matter of fact, if anything, I also helped the students in the class understand the concepts.

Going further, the students who were tracked and enrolled in STEM pathways had academic summer and community programming opportunities, while the three students who had not been tracked for high levels of math or STEM pathways reported no afterschool or community programming related to math or STEM. Imani had an abundance of afterschool and community opportunities revolving around STEM pathways.

> I was in the science fair and I went to state. I was also involved in the Health Occupation Students of America, HOSA. . . . I competed in that and went to state for that as well. . . . I also was taking the V-rotations throughout hospitals, doctor's offices, and clinics. . . . You do a project on that every week in school. . . . You're going to go to this doctor's office on Tuesday, and you're going to go to this one, and you have to have 100 volunteer hours and 100 research hours before you can graduate high school. It's a very intense program you have to do.

Maribel stated that she did not receive after-school math support from her secondary school, but she was involved in various summer programs through her community center.

> I don't think my school had tutoring. Only, like, paid tutoring. But yeah, I wouldn't pay for that. Oftentimes, in high school, even when I didn't have a math class with my teacher, my engineering teacher, I would still go to him and ask him for help. So, I would say he was my biggest help.
>
> Boys and Girls Club for one summer, and then I think they offered it to the people who were there. It was like a UC camp, but it was focused on STEM, if I'm not mistaken. Okay. Yeah. So, the counselors were UC students, so I talked to them, and I made relationships with them. I think they were also a big influence.

Unlike the previous participants, Esteban reported zero support in high school with math concepts or other topics in school. Frustrated, Esteban explained that his school did not offer after-school or summer programming:

> I feel like we have the potential. Students have the potential. We just don't provide them with the right resources to get through education. . . . [Tutoring] non-existent. . . . During

> my time in high school, [after-school programming] was something that I was really looking for. No one in there had anything to say about it like "Oh, this is something that you could do," or none of that. It was so bad.

Both Katherine and Rico were in the school band in high school and reported their only after-school or summer programs to be related to the school band. Katherine had little to say in regards to additional support but that there was no STEM or math support offered to her, "There were after-school programs; they just weren't STEM-related. Again, it wasn't until my senior year that I was like, 'Oh, there's STEM stuff." Similarly, Rico acknowledged the presence of STEM support, but he did not have access to that support as he was not admitted into the STEM program, "Sadly, no. Well, except for magnet, but as you know, I never really got into it."

Summary of Secondary Education Findings

The counter-narratives highlight the discrepancy between the mathematics preparation received by working-class Black and Latinx STEM students and their inherent potential, as observed through their secondary education experiences. For instance, while all students demonstrated high math achievement and interest, their secondary institutions failed to fuel and deepen their interests in math and STEM fields. Moreover, the educational offerings and lack of support mechanisms in place, coupled with variable experiences with teacher support, were found to be insufficient for fostering an environment conducive to the full realization of students' potential in mathematics. Instances of students feeling under-challenged, unsupported, overlooked, or even excluded from advanced math and STEM pathways highlight systemic flaws in recognizing and cultivating talent among working-class Black and Latinx students.

CHAPTER 5

FINDINGS OF CALIFORNIA COMMUNITY COLLEGE EXPERIENCES

This study explored the mathematics trajectories of five Black and Latinx community college STEM students as well as the barriers and strategies they developed to navigate transfer-level mathematics environments in the post-AB 705 (2017) contexts. To elevate student voice research in educational policy and practice, this study centered student voices to inform how students experience and understand their math and STEM trajectories (Solórzano & Yosso, 2002). Additionally, this study examined the intersectionality between race and class in their mathematics and STEM trajectories. Research that focuses on singular dimensions of identity risks overlooking within-group differences for negotiating mathematics trajectories. To disrupt discourses of STEM underachievement and underrepresentation associated with Black and Latinx students, this study aimed to qualitatively unpack their strategies of resilience and persistence in STEM higher education at the intersections of race and class. While the previous chapter provided detailed student portraits as well as the findings of the student's secondary experiences, this chapter addresses the second sub-research question, focusing on the students' community college experiences. Specifically, this chapter addresses the question: How do working-class Black and Latinx STEM students perceive and make meaning of contributors and barriers to transfer-level math success in the CCC system? Additionally, this chapter includes the additional narratives provided by the faculty, which provides further context for the study. The third sub-research question and discussion are addressed in Chapter 6.

Chapter 4 explored the students' secondary experiences in mathematics and determined that secondary schools failed to meet students' potential. This chapter's findings highlight the

barriers students encountered when navigating transfer-level math courses and the contributors to their success in transfer-level math and the STEM pipeline. Specifically, these findings underline how students unpack their strategies of resilience and persistence in STEM higher education.

Barriers to Transfer-Level Math Success

Although secondary schools failed to meet the study participants' potential, the study uncovered significant barriers and contributors to achieving success in transfer-level mathematics in the CCC system. When discussing the barriers to their success in transfer-level math courses and the STEM pipeline, the students revealed the virtual learning environment in math courses and challenges to belonging and identity validation for nontraditional identities in STEM pathways as the main barriers to their success. The abrupt shift to online learning modalities, coupled with existing structural racism and the exclusion of diverse identities in STEM courses, significantly hindered students' academic progress.

"Oh, My God, Taking Those Classes Online, Girl, That Was Crazy!"

In March 2020, the world was thrown into a global pandemic with the spread of the COVID-19 virus. Everyone was forced to work and attend school virtually, for which many schools were unprepared (Avidov-Ungar et al., 2022; Treve, 2021). Teachers and students were required to adjust to an online teaching and learning modality. When the student participants described barriers they encountered in completing transfer-level math in community college, the online learning environment, together with ineffective online teaching, was a major barrier to their success in math.

Modality and Class Structure

For the students in this study, the abrupt change in class modality and structure uncovered barriers to their success in math. Students detailed difficult situations ranging from test-taking, understanding concepts, and creating connections with their peers and teachers, uncovering insufficient math pedagogy in online learning environments. Esteban described having a particularly difficult time with online exams:

> Oh, my God, taking those classes online, girl, that was crazy! I remember we used to have midterms, and the professors would open the thing from a specific time to a specific time, and then you have to work on the PDF and submit the PDF. There would be nights that we wouldn't get any sleep. We're just working on those 50 questions.

Katherine described a similar frustration with taking online math courses. Learning affected how she absorbed concepts and exposed inadequate math pedagogy:

> Math is definitely one of those that I enjoy being in person and seeing the professor work out a problem right in front of me step by step. The remote learning was tough because professors had either pre-recorded stuff or. . . . Even though it was helpful to look back, they had PowerPoint slides that they would rush through, and so, even though you could have a copy of the PowerPoint slides, you can go back and hear the recording, they weren't doing the problems step by step with you, live. They were like, here's a PowerPoint with a problem done. And they would go through it quickly and then move on to the next PowerPoint slide. And there'd either be a lot of PowerPoint slides, like 80 or something, so they were just trying to get through all of them. So when you look back at the notes, you would be like, wait, how did you go from step one to step two? I see the

> work, but I'm not sure how you got there. And so, there was that change from in-person being in the moment to remote learning where everything was pre-recorded and already like . . . I don't know. It was going really quickly with less explanation.

Additionally, Maribel described how the online modality affected her connection with classmates and the college experience:

> Well, it was really different, I think, because it was COVID time, and it was like an online class. It was all really strange. Yeah. I don't think I got a full college experience at the start because of COVID, but as for how I felt, since it was online, I didn't interact with any of my classmates.

Like Maribel, Rico felt it was difficult to form connections in virtual modalities and saw the value in taking courses in person.

> I didn't talk to, . . . Because . . . it was asynchronous, I never really got in contact with my other peers in that class. If I had to say, most of them probably dropped. It's just reality. I feel like it probably would have made a difference if I would have reached out to my peers. But in asynchronous, I find that much more difficult to do rather than in person.

Although taking math online was hard for all students, Rico described that taking higher levels of math was particularly not conducive to online learning. Rico felt that he tried everything in his power to understand the concepts, but the course did not offer him sufficient support, so he looked elsewhere for a deeper understanding of the concepts:

> Discrete structures, yeah, that wasn't easy. Honestly, my worst experience. The first time I took it, I took it online, and I think that probably contributed to the grade I had at the

> end, I feel. Because a lot of times, I'd be lost. I wouldn't know what to do. I wouldn't be able to understand, despite the fact that I'd be concentrating, focused, thinking about it, doing everything I possibly could to understand the material, I just couldn't. And so, that's when I resorted to Chegg. I remember I was like, "Forget this!" I've had enough! Chegg! And so, . . . I'd get the answers, and I'd try to make sense. Even at the time, I'd look at the answers, I'm like, Oh, that makes sense. Oh, I see. I thought that would help me understand the process. . . . I thought I was learning, but no, not really. I wasn't really learning, I guess. I try to justify and convince myself, but no, that's wrong. And since then, I've never [cheated] again.

Ineffective Online Teaching

For the students in this study, both the class modality and the absence of teachers and ineffective online teaching practices were barriers to completing transfer-level math in community college. Esteban enrolled in his second semester of college in the spring of 2020. When he enrolled, all courses were to be taught in person. The pandemic altered the modality a few weeks after the start of the semester. Esteban described his experience when he took trigonometry in the spring of 2020 and the absence of his teacher once they began remote learning:

> Yeah, I ended up taking trig. That was the spring semester of 2020, and that's when COVID started. It was interesting because this one teacher, a professor that I had during that semester, once we went online, we never saw her again, ever again! We would only get PDF files and all of that. So it was like, Oh, my God. You're kind of teaching yourself. But that's how that started.

Although Esteban was understanding of the circumstances of the pandemic, he reported feeling disconnected from many of his math teachers when enrolled in remote math courses:

> I felt like I was teaching myself most of the time. Honestly, I think I had a neutral experience with every other professor I had. Not like, Oh, my God, I got to meet them to a deeper level. No, but it wasn't bad. I wouldn't complain. Yes, because we were doing it online, it was challenging. But [the teachers] were really understanding of how things were being done, especially because of COVID.

Esteban described the online math instruction he received as generic and reported teaching himself during his foundation courses. He hated the experience, and although it was a challenge for him when he was able to solve a problem on his own, he felt a sense of accomplishment:

> When I was taking, especially my pre-calculus and calculus series, I think those professors would give you the most generic concepts or lectures and then whatever you'd see in the textbook. Literally, they wouldn't really work out any problems, or if any, they would be the same ones that you would find in the textbooks. That was it. Then good luck to you. Go do the homework and then study for the midterm. You got this. That would be it.
>
> Most of the classes were either fully online or Zoom meetings. I didn't really feel . . . in my head, I was like, I understand what's going on, so let me just teach myself. It was fun. I'm not going to lie. While I was taking it, I hated it because math is not my thing. But it was fun. Going through the problems and being challenged, I think that was like, I don't know, you get a little reward when you solve a problem that you thought you couldn't.

> I ended up retaking it [physics course] the next semester. [I] got an A in the class. It wasn't me. I was not the problem. It was the professor.

Similar to Esteban, Maribel felt that her math professor was not as effective when teaching online during the pandemic as he was in person after the pandemic.

> I took multivariable calculus with a professor who I'd always heard good things about. But since it was still COVID time and his exams were on a website, it was kind of like I didn't really see the appeal for the professor. I kind of thought he was just an average professor. He offered workshops, but I didn't really see what the need was for the workshops because it was COVID time. But once I got into in-person math classes, I took him again because I already knew his style of teaching, and I actually started attending his workshops and saw how helpful he is and how much he's willing to give help to his students for them to pass, and how much he actually believes in his students as well.

"I Felt Like I Really Didn't Belong. What Am I Doing Here?"

The findings revealed that the participants struggled to find a sense of belonging in math, and their sense of belonging and identity validation were consistently undermined. Although they reported receiving high grades in their math and STEM courses with very few repeated courses, if any, they all stated feelings of self-doubt and feeling like they did not belong either on their campus, their STEM major, or math courses. For example, Esteban received As in all his math courses, yet he found himself feeling incapable of success and doubting himself. He attributed these feelings to being a first-generation student. For Esteban, not knowing how to navigate resources played a role in his level of confidence:

I'm first-gen, so I don't have anyone in my family that actually knows how to . . . Or somebody that has to pave the way or somebody to go and be like, "Hey, I'm thinking about this, what should I do?"

I deal with a lot of self-betrayals. I'd be betraying myself, my own thoughts, and stuff like that. That would be one of the things, and thinking that I'm not capable of it. Then, the next thing, it would be definitely not knowing how to navigate resources, feeling that you're stepping into computer science, which is what I'm doing right now, and not feeling confident. . . . How do I navigate this process? How do I access resources within my field? It can be scary. That was one of the things that I feel, like, made me shy away from the idea of, like, okay, am I going to be able to navigate a whole journey in STEM?

You don't come from a technical background. You don't have anyone in your family that knows how to code. You don't have . . . Because I remember when I first took my first computer science class, I didn't do the intro class. I went straight to the first one because I just wanted to graduate and move on. I was like, it should be fine. I should get it. But I took it during the summer. So, that was, like, fast-paced and everything. I remember we had the first assignment, and I remember vividly crying and thinking, this is not for me. I should drop it. Because they were asking you to download something on your computer that I had never heard of before. And I would see people understanding every single thing that was being taught in the class and me just sitting there acting or pretending that I actually understood what was going on. But yeah, I got through that class. I ended up getting an A. But it was really hard feeling like you didn't belong or like everybody else

was ahead in the game. You were just trying to not only catch up to their speed but also trying to understand things that they had already done so many years ago.

As a first-generation student, Esteban felt he would not be able to navigate college like others, but it was the institution that had done a poor job of introducing and connecting him to resources or making him feel like he belonged because he did not have the opportunities others had.

Rico recalled feeling like he did not belong when he first entered his community college as he had gone to an underresourced secondary school where most of the students were either Black or Latinx:

> That reminds me of my very first day at my community college. I remember that day. I felt like I really didn't belong. Like, what am I doing here? Like, so many White faces.
>
> I was like, What? What am I doing here? But then, over time, . . . I don't know if it's desensitization; you just get desensitized, and it no longer really becomes a big issue. Over time, it's just like, whatever, it's whatever.

Going further, Rico felt he had to figure out how to succeed on his own without the support of the institution.

> During that time, I viewed that if you needed support, you were lacking in something and very deficient. And so, I felt that if you needed support, it was because you were failing yourself in some way, . . . which is why I didn't really look for support until I think junior [year] because that's when all the classes started getting harder…that was my mindset throughout my early time in college. It was get through it on your own and don't really ask others for help. It's virtuous to be able to get through your own problems, to get through your own struggles without needing the help of others. It's like a really heroic

> thing because heroes make sacrifices without anything in return or asking anything from other folks. I've always wanted to have that persona, I guess, like I'm a hero. I don't need others. But that changed, obviously.

For Imani, self-doubt has followed her throughout life, regardless of the grades and accomplishments she has made. Her life trajectory and launch into motherhood have required her to take time off school, and as a result, she is often one of the older students in the class. Imani describes her experience with feeling like she did not belong:

> STEM is competitive as it is, but to go into the field of medicine, it's also extremely competitive. There's people who are like, they know they want to do it, they've been volunteering. They've been doing this, they've been doing that. They're 23, they're doing all the right things versus me where I'm like, I feel like I'm trying to catch up, but I'm still going to make this path the path that I choose.
>
> People would say to me like, Oh, but you're smart. You want to become a doctor, right? I'm like, Yeah, but I'm not smart. I don't know how I got to where I am. . . . I was looking at the stats the other day for UC [admissions], and I didn't realize that it was such a small percentage of people who got into UC until I was looking at the statistics. I was like, damn, how did I get into that UC? I'm like, I am not that good at things. I feel confident about math because I've always really liked math. I think that's part of it. But I've never really felt like . . . My mom has said, Oh, yeah, you're good at math, . . . and I'm just like, Okay, whatever. I think they're just letting me get away with things.

> I actually missed taking Calc 2. That was a great class. I got an A. I wasn't struggling. But I still don't feel like you've got this, you've earned this, you've worked so hard. And my husband tells me all the time that you're where you're supposed to be. You're doing this and that. I'm so proud of you. I'm just like, I haven't done all the things right. I still just have to withdraw for the umpteenth time from all of my classes again, which I sent so many emails to everybody being, like, "Is this a good decision to do?" Should I withdraw? I need to, right? They're like, "You're on the right track. This is a good idea." I had to get confirmation from people to withdraw. And I already wasn't doing well, and then my son was in the hospital. I'm like, 'Should I withdraw from the classes?' Yes, but I just still feel like someday they're going to wake up and be like, Oh, yeah, her. No. Why are you even here? You should go back to community college and start everything over.

Gendered Racism

Exclusion was particularly pronounced for students embodying identities at the intersection of race and gender. These aspects of their identity contributed to a compounded sense of alienation in STEM spaces. It is well documented that there is a scarcity of women of color in STEM, and that is a by-product of structural and institutional racism (Hall & Sandler, 1982; Reyes, 2011). Expectedly, the women in this study discussed moments of feeling as if they did not belong in their classes and STEM trajectories, but more importantly, they identified gender as a significant factor in their experience of belonging. For the women in this study, being a woman in STEM was something they were very aware of and thought about frequently.

Katherine detailed her experience with being one of few women in a high-level math course and the microaggression she experienced from her math professor:

> Being a woman, that's a challenge because eventually, I got up to . . . multivariable calculus, linear algebra, differential equations, and I forget what else. I was taking those math classes at the end. And when you get up to those math classes, you start off with a full classroom of 30 or 40 students. And then, by the end of the semester, you get down to six or eight students. My last math class was discrete structures. We were down to about seven or eight students. . . . Only two out of the eight students were women, and the tough part was feeling like we didn't belong. And so, not wanting to ask questions sometimes because you were a woman and be like, Oh, I'm the only one asking a question.
>
> Yeah, and then there was this one incident one time, and I don't know if this is for a different question, but I think about it in terms of barriers. . . . There was this one time the professor was working on a problem, and I looked at it, and I was like, hmm, that doesn't look right. I think he's meant to do this other thing instead. It took me a while to eventually say something. I was like, "Hey, I think you meant to do this other thing." The professor was like, "Hmmm, I don't think so." And it didn't take until a male student said, "No, I think she's right," that the professor was like, "Oh, let me check. Oh, yeah, you're right." And then just kept going. Not acknowledging me, the original student who had pointed it out, and then acknowledging the male student who had then pointed out my correction. And so, it was very subtle. It went very quickly. It was like a two-second like, No, excuse me, and then, "No, excuse me," and then, "Okay," and then moved on. It

> was one of those things that unless you're watching out for it. . . . And a woman who is like, Okay, I experience this all the time. Yeah, because for everybody else, they're like, Oh, yeah, it's whatever. Teachers aren't perfect. But from my perspective, it's like that's a little bit of a micro thing there. So that's another big challenge in my math courses . . . Being a woman in a math course.

When asked how she felt when she had to retake a high-level math course, Katherine explained her disappointment, but it was more than disappointment for herself but rather for all women and how this setback would be perceived:

> Devastated. Because I was like, I did this once already. It was tough. I felt like . . . Again, like the feeling of being the only woman in the math class of only eight students left, where it's like, Man, I feel like I'm letting women down because I'm the only girl left. I did so poorly in this class. I'm representing women horribly. And so, there was that pressure. Again, nobody is expecting that of me, but I felt that pressure. I was like, Man, I don't know, I guess I felt competitive in that sense. Ummm . . . sad. Sad because I got a D and failed the class. Also, I was stressed because it was a course that I needed to complete my Assist requirements for my major. So, definitely, I was stressed. I was like, Man, it's going to look horrible on my transcript, and they don't understand the story behind it.
>
> Whenever you got to those last math classes. . . . Not seeing enough women in those classes that always felt like a sense that we don't belong.

For Maribel, a challenge in belonging arose at the intersection of gender and ethnicity. Although Maribel received many A's in her college math courses, when asked if she experienced imposter

syndrome, Maribel explained that she felt imposter syndrome even when she received high marks because she was a woman of color:

> When I was getting As, I think I did sometimes still feel it [imposter syndrome], even with, like, the high grades, because I'd see, like, the other people who would get the high grades, and yeah, as a minority you don't see that many women in STEM, especially, like, Hispanic women. But it was . . . I mean, I think once I started doing better, I felt a little more in place, but it was still always in the back of my mind, like, lingering.

Imani described great appreciation and care for her pre-calculus teacher, and while she did not share any directly negative experiences, she did discuss the treatment her female teacher received from male students and the effect it had on the classroom experience:

> Pre-calc was not like . . . everyone felt like . . . they seemed a little bit more standoffish in class. Some people seemed like they either didn't know what was going on at all or they didn't like the professor as much as I loved her, obviously. I don't know if it was an accent thing because she was Eastern European, so it was like she had a very thick accent. So some people were like, I don't like her. That was like . . . you could feel that atmosphere in the air, unfortunately. Then some, I don't know if it was because she was a woman and there were a lot of male students in that class that would roll their eyes when she would speak, or people weren't as willing to ask questions.

Lastly, Iamni explained that her intersecting identities as a woman, mother, and student with a learning difference presented a challenge in a traditional class setting.

> I was struggling with the homework thing because that's just who I am as a person. Then I had this brand new baby at home that I was breastfeeding full-time, so I was trying to

go back and forth and all of these things, and I didn't have childcare that was convenient and close to me.

For Katherine, Maribel, and Imani, the lack of women in higher levels of math made them feel like they did not belong and created additional pressure. In some cases, they experienced microaggressions, and in other cases, they felt a sense of responsibility for the representation of their gender. Regardless, their gendered experiences as women in STEM created a barrier to their success in transfer-level math.

The narratives from Black and Latinx students illuminated distinct challenges in navigating the competitive and often exclusionary environments of math. The abrupt transition to virtual learning environments uncovered significant challenges in mathematics, a subject that thrives on interactivity, immediacy, and hands-on engagement. Essential learning components like solving problems in real-time, immediate instructor feedback, and collaborative group work did not translate to the online modality. Additionally, the shift to virtual learning environments as a result of the pandemic underscored a sense of isolation, leaving students feeling adrift without the usual community and support and deepening feelings of marginalization in a field where they are significantly underrepresented. Furthermore, challenges were not just academic but deeply tied to identities. The compounded effect of race, gender, and socioeconomic background contributed to a sense of alienation and struggle for belonging in spaces not traditionally designed to include them.

Contributors to Transfer-Level Math Success

Despite the challenges with online learning and sense of belonging for nontraditional identities in STEM, when discussing their success in transfer-level math courses, the participants

recounted connections with teachers, fellow students, support programs, and services to be contributors to their success. They reported two main contributors to success in transfer-level math: the first was the dynamic teaching ecosystem, which incorporates culturally responsive teachers, SI, and tutoring. Culturally responsive teachers include supportive and relatable instructors with whom students could build meaningful connections and consequently contribute to their sense of belonging, instructors who implemented pedagogical methods that accommodated diverse learning styles and needs, and in-class SI support to help further build on math concepts. The second main contributor was community formation. Students recounted student agency and the presence of robust support services such as STEM programs as contributors to their success in transfer-level math and the STEM pipeline.

Dynamic Teaching Ecosystem

Students detailed an ecosystem of support that was instrumental to their success. In their narratives, students detailed caring and effective teachers who implemented culturally responsive practices and supplemental content support. This ecosystem's trifecta propelled the students to success.

"I Guess It Was the Feels."

Every student in this study pointed to at least one instructor they felt a connection with and made the student feel cared for. For example, Imani had several great instructors. She described the relationship she formed with her first CCC teacher, "The Pre-calc one I loved. She's actually my friend now. We had babies months within each other. That's really cool. She came to my son's birthday party." The bond Imani formed with her first professor extended beyond the classroom. In another instance, Imani had a difficult experience in a math class with a

teacher she did not feel connected to. After deciding to drop the course, she enrolled in it again with another professor the following semester. The new professor made her feel supported and at ease:

> Once I dropped her class, I took it again later with a male professor, and he was like, 'Oh, Imani, you got this. You can do this. Everything's okay. It's great.' If I felt like I was struggling, he's like, 'You're actually not struggling like you think you are.' It calmed me down and resonated with me. Same thing with the one after. It was just, yeah, night and day.

Additionally, the new professor understood her struggles with childcare and allowed for accommodations that allowed her to be present in class. She was grateful to have a teacher who was flexible to student's life circumstances both in and out of the classroom:

> I learn better if I'm sitting in front of you face-to-face and I can write on a piece of paper. So, I went there, and I was like, 'but the only thing is I have my son, my infant son.' And he was like, "That's fine." So, two or three times, I just had my baby sitting in the office in his little car seat carrier, asleep in his stroller. I'm listening to my teacher and writing notes. Then, there was another day when my husband had to stay late at work. . . . I told [my teacher], I don't know what I'm going to do, but my husband's not getting home. I don't want to miss your class because there was no. . . . I think he did take a couple of points off for attendance or whatever. I was like, "I don't want to miss for attendance, and I don't want to come late because if I come late, I'm probably going to miss a lot. Is there any way I could bring my son into the classroom? Or can I stand outside of the classroom, and you keep the door open so I can hear and take notes?" He was like,

> "Yeah, it should be fine." I brought my son into class. My son stayed for the first hour of class in his little stroller, asleep for an hour, and I'm listening to notes and doing everything with everybody else. That was something that will always stick with me is that, like, my son took one and a half calculus classes because he was there. The professor was just like, "It's cool, I understand." He's got kids of his own that were young. It was really great to have teachers that not only understood where I'm coming from as a student but were extremely empathetic to the point of like, "Yeah, you can bring your baby in here, and he can sit and listen while you're getting your stuff done."

Imani felt recognized and had a sense of belonging when a professor recommended she join a STEM club on campus and believed she would be a good fit:

> When someone pulls you in and says, "Hey, I think you'd be a good fit for this club." It feels good to be like, Wow, somebody recognizes me. I think I'm doing okay enough, but she's like, "You've got this!" So, it's got that little bit of oomph behind you. Or in that same vein of things, when you're not doing so well, and then the professor, . . . they're actually taking the time to listen to you and be like, "Okay, you're not doing well in this part. Go to the tutoring center." I have always been on the fence about that, but I think it's the way that they said, "I will allow you to have this percentage off instead of this percentage off, but go to the tutoring center and get a little bit of help if you need it."

Esteban was similarly grateful for his first math instructor in community college as he encouraged him to go into math and the STEM field and helped him feel a sense of belonging in math:

> I generally don't think there goes a day where I'm not being appreciative of all the support that I got from him. . . . He was so great, and he saw the potential that I had when I took that class. In a way, he made me feel comfortable with math at a community college level. He was like, "I think you're good at your reasoning for math. I see the potential. Why don't you try to do something in math?"

Esteban had a welcoming computer science teacher to whom he could relate and who built community and connection in the class. Esteban explains that he felt safe in class and at his community college because of the care he received from certain professors:

> I think everyone that I had at my community college played an important role in [overcoming imposter syndrome]. But my computer science professor was African American, with no traditional background. When he opened up and went from being the professor to showing more emotions and being vulnerable, it clicked. I was like, This is crazy. He literally did the same things that I was doing. He went to college because he wanted to be a doctor and then ended up doing computer science. I was like, "This is literally me!" Just seeing somebody's struggle, . . . I think I'm very connected to people's emotions. That created a safe space for me to open up to my professor and be like, Hey, I don't quite get this. Is there anything that I could do? Or just being open to talking about mental health to my professors. Being open to talking about the things that I didn't understand, that helped a lot to just make . . . or created a safe space for me to open up about things that I was dealing with outside of the classroom with my professors and have them help me out with things that I didn't understand and then connecting with the people in my classes.

Similarly, Katherine recounted her experience with a female math professor who created a supportive, warm, and welcoming environment. The professor's pedagogical methods fostered a sense of belonging and attainability.

> Professor L. I think she teaches Calc 2. I really liked her. She's super nice. She really took the time to show us the concepts, talk to us, answer questions, work out problems, and gave us as much of the resources and support that we needed to pass that class. The rest of my math professors, they were all male.
>
> She went above and beyond, just giving us everything we needed to succeed in her class. And it was up to us to take advantage and do the work. Doing the bare minimum, you pass. But doing the actual work and learning, then yeah, you can get a good grade. But just friendly, clear, took the time, taught the subject in a way we could understand, lots of visuals because I'm a visual person, so it helped. That was my best experience.

Maribel described her math professor as understanding and welcoming. She discussed her experience with her math professor as one that was enjoyable and increased her interest in math:

> My Calculus 1 professor, I think she really made math enjoyable. She was a funny professor and really smart, and she knew what she was talking about, and she was understanding as well. I would go to her office hours often with my study group, and we would ask her questions, and she was always happy to answer and stuff like that. So, being in a math class like that for my first year, for my first full semester, was helpful in liking math a lot more.

Rico reported one teacher who was helpful because he felt connected and cared for. His teacher went above and beyond and created a fun learning environment while maintaining high expectations and pushing students to go beyond the material:

> The only professor I can really remember is . . . my professor for multivariable calculus, and . . . I think it's differential equations. For those two classes. I only remember him, I guess, because we had a lot of fun in class, and I don't know, it's more memorable. I guess it was the feels. I guess I probably enjoyed his class or just being a part of it.
>
> He's always great because he really wants his students to learn, and he would really go out of his way to drive in the concepts and do his best to really educate his students. I was once his student, so obviously, maybe I'm a little biased, but that's how I felt . . . during that time. He did care, too, because I do remember there was this particular time where I had done very bad in an exam, not going to lie. I did pretty bad compared to how I've done before. And he said, "I don't want to see that again." I was shook. I was like, What? I haven't heard something like that since high school. I was like, "All right, I guess I can." I felt guilty. I should have done better for his sake. I don't know why. He's not the student here. But still, I guess I felt like he cared. He mentioned a lot that it's important for us to learn these things because we're going to be seeing these things when we transfer to other schools, and that he really wants to prepare us for that. So he really went out of his way to show us . . . some things even outside of the scope [of the regular class content].

Students reported their strongest connections and enjoyable experiences in math as those in which the teachers cared for them and went above and beyond to explain concepts at a deeper

level. The connections they formed contributed to their sense of belonging. Additionally, students describe the teacher's pedagogical methods that contributed to their success in transfer-level math.

Inclusive Pedagogical Methods

The students in this study pointed to specific classroom policies and strategies teachers implemented that contributed to their success. Imani reported having ADHD and repeatedly expressed how difficult it was for her to get her homework done. Having understanding and equitable teachers helped Imani succeed in her math courses. Imani detailed her first experience:

> The first semester that I took pre-calc, she was like, Okay, I'll give you an extension. Instead of it being whatever amount off, I'll give you 20% off of the whole thing. If you turn it in by this day. So, I would be, like, I would turn in four chapters of work on one day because I would get it all done the night before versus I should have done it every single week and turned it in. But she was pretty understanding.

For Imani, the homework content was not difficult, but the amount of attention required to complete the homework was a constant stressor for her. So, it was a relief when she enrolled in a class where the teacher implemented an outcomes-based learning policy:

> When I got to his class, and it was a faster-paced summer course, he was like, "Imani, stop worrying about the homework." I'm like, "What do you mean? I've been doing it. I've been trying to, and it's a lot of homework." He's like, "Yeah, but the homework is like you only… need 37 or . . . 33 outcomes to get an A, which is just like you get a checkmark on whatever learning assignment you've done." One of the assignments was homework, just in general, homework. Not like homework for chapter one, homework for

> chapter three, it was just homework. So, he said, if you don't get that one outcome, that's okay because you'll still get this. I'm like, "Oh. Or if you do 50% of the homework, it still counts as the whole outcome is complete." So, I did less than half of it. He was like, "You still got the check for it." I'm like, "Well, that's amazing!" I was so stressed about homework for that class because it was a very fast course, and there was a lot of material to learn. . . . Every course I've been taking I'm trying to do better. I ended up getting an A in his class, which was a great feeling because I was like, "Okay, all I have to do is test well?! Okay."
>
> We had three tests a day. If you get that check that first day, you never have to worry about that outcome again. I'm like, so I can do that fun thing where I put it in my brain, and I memorize it and learn it and then not really forget about it because, for calculus, you have to use it on the next steps anyway. But I don't have to keep studying for the final. Then, when I took my final, it was only like three outcomes because I was trying to get . . . I wanted to get a 37 out of 37 and ended up getting a 36 out of 37! But I still got an A because you only need a 34. I loved that one. I was like, if anybody else could do this for any other class, that would be amazing.

In addition to grading policies, Imani mentioned a few instances where she and her classmates thrived due to the classroom environment the instructors fostered despite having significant age differences.

> We did have a lot of group and partner work, but I think because it was a late-night class, it was a lot more diverse in terms of age. So, I know I'm on the older side, but there were

people that were in their 50s. There was someone who I'm pretty sure was in her 60s, a lot older, a lot more willing to talk, a lot more willing to ask questions. It wasn't like there was a dumb question per se. If you didn't understand something, it's fine you didn't understand something, and we could more easily make each other laugh, make the professor laugh. It seemed like everybody in the class was asking questions or bolting out answers. We did a lot of work, not just in groups, but we would present it on the board afterward, and then he would go around and say, This is correct, This isn't correct, and This is why, and all those things. That was really great.

Even when the age gaps made Imani self-conscious about her age and school trajectory, the classroom environment made her feel at ease.

Then for the other calc teacher, it was very similar in terms of we did a lot of group work. We were all very communicative. We were extremely . . . We interacted well. We all melded well in that course, which was great because it was a summer, so it was way faster paced. There were a lot of very young people in that class, though. These kids were literally still in high school. I was like, 'What? These are 16-year-olds. What? You're 16?' That was weird for me. So, At first, I was not very on board with it because I was like, 'There's all these genius high schoolers in this class, and I'm over here.' But then the cool thing about his system was not just the learning outcomes but that we did a randomization. He would write everyone's names down, and whoever was not there, they would take them out. Then numbers 1 through 4, and you can put it in a random generator. Number one through four, you're in this group. It's not like we're picking our own groups of people that you're already comfortable with or people that are sitting near

you. It was like, I'm working with this person this day, this person the next day, this person the day after, or even before or after lunch. That was really cool. Then, like I said, in both of those calc classes, we all just seemed to get along really well.

Imani went further to describe an experience she had when struggling with her sense of belonging in school. Her initial feelings dissipated when her teacher employed group work:

> When I was in the math, the summer course where I was like, 'Why are all these genius, 17-year-olds in here? I'm like 29 with a baby and a husband. Why am I taking this class? They must all think I'm an idiot.' Here I was thinking I'm smart, and then there's this girl right here that got a four or a five on her AP, and she's literally 16 years old. She must think I'm an idiot. I felt like I was in the wrong place. Then, a couple of weeks later, I'm like, Oh, well, that 16-year-old is super cool and super nice. I shouldn't be thinking about her and what's going on with her life because I'm living my own separate life.

Most of Imani's teachers kept the lines of communication open. They created a comfortable environment in the classroom that invited students to ask questions and go to them when they were struggling.

> But it's like I would tell them as soon as I knew that I was starting to get overwhelmed, I would reach out to them and be like, I'm struggling with the amount of homework. And I think it also helped that I was testing well and that I was very . . . Like, I love answering questions in class. Teachers know my name because I'm always, like, raising my hand trying to get the right answer, or whatever. That was beneficial because they knew who I was. They knew that I wasn't struggling to understand the material. They knew that . . . I

> was trying to work through it with people [in our small groups] and all those things. It wasn't like I was just someone that was just like, Oh, I'm not [doing the work].

Esteban explained that teachers aligning the class material with the tests and making the content digestible and applicable was extremely helpful, something he did not always experience:

> The tests were very similar to whatever he was teaching. That helped a lot. I love that professor. . . . He literally breaks everything down nicely so that you would not only be able to get through the class but actually apply it in real life. That happened in both of the classes that I took [with him].

For Katherine, it was beneficial when the teacher hosted office hours after class because it allowed her to go to office hours regularly and get on-the-spot help, especially after struggling with remote learning:

> I was able to take, I think, one of my last math classes in person, and again, way better. It also encouraged me to go to office hours because, at least for that class, our office hours are right after our class. So, I was like, I'm there already. I'm a visual learner. I'm stuck. It's easier for me to go from the classroom to the office hours and visually see the professor working on the problem that he can help me on. So yeah, it was harder during the pandemic and remote learning. It was easier to go back in person.

For Maribel, although her Calculus 2 teacher employed a scare tactic at the beginning of the class, her teacher's flexibility and willingness to help during nontraditional times were extremely influential:

> My Calculus 2 professor, . . . I remember a week before class started, he sent out an email saying how not that many people pass this class. And then he told us how last semester,

> only four people passed with an A and maybe five with a B, which isn't that much, while his class was, like, 30-something students. And I guess it was a tactic to scare the students into maybe reconsidering, "Is this math class for me?" And it was definitely something that scared me a little since I'm not that strong at math, but I still enjoy math. But I still ended up taking his class. And it was, I would say, one of my favorite classes, my favorite math class, for sure. He was always helpful. I had a study group for that class as well. And he was in our class Discord, and we would sometimes ask him, "Oh, can you hop onto the Zoom in our study Zoom?" And he was like, "Yeah, sure." So, he would always be super helpful, and he was a genuine person, and you could tell that he wanted his students to succeed. He wasn't making it difficult just to make our lives difficult. He just wanted us to have a challenge, and that was really helpful. I would say he was one of the best professors at my community college.

Another of Maribel's professors offered workshops, which were small gatherings where students could work through problems together. They were similar to office hours but more in-depth sessions. These proved to be very helpful:

> So, he's a professor that I enjoy taking because of his belief in his students. His class wasn't easy, but because he believed in his students, I guess it was more motivating. Even though sometimes he would believe too much, he would make really challenging questions. But he was still a good professor, and I ended up taking him for 3 years of math classes. So multivariable calculus, linear algebra, and differential equations. Because I enjoyed him that much. Yeah. And the workshops he offered were really helpful. . . . We would have our classes, and then after the end of a chapter, he would

> assign homework, and then the workshops were him going over homework problems that were difficult and explaining it thoroughly and stuff like that. . . . That would be, like, on a different day at a specific time. So, not like after class, but a different day at a different time.

Rico felt that taking courses in person created a better experience because he built more community and connection with the teacher and classmates:

> I have more experiences with that particular professor because that's when I did take those live. . . . But I was like, I had a good time in calc one taking it online. And it saved me time and gave me more time. So I took that one. But then I was like, maybe I'd have a different experience going back in person. So, that's why I decided to go back in person for multivariable calculus and differential equations. I also met good people there, too. So it wasn't just a professor, but it was also the people. . . . I'm always willing to be in classrooms with people that just love the same things as I do or are doing the same things as I do, strengthen the struggle.

Participants reported pedagogical methods as contributing significantly to their success in transfer-level math courses and STEM pathways. Teachers who accommodated diverse learning styles and needs were highlighted as instrumental to student success. Innovative grading policies, such as outcomes-based learning and the incorporation of group work, helped students understand the course material.

Tutoring, Supplemental Instruction, and Support

For most of the students in the study, tutoring, SI, and support from campus resources were contributors to their success in transfer-level math courses. Esteban was a strong proponent of additional academic support:

> Another thing I took advantage of . . . office hours, especially with my favorite professor. . . . I took stats with the support session. We would always have that additional hour, and I would be able to review content that we had probably seen in class. That helped a lot. Then, meeting with my SI coach…just to reinforce whatever you're being taught in the class. That helped me a lot in trig as well. I think going through that experience really prepped me for all the things that I had to do for pre-calculus and all the rest of the courses that I needed to take.

Esteban explained that utilizing outside class resources was essential to success, especially during COVID:

> The whole COVID thing. . . . Made me a lot more comfortable with navigating resources. I became more comfortable. Just because if you didn't do it and you were not doing it, there was no way for you to get out of those classes because you needed that support.

Esteban was enrolled in a class that provided embedded support: SI and counseling services. He credited this in-class combination with increasing his sense of belonging and the success he had in his math class:

> I think I was blessed to have all the support that I got in that class in particular because we were assigned …a counselor for a specific class, and you would have your . . . The SI coaches, they used do that. In that particular class, I had a counselor and I also had a

> coach. Those two got me through that class because, number one, I finally was able to meet with an advisor and work on a plan, and it was somebody that I could relate to . . . She was a Dreamer. Just seeing her doing something that in a way, I was like, Oh, that's what I want to do. I want to be able to inspire students. That made me reflect on like, Okay, I feel inspired. I feel like I can do it, too. Because I was still going through that phase of, like, I don't think I'm capable of doing anything that has to do with higher education and battling those feelings, but having people like her and my SI coach helped me a lot, especially through that class.

As previously mentioned, there was a moment when Katherine experienced a microaggression in her math class. She noticed that her teacher made an error, and when she spoke up about it, it was the SI coach who validated her thoughts and feelings:

> When I raised my hand and said, hey, you're doing that wrong. And he said, no, it's okay. And then the other student was like, no, she's right. And I remember now it was the SI [coach] in the chat because we were in a Zoom class, and he did one of those memes or something or gifs in the chat, and the eyes were like, ooooh. So, he was aware! He was also aware. He was a male SI student, but he was also aware and was like, okay, I see it, too. I was like, okay, so it's not in my head.

Maribel attributed some of her success in multivariable calculus to her SI experience:

> So, the first support system that I got introduced to at my community college would be SI tutoring. . . . I guess I didn't realize how helpful they could be if you actually utilize them. But I learned that once I was in my second year. Yeah, one of my math classes, my multivariable calculus class, had an SI tutor, which is the second time a math class had an

SI tutor for me. And I actually utilized that tutor, and I went to his assigned hours and stuff like that. And it was just like, me and two other people, but it was really helpful, I would say.

The students in this study identified a dynamic teaching ecosystem where teaching, pedagogy, and support extended beyond the classroom as a key contributor to their success. Among those support services were tutoring and SI. For many, these support services were even more instrumental with the onset of the pandemic and the virtual modalities. The following section describes the strategies students utilized to create the sense of belonging they were missing.

Community Formation

As previously mentioned, students reported experiencing a low sense of belonging in either math courses, STEM pathways, or community college as a whole. As a result, students were compelled to foster a sense of belonging through community. The formation of community came in two forms: the first was through student agency, and the second was through formal STEM spaces provided by the college. The community engagement actions taken by students played a crucial role in their academic persistence and success.

"I Found a Community of Students."

As students navigated their STEM pathway, they enacted student agency and sought to create a community where there was none. Esteban explained how he built community in the classroom by sharing information and connecting with other students:

Just, like, chatting with people. Even though we didn't get to see each other in person, it was like, okay, what if I work on this problem, then you work on this one, and just

> support each other to get each other through that class. That's how we went about it. Then connecting whenever we got stuck, it would be like, okay, you go to office hours, and then we share the content, or I'm going to talk to this person, and then we're going to try to figure it out together. But that's how [we] went about it, and that made me become a lot more comfortable with connecting with people and just networking, accessing resources, and navigating the whole higher education journey.
>
> I would be the one emailing everyone, "Okay, you guys, I made a Discord channel if you guys want to help each other." I would always try to do that. I wouldn't mind . . . not sharing my answers, which sometimes I would do it, but . . . I love teaching people. I'm not the type of person that's going to keep things to themselves or gatekeep things. I would always try to connect with people, not only for my math classes but for any other class.

During remote learning, Esteban took it upon himself to help his fellow classmates and found that helping others was helpful for him because it built his confidence in math and higher education. "That's when I started stepping into helping more people, too, especially because we were going through COVID. It made me feel like, okay, I'm actually getting the hang of things. I can help people." Maribel built community through the formation of study groups and attributed part of her success to the group:

> I formed a study group with two people who had already taken calculus, and they were really helpful. And yeah, at the end of the class, like, throughout the semester, my grade went from a low D to a high C to a high B, and then an A, I'm pretty sure. And since my

> professor dropped the lowest grade, I was able to finish the class with like a low A, which is still an A. So, yeah, I finished the class with an A

For Maribel, study groups with classmates were motivating and kept her accountable in her math courses:

> Calc 2, I finished with a high A. I remember I put a lot of effort into that class because I really enjoyed the professor and also my study group. They would always motivate me. They'd be like, "Oh, study session at this time." And even though I wouldn't maybe want to be doing math, I would still join and do math with them.

Rico studied on his own during remote learning. He did not form study groups or attend tutoring until later in his community college studies, once he had moved to in-person learning and suspected a community could help him through the tough classes:

> That was early on because I did change that probably by the time. . . . I just really couldn't do it on my own, which probably came around after discrete structures after I failed that one. That's when I realized I got to change my strategy. And maybe it wouldn't hurt to reach out and get some help, such as . . . I know, not tutoring, but just deepening my connections with other classmates and getting their input and receiving their help. Kind of like a Stack Overflow, if you're familiar with that. It's like Reddit, stuff like that. . . . [Connecting with other students] I think is a work in progress, to tell you the truth, . . . to find your place.

Katherine took it upon herself to find and form communities for her intersecting identities to further increase her sense of belonging:

> The Dream Program because I am an undocumented student. That one helped a lot with finding resources and helping me picture me in that higher education space because we did a lot of campus trips where we went to visit the other schools, which I haven't been able to do with any of the other programs. Visually seeing me there in those spaces was eye-opening. Then, the Latinx program was, again, very supportive. They had their own tutoring that you could attend. I went there once or twice just to introduce myself and network with the people there and be like, "Hi, my name is so and so," and see the place.

Creating community with each other through agency provided emotional and academic support and motivated students to navigate the challenges of rigorous courses. Additionally, students enrolled in STEM programs to further meet their academic and community needs.

STEM Programs

The students in this study created informal community spaces, but going further, all participated in a STEM program, club, or both at their community college. Some students were more involved than others, but they attributed some of their success to the connection and community they built in the STEM programs. Imani described her experience with the Women in STEM club as an empowering one that kept her motivated:

> I actually joined the women in STEM club at my community college. . . . It wasn't like a resource that I needed, like, "Oh, I need study help." But it was nice to be around other women. The majority of them were women of color in that club. Like . . . the president. . . . It was cool to be around them. . . . There were a lot of math majors in there, which was really cool just to be around that. That, to me, as a resource, was just like something to do. We were always talking about math, and we're always doing STEM

> stuff, but it was cool to be around other women and be like, . . . cool, there are other people here at this school that are . . . doing this. . . . They're there for you. I really wanted to have an upward trend in my career after having a not-so-great trend, and I was determined to go . . . to transfer out of CC… [and] there were a lot of people talking about [transferring] in the women in STEM club, [and they] would say, "if I was struggling, this is what I did." . . . I was like, I got to do what they're doing. Even if I don't want to, I've got to go do what they're doing.

After experiencing a period of little to no support from his secondary school, Esteban was eager and excited to have support in college. He was in a STEM program and was extremely grateful to have received the support he did from the program and his college.

> For STEM, I was really hoping to have support, which I did. I didn't have any specific things that I wanted to get out of it; I never thought that going to my community college . . . That's why . . . I'm so biased. But if I meet anyone, I'm always going to tell them, go to my community college, we're better. Just because my community college prepped me and it transformed my life in so many different ways, specifically like STEM, accessing resources, becoming a better… Developing myself not only as a student but personally and professionally. It was the right choice. If I had to make it again, I would definitely do it all over again.

Katherine was in a robust STEM program at her community college. For her, it provided a community and access to resources:

> The big one was joining the STEM program. That was a really big one because I found a community there of students on the same path that I was. And so, they were like, Hey, do

> you need a PDF version of this textbook? You don't have to buy it, right? It starts there, and you're like, . . . nice . . . one with expense.

When discussing imposter syndrome and being a woman of color in STEM, in addition to time and experience, Katherine credited the STEM program with helping her heal.

> In terms of that imposter syndrome of being a woman in a math class or in a STEM field, that one's still a little bit tough, but I feel like that one has just come with age where it's like I have like an . . . I don't care to take up space, not an I don't care if I get a bad grade, that's not the I don't care. But I don't care if I take up space attitude. So, now that confidence just has to build up with time, unfortunately. And so, now, it's still hard sometimes because I'll still doubt myself. So, if I was in that same scenario and I saw an error, I would still doubt myself that I see an error somewhere and could call it out. And even when I'm stuck on a problem, I still feel bad being stuck somewhere in a math class because I feel like when I'm the only woman in that class, it feels like, man, I'm the only woman, and I'm the only one struggling here. It still feels bad, but it just . . . Yeah, it's just come with time, that one. Yeah. Then, in our STEM program, we have a lot of women on the team and faculty and staff. It always gets a lot more comforting going there and getting support. That's always been good to see a lot of women there visually represented. I guess that representation helps.

In addition to helping her through tough content in math, the STEM program helped Katherine gain confidence, take on more responsibility, and engage on campus:

> The STEM program itself being not just a participant, but being actively a member of tutoring and mentoring, and then eventually taking on more responsibilities within the

> STEM program, gave me the confidence to network and talk to people. So, by my last year and a half, I definitely was a lot more confident in talking to people and meeting people, and meeting people from other departments. That helped a lot because I felt comfortable going to look for those resources. . . . I had the counselors, I had student clubs, the academic programs. I think . . . it was really good. I ended up building a good support system in my last couple of years. . . . That feeling that I initially had coming into college, that lonely feeling that I described helped with that. It helped with building a network, building a support system, building confidence to talk to people. Now, I was actually actively seeking help when I was stuck, so I had a positive experience not just in my math courses and my other courses as well, but I guess particularly in math, especially when it got harder. Especially with the higher-level math courses.

Furthermore, the STEM program helped her build community on and off campus by encouraging her to apply to an internship in STEM:

> I applied to . . . a scholarship through an organization. And I got the scholarship, and the scholarship came with attendance to a conference. This was during the pandemic, so the conference was virtual. There were recruiters there for the internships and jobs and stuff at that conference. There was a recruiter for this internship program, and I interviewed with them. I have been doing a summer internship with that company now for two summers, and they offered me to come back next summer as well and then once you graduate, they have a full-time program.

Maribel built a community in the STEM program and was tutored by other students who had gone through similar experiences. Seeing other students achieve their goals motivated her to continue to pursue her own goals.

> The STEM program. I learned about that entering my community college, but I applied too late to join, so I wasn't able to get into the STEM program. But, I still heard about their tutoring resources. So, I went to that really often, actually, and it was really helpful. But as for how comfortable I felt, I think I started feeling more comfortable once I realized how other people had already seen these things, and I just wanted to understand as much as they understood. So I felt quite comfortable, especially going to STEM tutoring since they were students themselves, so they understand how difficult it can be.

Additionally, Maribel described her relationship with and connection to her STEM counselor and said she was grateful for her guidance. In fact, Maribel felt the most supported by her STEM counselor when struggling with her sense of belonging.

> I had one go-to counselor throughout my whole time at my community college, and I would say she was really helpful. The first time I went to her counseling appointment, I knew that she was the right counselor that I would want to go to again and again because she was a realistic counselor who helped me organize my things, and I felt comfortable talking to her. . . . She was realistic and told me as a STEM major, people usually do, like, 3 years. And I organized my classes and saw that, yeah, 3 years would probably be best for me. And, yeah, I did 3 years.

> Just being in the STEM program and feeling like I do have someplace where I belong. Talking to the [STEM] counselors as well, I would say I formed a great counselor relationship with my counselor where she helped me feel like I was a part of my community college and I was a part of my major.

In his last year, Rico joined the STEM program and found a community. He saw that other people around him were comfortable asking for help, and seeking help was a positive trait:

> And I'm like, you know what? I've met many smart people who also needed help, you know what I mean? I'm not the only one. There are definitely very talented people with great skill who also search for help, and they're not ashamed of doing it. And so, it's okay for me to do it as well. I guess that's why when I heard about the STEM program, I'm all like, Wow, a space primarily for STEM students. Also, to me, it was like, Okay, another opportunity to find somewhere to belong and find a community.

> What I loved about the STEM program is the space to think and to dedicate myself to my coursework and classes. . . . Having that space, that quiet space to be able to concentrate and think and just be able to just be there without any interruptions, was really helpful. Also, some of my peers were also part of the STEM program, and so I could also talk to them about any problems I'd be having with any of the assignments, and we could work together to arrive at a solution. Not to mention, Discord is also a pretty good tool. . . . Just that communication, being able to communicate with everyone else and get your problems out there, get feedback, and then everyone works as a community to figure it out because everyone is struggling. I wish I could have done more in the STEM program.

Students identified two main contributors to success. The first was a dynamic teaching ecosystem that included culturally responsive teachers, SI, and tutoring. This ecosystem featured supportive and relatable instructors with whom students could build meaningful connections, thereby enhancing their sense of belonging. These instructors implemented pedagogical methods that accommodated diverse learning styles and needs alongside in-class SI support to further reinforce math concepts. The data also indicated that a sense of community, whether initiated by students or formal STEM spaces provided by the college, was crucial for student success. This theme highlights the role of social support networks and inclusive spaces in fostering a sense of belonging and validating diverse lived experiences among Black and Latinx STEM students.

Supplemental Narratives: Faculty Perspectives

Faculty narratives offered a multidimensional view of the educational landscape. Faculty members, given their roles and experiences, can provide insights into the systemic and institutional dynamics that influence student experiences. Their perspectives can uncover the complexities of teaching practices, institutional policies, and classroom environments that may not be fully apparent from student narratives alone. Two community college faculty members were interviewed for this study. Both the STEM counselor (Alejandro) and the math instructional faculty member (Jada) were interviewed. The faculty spoke about the barriers and contributors to success in transfer-level math courses for STEM Black and Latinx working-class students. When asked to describe what they felt were the barriers to success in transfer-level math, they both emphasized the lack of equity-minded practices in teaching faculty. For example, Alejandro and Jada discussed the pride some math faculty embody when they have low pass rates. Alejandro described the impact teacher dispositions can have on student grades:

> So, number one, teachers, we have teachers at my community college that are just terrible. If you look at [their final grades], it is consistently no As, no Bs, no Cs, and two-thirds of the class drop. No matter what you do, if [a student] takes a class with one of those individuals, it's not going to work.

Jada also spoke to the prevalence of low pass rates in math courses and teacher resolve.

> You'll have some colleagues who, if 10% of their class passed it, that was a success because "I'm a rigorous professor, and only those who really worked hard passed it." Whereas if only 10% of my class was passing, that would hurt my feelings. Right? Because I'm like, there's 90% who I wasn't able to help learn this material and pass over. And so, we still even go back and forth because some professors will say they didn't pass, but they learned. And so, the next time they try it again, they have a better chance of passing.

Additionally, Alejandro spoke about the classroom environment created by faculty and what he called a 'strict socializing experience':

> I think that a lot of faculty come to community college, especially your science and math faculty, and undergo a really strict socializing experience called getting a Ph.D. in science and math, which is very exclusionary. Right? Jump through these hoops and you're going to be part of this elite group of having a Ph.D. in math or having a Ph.D. in physics. And that mindset when they come here isn't, again, I don't want to generalize for everybody, but kind of. . . . They come here, and they still have that mentality, and it takes a while, and some of them, it never clicks, but they come here, and they kind of say, this is how it was for me, and this is how it's going to be for you. So we teach things sometimes, like

> our anatomy classes, right? Forget dumbing them down; they're teaching them like if these kids are in medical school, right?

Jada also spoke to the classroom environment and discussed the importance of culturally responsive teaching pedagogy:

> I would say the environments of COVID definitely impacted the working-class Black and Latinx students, and it's just the way that we sometimes teach. So, I've been studying culturally responsive pedagogy in the math classroom that's a bit more responsive to students of color in terms of how they learn. I mean, sometimes we learn in community. Sometimes, we learn by doing practice problems right on the spot. Sometimes, we learn by talking to each other. And sometimes, that behavior is considered to be disruptive in your traditional classroom. And so, I think better training the faculty to understand these different types of study or learning avenues for working-class Black and brown students can make that classroom more student-centered, if you will. And it does slow us down. I've been trying these techniques. It does slow me down at the beginning of the semester, but once I get into a groove, I'm able to pick up the pace toward the end of the semester to make sure all the material is covered. For teaching math, we need every minute, every second that that class is designed for. So, we think anyway. And so, to ask us to try something different or to try this new approach when we haven't done it before, we are concerned about how this will impact our timing in the classroom and if we're able to cover the material. But I've been learning through the years to take the mathematician out of myself and just really focus on how I can create an environment that is really

empowering for students. Because once you have that environment, your pace can be picked up. But I learn something new every semester, so it's an evolution, if you will.

Alejandro considered the traits he sees in faculty who have higher pass rates and faculty who embody culturally responsive teaching, as well as the importance of learning in community:

> So, if they happen to take it with one of the individuals that has a more normal grade distribution, [they might succeed]. Then again, that faculty member is, I think, understanding how to teach math to students who may have other challenges in their lives, not dumbing down the curriculum but just using some level of flexibility and scaffolding. And in accommodations, not just accommodations for students with learning differences, but for everybody, right, as best as you can.
>
> When they take a five-unit calculus [course, students] don't want to do it alone. They don't want to just lock themselves up in their bedroom or the library and do this alone. That success in math is communal. It's based on study groups, visiting office hours, attending supplemental instruction, and all of that. If you get stuck, and everybody gets stuck, nobody has picked up a math calculus chapter, read through it, and said I have no questions, right? You get stuck. That's what's going to happen. And if you get stuck and there's nobody to help, it's going to take you so much longer to get unstuck, and you don't have that time. Right. I can try to figure out this problem in 4 hours on my own, or if I go see my teacher or if I go to a tutor, maybe I can get unstuck in an hour or an hour and a half. I've now freed up two to 3 hours to study some more. So it's just not efficient if I go at it alone.

Like the students, Jada and Alejandro unanimously declared that CCCs have created great support programs for students that provide content support and community building. Alejandro explains the details of an effective STEM program:

> A good STEM program…helps them normalize this idea that you go to tutoring, that you go to SI, that you go to study groups. They see other people like them in something like a STEM lab, being tutored, doing tutoring, creating unofficial situations where they get to geek out about science and the intersection between artificial intelligence and physics and the latest game that's out there. Right. So it's a community, but it's also a community that's teaching them that it's okay to get tutoring and ask questions. And the other part of a STEM program is that it teaches them that you don't want to just be a transcript when you transfer or even later on when you graduate. You don't want to be a diploma and a transcript. You have to begin to make inroads into things like undergraduate research and internships and activities. And so, for our program, we're not the only program, but we have this whole component where there's counseling [STEM career classes], and it's just part of our culture that we're always talking to them about… all these internship opportunities. And that, yes, it's really scary, but don't worry about it. Apply, see what happens, and we'll help you along the way. So, again, there's a professional development component to it that I think is really important. So. I think it's getting them to engage with the academic support, the professional development, and providing a modeling community that lets them know that this is how you do it.

Jada details the impact support programs can have on students:

> I think my community college does a great job with our STEM program, with our SI program, with our tutoring programs, as well as with our special population programs. . . . So, I think having those types of resources for Black and brown students that are specific and intentional, that could actually increase their success and aspirations and staying in the STEM field. And within these programs, they are encountered with people that look like them. They're encountered with role models. I know the STEM program will have former students come back who have gone through this and now are in their careers. And those kind of things are very motivational. I'm a product of programs like that, and that's what helped me to stay on track as well.

In line with student narratives, the faculty members reported culturally responsive teaching and the importance of the overall comprehensive teaching ecosystem, which includes SI and STEM support programs for working-class Black and Latinx student success in transfer-level math courses and STEM pathways.

Summary of California Community College Findings

In this section, Black and Latinx students shared their experiences in math throughout their community college journey. The student narratives exposed the distinct challenges in navigating the homogenous and exclusionary environments of math and STEM pathways in community colleges. The onset of the pandemic and abrupt move into online learning left students feeling disconnected from their math courses, content, and STEM communities in college and further deepened feelings of isolation and marginalization. Moreover, the challenges and barriers reported by students were deeply tied to their identities. Their struggle to find

belonging and identity validation was compounded by their intersecting identities of race, gender, and socioeconomic background in spaces not traditionally designed to include them.

To combat these challenges, students discussed two main contributors to their success in transfer-level math courses. First was a dynamic teaching ecosystem that consisted of culturally responsive teachers, SI, and tutoring support. In this ecosystem, students reported forming meaningful connections with their teachers, which extended beyond academic guidance to include personal support and understanding of students' life circumstances, such as childcare needs. These connections facilitated a deeper engagement with the subject matter and fostered a sense of belonging, crucial for navigating the challenges of higher education. Additionally, pedagogical methods that accommodated diverse learning styles and needs were also highlighted as instrumental to student success. Innovative grading policies, outcomes-based learning, and the incorporation of group work and hands-on activities helped students grasp complex concepts more effectively. Moreover, access to tutoring and SI reinforced learning and providing additional support outside of regular class hours. Secondly, students reported community formation as a main contributor to their success in transfer-level math. Community formation was demonstrated both through student agency and formal support, such as STEM programs that offered mentorship and exposure to the STEM field and built community among students, helping to mitigate feelings of isolation and imposter syndrome. Overall, the findings underscore the importance of social support networks and inclusive spaces in fostering a sense of belonging and validating diverse lived experiences among Black and Latinx STEM students.

CHAPTER 6

DISCUSSION AND IMPLICATIONS

The counter-stories presented in this study offered the perspectives and experiences of Black and Latinx STEM transfer students. The counter-narratives allowed for a deeper dive into the participants' lived experiences by focusing on their understandings and lived experiences regarding the STEM pipeline that may not be adequately captured or represented in mainstream discourse. The counter-narratives reveal systemic flaws in the education system, from secondary education through community college. Their stories identified systemic barriers primarily in secondary education that hinder the recognition and development of working-class Black and Latinx students' potential. Concurrently, these stories shine a light on the pivotal aspects at community colleges that contribute to their success, including supportive academic environments, culturally responsive teaching, and inclusive communities, thereby highlighting the barriers and challenges that arise when such aspects are absent in transfer-level math and the STEM pipeline.

The findings revealed structural racioeconomic barriers that create obstacles for Black and Latinx working-class students in STEM pathways. The study points to systemic failures to address these barriers effectively, from the persistent tracking practices in secondary education to the racism that is veiled as imposter syndrome in community colleges. In secondary school, students were deliberately excluded from accessing higher levels of math and STEM pathways. This exclusion of resources contributed to the maintenance of the status quo and institutional racism. While all the students in the study expressed an interest and aptitude for math, most of them were tracked out of STEM fields or prohibited from entering higher levels of math. When

students were tracked for STEM fields, they reported being one of a few students of color in their math courses or did not all receive a similar or robust experience. The tracking mechanisms in secondary schools undermine working-class students of color and their abilities in STEM fields and suggest that despite individual excellence, race and class continue to matter.

In addition to the findings presented in this study, previous research supports the analysis that working-class Black and Latinx students face systemic barriers in STEM education rooted in practices like tracking, resource allocation, and the lack of supportive educational environments. There is empirical evidence to support findings about the negative impacts of tracking systems in schools, which exacerbate racial and socioeconomic disparities and contribute to the educational segregation that limits access to quality STEM education for Black and Latinx students (Education Trust, 2023; Gentry et al., 2021; Rogers & Oakes, 2005). For instance, research on tracking and STEM course offerings in working-class schools has documented a disparity in the number of AP or higher-level science courses and STEM-related activities that are offered and taken by working-class minoritized students compared to White students (Anfuso et al., 2022; Crisp & Nora, 2012; Young, 2005). Just like the students in this study, despite their potential and abilities, Black and Latinx working-class students continue to be excluded from taking advanced and STEM-related courses due to tracking and ability grouping (Education Trust, 2023; Rogers & Oakes, 2005). The issue of tracking in schools, where some students are guided into advanced courses while others are excluded, reflects a selective distribution of opportunities (Education Trust, 2023; Rogers & Oakes, 2005). As a result, capable Black and Latinx students might find themselves in educational pathways that do not align with their capabilities or aspirations and are underprepared for college-level mathematics.

As the student participants transitioned to college, structural racism and classism continued to create barriers to success in transfer-level math courses in community colleges. The students in this study reported several instances in which they felt a lack of sense of belonging and characteristics of imposter syndrome when taking online courses. However, their skillsets and aptitude for math did not align with their psychosocial experiences. The literature suggested that although students have demonstrated strong mathematical abilities, structural racism can lead them to an identification of imposter syndrome, where they experience negative mental health effects and constantly feel like they have to prove themselves, which contributes to and exacerbates barriers (McGee, 2020; McGee et al., 2022; Versey et al., 2019).

For example, despite receiving all As in his math courses, Esteban, a first-generation student, discussed at length feelings of self-doubt and characteristics of imposter syndrome because, as he said, he "did not have a technical background" and did not know where or how to access resources on campus despite consistently demonstrating agency during his time in community college. Therefore, the feeling that he did not belong was not self-induced but created by institutional racism and the lack of a culturally responsive campus, particularly when taking courses online. His secondary school failed to provide a technical background, and his college failed to provide the information on resources in a culturally responsive manner. For Esteban, the lack of preparation provided in secondary school planted the seed for symptoms of imposter syndrome, and his online classroom experiences only fueled those symptoms. The solutions to address imposter syndrome often focus on fixing the student without directing the responsibility to the institution. Prior research suggests that structural racism is veiled as

imposter syndrome for Black and Latinx working-class students (McGee, 2020; McGee et al., 2022). This is particularly evident for women of color in STEM.

In addition to class, gendered racism continues to play a role in the experiences of students of color in education and the STEM pipeline. All the women in the study referenced additional stressors produced and often unaddressed by the institution due to their gender and intersecting identities. These gendered and racialized experiences contributed to a lack of sense of belonging and an identification with imposter syndrome. For example, despite Imani's good grades, she felt like an imposter because she was an older student with a child. Additionally, Katherine and Maribel spoke directly about the weight and pressure they felt being a woman of color in high-level math courses, and Katherine pointed directly to microaggressions she experienced in her math course. Consistent with this study, previous literature states that White men have the highest sense of belonging in STEM, and women of color have reported the lowest sense of belonging in STEM courses and careers (Rainey et al., 2018). Additionally, having a lower sense of belonging has often been attributed to imposter syndrome or imposter phenomena. Imposter syndrome is tied to negative mental health outcomes, which can create barriers to success in education (Clance & Imes, 1978; McGee et al., 2022; Rainey et al., 2018).

The counter-narratives presented in this study suggest that imposter syndrome, in this context, is not merely a result of individual psychological struggles but is rooted in the structural inequalities embedded in the educational system. When women of color are tracked out of STEM fields, the few that remain are singled out and made to feel as if they do not belong and have more to prove. By focusing on imposter syndrome without addressing the underlying systemic racism, there is a risk of misdiagnosing the problem, thereby failing to confront the

institutional barriers that perpetuate these feelings of self-doubt. Furthermore, research on intersectionality establishes that People of Color are multi-faceted and, therefore, affected by social structures on more than one level (Carbado et al., 2013; Solórzano et al., 2000; Yosso et al., 2022). For the women in this study, the barriers they experienced as students of color were compounded by gender and further intersecting identities. In fact, all of the students in the study expressed feelings of marginalization stemming from their intersecting identities. The Black and Latinx student narratives reveal the institution as the primary issue and cause of imposter syndrome and not one of their own making, thereby pointing to a persistent issue of institutional gendered racism, classism, and White supremacy in the educational system.

Although the students' narratives revealed persistent institutional barriers grounded in racism and classism, in their lived experiences, it was the instances of community and belonging at the community college that allowed them to actualize their potential. Consequently, the study revealed that fostering community and belonging in education increases students' success. The formation of community and belonging both through student-initiated efforts and formal spaces provided by the college, such as STEM programs and clubs, proved to be essential. When students felt the institution was not providing the community they needed to thrive, they created it for themselves. The students in the study demonstrated great agency by filling in the equity gaps that persisted in their spaces. For example, all discussed creating informal connections with their classmates or faculty outside of class. These connections took the form of study groups, Discord and Slack group messaging, and student-initiated STEM clubs.

Going further, three of the participants worked on campus as student tutors or ambassadors in their respective centers. Maribel's formation of study groups played a pivotal

role in her academic improvement, showcasing how peer-to-peer support can transform academic outcomes. When students struggled to get what they needed from their institutions, they created what they needed- connection and academic support for themselves and others like them. Thereby resisting marginalization, taking up space, and becoming trailblazers in STEM. These actions demonstrate how students can be instrumental in creating their own support networks to fully address their needs for connection and collaboration. Additionally, the formal spaces created by the college validated students' lived experiences and created support networks that counter feelings of isolation and marginalization in an often competitive and exclusionary environment. Every student in the study participated in a formal STEM program or club and discussed at length the positive impact these programs had on their trajectories. Several discussed the connections they made with other STEM students, counselors, tutors, and spaces in the STEM program. Rico shared the comfort he felt having a physical space to study in and being surrounded by other STEM students. Katherine and Imani talked about the representation of women in the programs and how that representation helped them overcome feelings of imposter syndrome in STEM.

Previous literature on socio-emotional elements of student success in STEM stated that a sense of belonging and self-efficacy can contribute to success in math for students of color. Additionally, the experience of racial and cultural isolation in predominantly White academic settings can lead to feelings of self-doubt, anxiety, and disengagement (Anfuso et al., 2022b; Boettcher et al., 2022; Ingram, 2018). In line with the literature, the narratives in this study indicated the value of formal spaces that contribute to community and belonging. Institutions cannot place the onus of responsibility on the student and solely rely on student agency to close

equity gaps in math and STEM pathways, so campus-initiated spaces that foster belonging and community building are key to student success. Failing to offer open access to such programs will only further perpetuate barriers.

Finally, in addition to formal and student-initiated community formation, the study points to the importance of culturally responsive teaching practices that recognize and value students' diverse backgrounds and needs. Culturally responsive teaching enhances students' academic understanding and contributes to their sense of belonging and sense of community. When examining the barriers presented in the study, the COVID-19 pandemic revealed not isolated incidents but reflections of deep-rooted systemic failures that disproportionately impact students at the intersection of racial, gendered, and economic marginalization. The shift to online learning, while a logistical response to the pandemic, inadvertently magnified these disparities, revealing a lack of institutional adaptability and sensitivity to the nuanced needs of these student groups. As a result, students reported ineffective teaching practices during the transition to online learning.

However, the students in the study described instructor interactions that demonstrated culturally responsive teaching practices and contributed to their success. Imani, who was a new mother and a student with a learning difference, described several math instructors who met her needs. She described a math instructor who allowed her to bring her newborn son into the classroom so she would not miss vital material. She also described math teachers who created group work and encouraged group collaboration in the classroom. Most notable was the instructor, who utilized outcomes-based grading, which really allowed her to thrive despite struggling with homework due to her ADHD. Maribel spoke about a math instructor who would

join her study group outside of class hours and another who hosted separate study sessions for students.

These practices facilitate a community environment where students feel welcomed and encouraged to thrive. This is especially true in an environment that is traditionally competitive and individualistic and fosters feelings of isolation. Innovative teaching and pedagogy, especially those that are culturally responsive and tailored to meet the diverse needs of students, emerged as key components in dismantling systemic inequities. The interplay of race and economic factors that shape these students' educational pathways underscores the importance of teachers who are aware of these intersecting issues and also equipped to address them through inclusive and responsive pedagogical strategies. Educators who employ these methods go beyond traditional teaching techniques, creating learning environments that are both equitable and empowering for Black and Latinx working-class students. Such environments facilitate academic success and enhance students' sense of belonging and identity within the STEM field (Ladson-Billings, 1995; Johnson & Elliott, 2020; Rainey et al., 2018). Ultimately, creating educational environments where students feel seen, understood, and supported by their instructors can greatly contribute to successful transfer rates into STEM degrees.

Furthermore, the study suggests that the teaching ecosystem, which encompasses strong instructor-student relationships, innovative pedagogical methods, and an extended network of SI coaches coupled with robust campus support programs that foster a sense of belonging, were the equalizers for working-class Black and Latinx students. This ecosystem encompasses more than the direct transmission of knowledge; it is a dynamic, multi-faceted engagement that fundamentally shapes students' academic and personal development. When students were

entrenched in the culturally responsive teaching ecosystem, they thrived the most. The role of educators, pedagogy, and targeted tutoring needs to be both effective and transformative to overcome the barriers that math poses as a racialized and intersectional gatekeeper in STEM education.

While students praised the instances in which they received support in community college and the recent policy, AB 705 (2017), created access to transfer-level math courses, the data suggests that institutions are not adequately and consistently addressing the intersectional oppression students face in the classroom, thus contributing to the persisting equity gap in the success of transfer-level math courses. While success rates have increased, equity gaps persist (Park & Ngo, 2021; Sims, 2020; Trinidad, 2022). Considering that secondary schools failed to meet the study participants' potential, the inconsistency of guidance and culturally responsive teaching in math in community colleges leaves many Black and Latinx working-class students falling through the cracks and contributes to institutional racism and classism in transfer-level math.

Additionally, new reports on *California Assembly Bill* 1705 (AB 1705; California Assembly Bill 1705 [AB 1705], 2022) AB 1705 stated that students who entered directly into calculus had a higher throughput rate than those who entered calculus prerequisites, such as trigonometry and pre-calculus (RP Group, 2024). The study aligns with the counter-narratives presented in this study; students can succeed when given the proper support—anti-racist and culturally responsive support. The combination of consistent culturally responsive teaching, tutoring, SI, and STEM programs—the teaching ecosystem—paired with an understanding of the intersecting systemic barriers and ways in which the institution perpetuates oppression can be the

equalizer and close equity gaps for Black and Latinx working-class STEM students in community colleges.

Recommendations and Conclusion

The purpose of this study was to examine how working-class Black and Latinx STEM students interpret and derive meaning from their mathematics trajectories, as well as the strategies they develop to navigate transfer-level mathematics environments in post-AB 705 (2017) contexts. Utilizing CRT as a framework, the research documented students' counter-narratives with the aim of enhancing transfer rates and STEM transfer readiness for students of color in STEM fields. Also, in analyzing Black and Latinx student counter-narratives, the study establishes connections between the policy and existing research on STEM momentum and transfer success through the student's lived experiences. Ultimately, the research sought to identify potential leading indicators of transfer readiness, offering insights into the efficacy and limitations of policy interventions designed to promote upward STEM transfer for students of color. As such, the study argues for a comprehensive policy approach that addresses multiple facets of the educational experience for working-class Black and Latinx students (i.e., supportive academic environments, culturally responsive teaching, and the establishment of inclusive communities).

Recommendations

In this section, recommendations begin with the student participants' narratives, foregrounding the significance of their educational journeys, the essential role of building connections, and the empowerment found in owning their narratives. These student perspectives lead into strategic recommendations, where calls for humility and active listening from

institutional leaders lay the groundwork for a set of strategic recommendations in practice, policy, and research. To honor their voices, the recommendations begin with their responses.

Student Recommendations

"You've Made the Right Choice"

Despite the challenges and barriers students experienced in community college, all the participants unanimously celebrated their decision to attend a community college. Many of them attributed their success and growth to their community college experiences. Katherine spoke about the confidence she gained to continue her STEM pathway as a woman of color:

> It's influenced me to take up space as a woman, as a woman of color, and as a non-documented person. Being in those math classes and being one out of eight, one out of six, one out of whatever amount of students being the only woman, whatever. It motivates me to keep pursuing STEM because the exposure was so important to me that I want to [be] that exposure for other people. And I want to be in those places, those career spaces. . . . I know it'll be tough, and it'll be, like, an uphill battle. But the experiences I had in math just feel more like, I don't know, . . . motivating.

Additionally, Katherine felt that the community college system prepared her both academically and mentally for the future:

> At first, I was sad that I wasn't going straight from high school to a 4-year university. But I love that I was able to go the community college route and be able to take all these classes, including math, because . . . I do think I'm mentally prepared for what the classes will be like in the future . . . Yeah, I do think it prepared me.

Similar to Katherine, when reflecting on his experience and thinking of future students, Rico felt the community college system provided him with a quality education, and community college was the "right choice:"

> You've made the right choice is the very first thing I say. You've made a good choice, even if it's not 4-year. …To tell you the truth, you're in good hands. Because I think community college is slept on. You think you're not getting the same quality of education at a 4-year? Man, I think, at times, you'd probably find better quality education there because there are some professors that really want you to be prepared for that next step, which would be transferring. If you're thinking of transferring, they really want you to be proficient out there and to know what you're doing. Definitely, you're in the right hands.

Esteban felt that the community college encouraged him to persist and pursue his dreams:

> My community college shaped me to be really strong and also to [have a] . . . "I-don't-give-a-fuck mindset." I'm just going to go for it. That's how it was the whole time going through my education at my community college, specifically in STEM. It was . . . continue to push myself. That's something that I'm taking with me everywhere and every day.

In addition to preparing her academically, Maribel felt that her culturally responsive community college professors provided motivation:

> Well, going into community college, I think it just helped me better myself in my studies and stuff like that. Especially my math classes with the professors that I got. [They] made me see how important math is and value what I was learning. Even though it was difficult, mostly all the time, I think I had some good professors who would talk about

> their experience when they were in college and how it's okay to fail because that's how you learn and stuff like that. So, just having them talk about things that they've gone through and sometimes they'd say motivational things, and it was touching, honestly. I didn't think that a community college could have professors who actually cared as much as they showed that they did. It was motivating to hear all that from professors at a community college, especially since everyone in my classes [was a STEM major].
>
> But having gone to a community college, I feel way more prepared than I did having exited high school. Now that I know my study habits and what helps me and what doesn't.

Lastly, Imani felt the community college helped her build confidence in her skills and abilities:

> I definitely think they've made me feel more confident in taking my other courses and feel like I can continue to take other classes at the UC that are math-related…I could definitely take an additional math course, and I would feel more confident, even if there's less support from professors, [and] being a bigger class size.

Overall, the students in this study were proud of their community college experiences and attributed some of their resilience and growth to their experiences in STEM classes. Although their journey was not easy, ultimately, students felt the community college system prepared them academically and mentally to enter 4-year universities. The following section highlights recommendations to students from students.

"I Didn't Let Something Like That Affect My Decision"

Students provided advice to future Black and Latinx STEM students in community college. Participants stressed the importance of creating connection and owning their stories.

Katherine spoke about the value of networking with peers and owning that their student experiences will be different:

> I would say to probably network with students because maybe your experiences as a Black and Latinx student is going to be different from a student who comes from a background who had more opportunities. . . . Definitely networking because they might have the same struggles as you, and they might have some solutions or something that they can guide you in.

Imani advised students to find their community on campus even if when they struggle to find people who look like them. A community can be made up of other students and/or professors:

> I would say find your community and use your resources for sure. I would say that specifically because there aren't that many of us. I grew up in, like I said, in my high school years, where I'd look around and like, "Oh, I'm the only Black girl in this class." That happens so often that it's like my norm. You have to be comfortable to find community outside of those who look like you but people who make you feel like they know you. Even in my last Calc 2 class, there were a lot of Black men in my class. There were no other Black women in my class. There were a lot of Latinos and Latinas, but again, no Black [women]. It was like, all right, well, at least there's more people of color, but I'm still the only one, the only Black girl in here. That's fine with me because, at the end of the day, I became really great friends with that [17-year-old] girl. . . . It was like, okay, cool, we are women that are doing this thing. . . . Different ages, different lifestyles, but we're people that are going to make it work. Finding that community is essential, even if it's not people in your class, people that are in the library, people that are your

> professors, and then definitely be willing to talk to anybody that you feel could help you if they knew your story. If I hadn't made the decision to tell my professors as much as I did about my life, if I had just been like, I'm struggling on my homework, they would have been like, "Okay, go to the tutoring center. Okay, I got office hours for this." But to be like, "I'm not just struggling, but just I'm a new mom. This is what's going on. I could really benefit from you if I could bring my baby into this setting session." If they didn't know those things about me, then they wouldn't be able to offer me help.

Maribel disclosed her feelings of intimidation and advised Black and Latinx students to look beyond that intimidation:

> I would say don't be intimidated. I think everyone has a lot of potential. Even though there are people who come from different backgrounds and look different from you or started from a different place, you can still get where you want to go if you really believe that you want to be there. . . . I think I still might be a bit intimidated since I know my transfer university has primarily White students. But I still chose to go to that school since that's somewhere I wanted to go and I didn't let something like that affect my decision to go there.

Rico advised students to be patient with themselves and stay the course:

> I'd also say don't really worry too much about how long you're going to spend there. Take your time. Don't rush things because rushing things can lead to careless errors. So, definitely take your time. Be patient. What's that saying? …Everything comes in good time. Don't be too hasty. And there have been people there, too, who have been in community college for quite a long time. I think I met someone who's been there for

more than I was there. So that also shows you can find some really motivated people there.

Esteban asked students not to be afraid to connect and continue:

> Connect. Don't be afraid to ask questions. Don't be afraid to make mistakes. If anything, you're going to learn a lot more from your mistakes than you will learn from getting things right. And you got this. We're rooting for everyone out there, and especially myself. . . . Just put yourself out there. It might be scary. You might feel lonely, but whatever it is that you decide to do, love yourself, appreciate every single step of the journey.

The students shared deeply moving advice to future Black and Latinx students based on their lived experiences. Overall, all the students in this study recognize the potential Black and Latinx students bring with them and advise students to make connections and build a community to help them fulfill that potential and push through the intimidation. The students in this study are "rooting for everyone out there."

Recommendations for Institutional Practice

"Be Humble. . . . Listen to Your Students' Concerns"

The students in this study provided advice to CCC leaders who are interested in supporting students who are pursuing a STEM major. The term "leaders" encompasses all who work in and for the community college system. Esteban suggested that leaders humble themselves and meet students halfway:

> Be humble. Yeah, be humble. Don't take everyone's feedback, but also hear the students' needs. If you're like a coordinator for a specific program, don't just listen to what the

> authorities, like professors or staff, are telling you. Listen to the student's needs. Study your demographic, study the people that are coming to your school and see where their needs are, and meet them halfway. There's going to be a lot of people that are probably shy to even consider going to STEM because like myself, we probably don't come from a privileged background where we had access to touring services or any advanced courses. So, try to mediate or find a way to meet your students halfway. You're going to see that if you ever go out of your way and just make time to listen to your students' concerns, you're going to build a bridge that is going to be able to connect.

Similarly, Imani asked leaders to keep their doors open and become someone anyone can ask for help:

> Keep your doors and your emails open. [Leaders] have to be willing to talk to you. So [leaders] have to have an open attitude [so students have the] feeling and trust that you know that they're there for you. I think that's what really has stuck in my mind, especially my math professors since we've been talking about those a lot, but also my chemistry professor that I absolutely adore. Even to this day, she was like I'll write you a letter of rec for anything. It's just a great feeling. But then my bio professor, I'm like, Do you hate me? . . . Having that approachableness, that feeling of someone can ask you anything.

Going further, Rico asked leaders to actively pursue students to encourage them to take advantage of resources:

> Definitely convince [students] in some way to search out resources because definitely, for sure, it ain't easy. Even if [students] say they're okay, they're going through something. I

> just already know it. Definitely, don't be afraid to make use of those resources. And somehow, I don't know, I guess somehow bring it to [the students] instead of them going to get [the resources]. Because if you leave them to their own devices, most of the time, they're not really going to do it, especially if they're commuting. They're like, Well, I got to be home now, so I'm just going to leave. Yeah.

Katherine and Maribel both suggested CCC leaders be realistic with students in a caring manner. Katherine asks leaders not to romanticize the STEM experience and go beyond generalized advice:

> Being realistic about the challenges, so not just romanticizing it, just saying, 'Well, this is going to be a great experience, and you're going to make lots of friends.' There are so many opportunities. But being realistic about what it takes to take advantage of those opportunities. So, you have to tell them, 'Hey, you have deadlines, make sure you're applying.' And not just saying the general . . . like go see the counselors or something like that, but the specifics of what it takes to succeed in STEM.

Maribel asks leaders to be realistic and provide options for support:

> I would say to be realistic with someone's goals. Not to crush people's dreams, just to tell them what they're going in for because it's not an easy thing. But also giving them support and telling them about programs and stuff like that, because that's something that really helped me, especially the STEM program for someone who wants to pursue something in the STEM field.

The students in this study provided specific advice and examples for community college leaders. Among the advice was to listen to students' needs and meet them halfway, have an

open-door policy, and be realistic about how difficult STEM can be. However, they also advised leaders to provide support and take the resources to the students. Essentially, students advised community college leaders to embrace and embody anti-racist and culturally responsive practices when working with Black and Latinx STEM students.

Additional Recommendations

While legislative measures like AB 705 (2017) have made strides toward increasing access to advanced mathematics courses, the counter-narratives surfaced the prevalence of institutional and intersectional oppression in secondary schooling and the community college system. The CRT lens highlights the urgency of addressing deeper systemic issues of racism and classism that continue to pervade educational settings. Additionally, this study shed light on the strength and power of student agency and community building and brought to the forefront the often overlooked yet critical role of teaching excellence and pedagogical expertise in shaping the educational journeys of Black and Latinx students in STEM fields. The narratives challenged the conventional understanding of resources by spotlighting the contributions of educators who built supportive connections with students and skillfully navigated the complexities of their lives. This study revealed how the mastery of inclusive and culturally responsive pedagogical practices, which honored learning differences and backgrounds, alongside the provision of comprehensive tutoring, SI, and STEM support programs, was essential for fostering academic success. The study, thereby, signified a collective of these parts as the teaching ecosystem and the equalizer.

Recommendations for practice, policy, and research need to extend beyond mere access, focusing on eradicating racioeconomic institutional barriers. The study's central recommendation is the call to cultivate a STEM ecosystem of practice focused on exemplary teaching that

intentionally bridges the educational gaps identified in secondary schooling and leverages the potential of working-class Black and Latinx students. Adopting a CRT approach to develop a teaching ecosystem in community colleges aims to address disparities and enrich the STEM journey for Black and Latinx students by creating environments that nurture their growth, affirm their identities, and propel them toward success in their STEM fields. The following outlines how institutions can support the teaching ecosystem's innovation and cultivate culturally responsive and anti-racist practices in CCCs:

- Cultivate culturally responsive pedagogical practices: It is recommended that STEM departments provide and require professional development programs that train faculty in culturally responsive and anti-racist pedagogy, ensuring that teaching methods, curriculum design, and assessment practices are inclusive and reflective of the diverse experiences and identities of Black and Latinx students. Professional development should directly address grading practices and classroom environments that foster community among students and faculty. While teaching faculty may be interested in helping students succeed in math, they may not have the time or resources to learn and engage with the nuances of culturally responsive teaching. Providing in-depth training on different approaches to culturally responsive teaching can facilitate a breeding ground for culturally responsive teachers. Additionally, in an effort to continue to embed anti-racist and culturally responsive practices and meet the student populations' evolving needs, it is recommended schools continue to work with instructional faculty over the years to ensure and reinforce culturally responsive

teaching practices. This way, instructional faculty receive continuous support throughout the implementation process.

- Develop a community of practice: It is recommended that math and STEM departments alike develop a specific community of practice that cultivates and facilitates an anti-racist teaching ecosystem in which culturally responsive pedagogy is at the forefront. In this community of practice, faculty and staff can focus on sharing strategies, resources, and experiences related to effectively supporting working-class Black and Latinx students. This community should work collaboratively to refine and implement practices that enhance student engagement and success.
- Enhance support systems in the teaching ecosystem: Part of the teaching ecosystem are the support systems that surround class instruction. The teaching ecosystem requires institutionalizing support programs that meet the needs of Black and Latinx students. For example, rather than having an inconsistent number of courses with supplemental instruction, community colleges should allocate resources toward institutionalizing SI with every math course. Additionally, they should post SI times on class schedules at the time of registration so students can optimize their chances of attending SI. These support systems should be integrated into the fabric of the teaching ecosystem, ensuring that all students have equitable access to the resources they need to succeed.
- Foster inclusive spaces and representation: To increase sense of belonging and identity validation for students' intersecting identities, CCCs should actively work to

increase representation in math and other STEM faculty positions. Doing so can create visibility and student-faculty connections. Additionally, create open-access spaces that affirm Black and Latinx students' intersecting identities where they can create peer connections and learn from each other.

- Implement equity audits in curriculum and teaching practices: Regularly conduct equity audits of math curriculum content, teaching practices, and student outcomes to identify and address any racial biases or disparities. This process should be collaborative and involve both quantitative and qualitative analyses to ensure that the teaching ecosystem is effectively serving the needs of working-class Black and Latinx students.

Recommendations for Policy

It is recommended that the state and CCC system work toward policy changes that support the development of an equitable teaching ecosystem. This could include initiatives that promote the hiring and retention of diverse faculty and enhanced funding to fully implement SI across all math courses, especially those benefiting Black and Latinx working-class students.

- Hiring practices: The hiring practices, as they stand, are created to be equitable, but they are built on procedures influenced by the dominant culture and White supremacy. The state and CCC system should create initiatives that investigate and alter current practices with the intention of hiring diverse and culturally responsive faculty that represent the student populations at each CCC.
- Funding: While CCCs currently receive some funding for supplemental instruction, it is recommended that SI be implemented in all math courses offered to students, particularly

those in which higher numbers of Black and Latinx students enroll. Although AB 705 (2017) was implemented, it did not come with sufficient funding to implement SI across every course. Without this funding, the teaching ecosystem is incomplete. Additionally, when considering the findings and the importance students placed on community and connection, it would behoove the state to provide significant funding to allow for a decrease in class size for math courses while continuing to provide a sufficient number of course offerings. Smaller class sizes can help in relationship building and more specialized attention to each student. Lastly, with the passing of AB 1705 (2022) and the push for all students to be eligible to enroll in calculus courses, it is more important than ever that teachers develop culturally responsive and anti-racist practices. For faculty to be able to learn and implement such strategies, funding is necessary to support systematic shifts in pedagogy and campus culture.

Recommendations for Research

In light of quantitative CRT (QuantCrit; Gillborn et al., 2018), which emphasizes the importance of examining how racism influences quantitative research and its outcomes, future studies should adopt a QuantCrit framework to critically analyze the quantitative data concerning Black and Latinx working-class STEM students in the CCC system. This approach will allow for a nuanced exploration of how systemic racism and classism manifest in statistical trends, such as enrollment numbers, retention rates, completion rates, and transfer rates to 4-year institutions, particularly following the enactment of AB 705 (2017) and AB 1705 (2022). Furthermore, future research should include comparative QuantCrit analysis between California regions—southern, central, and northern—to identify any regional disparities or patterns that emerge. Such an

analysis could reveal regional variations in the effectiveness of AB 705 (2017) and other relevant policies, as well as differences in institutional support structures for STEM students of color. Finally, this study investigated students who transferred from a CCC to a 4-year public university in California in the fall of 2023. At the time of this study, 4 years had passed since the passing of AB 705 (2017); therefore, another qualitative study interviewing students entering fall 2025 or later would provide a greater understanding of the impact of the policy and STEM pathways and deepen the empirical data on community colleges, Black and Latinx working-class STEM students, and multiple methods.

Conclusion

The CCC system is the country's most extensive higher education system, with almost two million students enrolled every year. From the beginning, community colleges have primarily educated underserved and marginalized communities. The majority of the student population comes from a diverse background, and many CCs identify as minority-serving institutions. It is the primary goal and responsibility of the community college system to provide students with an opportunity to advance their educational and career aspirations, but many students of color, nontraditional, and students from historically marginalized communities continue to face barriers to success. This is especially true for Black and Latinx students. Historically and presently, one of the biggest barriers to success for Black and Latinx students is math. Math is one of the largest gatekeepers for Black and Latinx working-class STEM majors.

This study investigated the lived experiences of five Black and Latinx working-class STEM students who transferred from a community college in Southern California to the UC or CSU. Throughout this study, students shared moments of strength and bravery as well as

moments of fear, disappointment, and frustration. Their resilience, tenacity, and aptitude for math were both impressive and inspiring. This study consistently proved that students have an inherent potential to succeed in higher education, and while institutions of White supremacy, both in secondary school and college, continued to create barriers to their success, it was their courage to take up space coupled with instances of connection and the teaching ecosystem that propelled them to success.

As I reflect on my time as a member of the community college system, I can recall similar instances in which this study's findings play out in my day-to-day practice, and just like the stories shared in this dissertation, they have impacted the way I approach both my counseling and research. I have gone through the system as a student, a classified employee, a faculty member, and a leader. Throughout my time, I have personally experienced the damage that can be done when systems do not embody culturally responsive and anti-racist practices. So often, I have worked with people who were more interested in rules, deadlines, and policies and less concerned with the student's success. It is a bootstrap "teach them a lesson" mentality, and I believe it plagues the education system.

When I think of equity and a major marker in my life that moved me to do the work I do as a counselor and researcher, I think of a time when I was in my first year of graduate school, earning a master's degree in counseling. I had the pleasure of working in the student equity office at a local community college. While I was there, I helped launch a support program for Latinx and African American students who were placed in non-transfer-level courses. I was the interim co-coordinator of the program and was still new to the institutional work of equity. At the time, the idea of equity was relatively new, and many were trying to make sense of and

justify this new concept called equity. Then, many had been raised to think that equality was the goal, but in fact, equality only perpetuates the status quo. Changing this shift in mentality proved to be difficult for many.

While I was a coordinator, I oversaw the logistics of the program, but more importantly, my goal was to create a sense of community in the center and collaborate with instructors to give Latinx and African American students a more equitable education. I would chat with students and ask them questions about their lives and courses. I wanted them to have a home away from home and feel truly supported in an institution that historically failed them. I had one particular student who really struggled in school. He was African American and in his second year of college. He attended class and came to the center daily but rarely turned in work. His home life was not ideal, and I could see that he really wanted to be a student but did not know how. He had given in to the idea that he was not smart and did not belong. I worked with him for months to help him see his potential, and finally, at the tail end of the semester, he started to turn in work.

He was making real progress in his class. I was so proud of how far he had come in just 3 months. A few weeks after he started submitting work, he came in and said he was dropping out of school. He said that he received an F on all his assignments and was not going to pass the class. I was shocked because I had looked over all his work and watched him complete the assignments, so I knew his work was good. I contacted the teacher, and she said that her policy was to deduct 10% for every day the assignment was late, and she could not give him special treatment. I was livid! This teacher and I had many conversations about equity, and she appeared to understand what students needed. Most importantly, we had many conversations about this student and how impressed we were with his recent commitment. However, I think the education

system has trained us all to be rule followers and does not always allow room for us to look at the human factor. After hearing the student was dropping out, I could not help but go to the restroom and cry. I cried out of frustration with the system. To see how the system once again failed him was heartbreaking. His story is one I have not been able to shake, and it has been one that I call on when I am struggling with an ethical or moral dilemma.

As practitioners, educators, and members of the community college system, we must ask ourselves how much the current rules matter in this situation. Will we look back at these moments and regret not making an exception or accommodation for a student because the rules of today do not allow it? Are the barriers to their success necessary and worth it? What are the potential student consequences of our decisions? These are questions I urge us all to employ because, as shown through this study, our actions matter to the students who have been underestimated and marginalized, and they can make a difference.

Finally, I would like to thank the participants of this study, as their contributions to empirical evidence have made a lasting impact. Thank you for your time, kindness, and energy to pay it forward to future students. This dissertation was written for and in honor of every working-class Black and Latinx community college student. I see you, and I will continue to work to create a space in higher education designed for you.

APPENDIX

Interview Protocol

Research Question: How do working-class Black and Latinx STEM students author themselves into the narrative of mathematics and the STEM pipeline in California community colleges?

1. How do working-class Black and Latinx STEM students describe their academic preparation in mathematics before entering the California community college system?
2. How do working-class Black and Latinx STEM students perceive and make meaning of contributors and barriers to transfer-level math success in the California community college system?
3. How can the perceptions and understandings of working-class Black and Latinx STEM students inform recommendations for successful transfer rates and transfer readiness to baccalaureate degrees in STEM?

Part 1: Three-Interview Series Protocol to Research Questions and Interview Questions

Research questions	Three-interview series	Interview questions
How do working-class Black and Latinx STEM students describe their academic preparation in mathematics before entering the California community college system?	Focused Life History: Examine the context of the participant's lived experiences, including an understanding of their background, educational journey, and other factors that may influence their perspective on mathematics and STEM aspirations.	What were your secondary education experiences with math like? How did these experiences shape your attitude towards pursuing a STEM field? Can you share any role models, teachers, or mentors who have influenced your decision to pursue a STEM major? What impact did they have on your educational journey?

Part 1 Continued: Three-Interview Series Protocol to Research Questions and Interview Questions

Research questions	Three-interview series	Interview questions
		Can you describe any support you received or lack thereof in K-12 when learning math concepts? How did these experiences shape your attitude towards pursuing a STEM field?
		What type of math classes did you take in secondary school? How did these experiences shape your interest in pursuing a STEM field?
		Were there any after-school or summer programs you were offered and took advantage of? How did this shape your attitude towards pursuing a STEM field?
		Can you describe your impressions of math in secondary school? What was your perception of pursuing a STEM major in college?
		Please describe your secondary school setting. What programs if any did your school provide to support you on your STEM pathway? Was there an emphasis on STEM fields?

Part 2: Three-Interview Series Protocol to Research Questions and Interview Questions

Research questions	Three-interview series	Interview questions
How do working-class Black and Latinx STEM students perceive and make meaning of contributors and barriers to transfer-level math success in the California community college system?	Detail of Experience: Participants recall and reconstruct specific details of their racialized and classed lived experiences in math and the STEM pipeline in the California community college system.	When did you decided to be a STEM major? Did you start with another major? Can you discuss any expectations you had of your experience entering community college as a STEM major? What was the first math course you took in the community college? Did you pass this class with a C or better in your first attempt? Can you recall how you felt while taking your first math course? Can you discuss any specific challenges or barriers you have faced in your math courses at the community college? How did you overcome them? Describe the support systems available to you during your time at the community college, such as tutoring, counseling, or peer networks. How have these resources impacted your experience in math courses? How comfortable were you in seeking these services?

Can you recall any pivotal moments or turning points in your educational journey that have influenced your commitment to pursuing a STEM major? Please describe the details and context of these moments.

Describe in detail your experiences with your math teachers in the community college. What positive or negative teacher experiences stand out?

Can you discuss what the classroom environment was like and how or if it influenced your decision to continue as a STEM major?

Did you repeat any math courses? If so, how many courses did you retake and how many times did you retake them? Can you recall the feeling or thoughts you experienced during this process?

Did you ever have any feelings of imposter syndrome or low sense of belonging in your major? If so, describe them in detail.

Part 3: Three-Interview Series Protocol to Research Questions and Interview Questions

Research questions	Three-interview series	Interview questions
How do working-class Black and Latinx STEM students perceive and make meaning of contributors to successful transfer rates and transfer readiness to baccalaureate degrees in STEM?	Reflection on Meaning: The third interview will prompt participants to reflect on the significance of their experience and how it relates to their understanding transfer readiness to baccalaureate degrees in STEM?	How do you believe your experiences in math at the community college have influenced your personal and academic aspirations in STEM? When considering the transfer process, what experiences or support do you believe helped you in completing the transfer process and being admitted to the university? When and how did you learn about the math requirements needed for your STEM path? How early on did you hear about these requirements and from whom? At what point in your journey did you become confident in what your STEM requirements were? What opportunities, support, or services do feel were missing from your community college experience? Discuss the factors you feel contributed to your commitment and persistence in pursuing a STEM major. What kept you motivated?

	How prepared do you feel to enter the university this Fall 2023 as a STEM major?
	What advice would you give to community college leaders who want to better support students who have an interest in pursuing a STEM major?
	Reflecting on your journey so far, what advice would you give to other Black or Latinx students entering community college with an interest in pursuing a STEM major?

Note: Adapted from (2019). *Interviewing as Qualitative Research: A Guide for Researchers in Education and the Social Sciences*, 2019, by I> Seidman, Teachers College Press, copyright 2019 by Teachers College Press.

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