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The Influences of Equity and School Culture on Black, Latinx, and Mixed-Race Student Enrollment in Advanced Secondary Mathematics Courses

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THE INFLUENCES OF EQUITY AND SCHOOL CULTURE ON BLACK, LATINX, AND MIXED-RACE STUDENT ENROLLMENT IN ADVANCED SECONDARY MATHEMATICS COURSES

By
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Approval Page

This dissertation was submitted by Fyniss T. Nixon under the direction of the persons listed below. It was submitted to the Gardner-Webb University College of Education and approved in partial fulfillment of the requirements for the degree of Doctor of Education at Gardner-Webb University.

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My mother, my everything.

My husband of 22 years has become my best friend. My son and my two daughters are gifts from God. My in-laws, my aunt, and my uncle have always been examples of Black Excellence. I pray that every BIPOC child does not have to go far to find mentors and role models.

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The 2020-2021 NC Math 3 Team at my former high school made my life easier while teaching through a deadly global pandemic. Our discourse and our laughter were on a scale that I had never experienced in such a multitude before and cannot imagine experiencing ever again.

Breonna Taylor…I can't explain how emotional I am from simply typing her name.

Abstract

THE INFLUENCES OF EQUITY AND SCHOOL CULTURE ON BLACK, LATINX, AND MIXED-RACE STUDENT ENROLLMENT IN ADVANCED SECONDARY MATHEMATICS COURSES. Nixon, Fyniss T., 2022: Dissertation, Gardner-Webb University.

This quantitative, descriptive analysis of three large, urban secondary schools in the South used equitable practices to intentionally increase the percentage of Black, Latinx, and mixed-race students in advanced mathematics courses. Each high school observed in this study acknowledged a disproportionately higher percentage of White students taking rigorous college and career-ready courses when compared with the Black and Latinx population. This disparity was not just isolated to the schools in this study. District, state, and national initiatives across the country are becoming acutely aware of the accessibility gap between (Black, Indigenous, and other People of Color) BIPOC and non-BIPOC secondary learners. The opportunity to interact with and explore a rich curriculum may affect the quality of life for Black, Latinx, and mixed-race students. Otherwise, left unchallenged and unmotivated, they are more likely not to pursue high-income STEM-based professions. The idea of "cultivating" a deeper understanding of mathematics for BIPOC students could potentially expose this marginalized group to college and career paths previously unimaginable or unobtainable. Each secondary institution in this study intentionally addressed advocating for a positive school culture and enacted equitable practices to provide high-quality instruction and curriculum for all students, emphasizing not leaving BIPOC students behind.

Keywords: equity, secondary mathematics, teacher perception, school culture

Table of Contents

Tables

Figures

Chapter 1: Introduction

Black, Indigenous, and other People of Color (BIPOC) students in public high schools do not have equitable access to advanced mathematics courses compared to their White peers. The United States (U.S.) Department of Education (2008) believed that mathematical knowledge is often used to determine intelligence and access to high-level mathematics coursework and continues to be utilized as a gateway to academic and economic opportunity. Because of its affluent ranking, academic mathematics has consequentially been an area of political argument among mathematicians, mathematics educators, and the populace concerning its content, favored teaching methods, evaluation processes, and more recently, matters of equity and inclusion (Martin, 2019). This significant gap in accessibility contributes to why BIPOC students are not entering 4-year colleges and universities at the same rate as their counterparts. In 2018, The Institute of Education Sciences (IES, 2021) found that Asian students enrolled in college at higher rates than Black, Latinx, or White students. Apart from 2016, between 2000 and 2018, White students' enrollment rates were higher than Black and Latinx students (IES, 2021).

Conversations centered around equity in mathematics education should consider the harsh social and structural facts imposed on the lives of BIPOC students and curriculum modification, school culture, and classroom environment (Martin, 2019). In 1989, The National Council of Teachers of Mathematics (NCTM) published math standards designed to address the advancement in technological resources (NCTM, 2021). Included in the standards was a pathway to mathematical literacy that missed an opportunity to provide Black, Latinx, and mixed-race students access to culturally relevant and engaging mathematics (Martin, 2003). Authentic policy and curriculum

changes are needed for academia to succeed in positively transforming the landscape of advanced secondary mathematics classrooms (Martin, 2003). The ethnic background has endured as a noteworthy affair of education. General and academic conversations perpetuate the racial achievement gap in education, presenting numerous descriptions: cognitive shortfalls, cultural deficits, cultural dissimilarities, defiance, and systemic racism. School systems continually brainstorm BIPOC student school foundering by inquiring into what is wrong with "those students" or their family members instead of investigating how schools (and larger humankind) design and manufacture the demise of particular groups (McDermott, 1997).

Purpose

This study examined three urban, southern high schools and addressed replacing segregated classrooms with inclusive learning environments led by teachers engaged in culturally responsive training. The Southern Coalition for Social Justice's recent explorations indicated that de facto school segregation within the district affects marginalized students (Bose, 2021). The purpose of this quantitative research study was to examine the number of Black, Latinx, and mixed-race students enrolled in advanced mathematics classes as compared to their White peers. Additionally, teacher perceptions of school culture, instructional practices, and supports were analyzed in association with the percentage of BIPOC students in advanced math classes.

This research analyzed intentional equity work's effect on enrollment and access to postsecondary preparatory courses and examinations in a secondary setting (College Board, 2021). This study had the potential to ignite hard conversations related to the conscious and unconscious inequitable treatment of minority students at public secondary

education sites across the nation.

School A, School B, and School C were members of a large district in North Carolina. These schools (through district affiliation) had agreed to be a part of an equity movement that had begun to take hold in the U.S. This initiative included consultation, collaboration, and a commitment to specific and measurable results (Equal Opportunity Schools [EOS], 2021). Equal Opportunity Schools (EOS) has helped hundreds of institutions recognize students of color who were equipped for but missing from Advanced Placement (AP) classes. Working collaboratively, EOS consultants and school leadership successfully enrolled BIPOC students in Honors North Carolina Math 3, Honors Pre-Calculus, Honors Discrete Mathematics, AP Calculus, and AP Statistics classes. This placement was an opportunity to access advanced mathematics courses for BIPOC students while rebuilding school culture and adjusting adult mindsets (EOS, 2021). The school district associated with this study was part of a multi-phase model designed to help secondary settings promote equity and viability at the highest levels of mathematics course offerings. This equity initiative served as a reference to ensure BIPOC students' entrance and achievement in the most academically rigorous learning environments. Linton (2011) considered that equity in education, at its core, facilitates discourse centered on individual students' unique needs and supplies all students with a higher quality of learning and teaching available to ensure command of content. Perry et al. (2010) noted that the American academic system should not forget that Jim Crow included education from the beginning. In 1868, the South Carolina Constitution stated in Article XI, Sec. 7 that "separate schools shall be provided for children of the White and colored races, and no child of either race shall be permitted to attend a school provided

for children of the other race" (Riley, 2007, para. 2). Equity initiatives across the nation ensure that states do not propose establishing separate schools for BIPOC and non-BIPOC students by schools' boards of directors in any of the schools in the state (Martin, 2019). Dumas et al. (2021) understood the need to "interrogate the opportunity gap" (p. 9); put an end to the "underrepresentation of Black students in advanced courses, curricular misrepresentation, and erasure" (p. 9); and discontinue the "lack of access to quality teachers, counselors, and material resources" (p. 9).

Table 1 shows 2019 College Board data for the number of students who took an AP Calculus AB, AP Calculus BC, or AP Statistics course by race in North Carolina.

Table 1

2019 College Board AP Mathematics Administered Assessments

	Calculus AB	Calculus BC	Statistics	Total	%
Black	502	203	658	1,363	7.6
Hispanic	696	343	849	1,888	10.5
Mixed race	331	207	410	948	5.3
White	4,662	2,675	6,093	13,430	74.9

In 2019, 13,430 White students completed at least one AP mathematics assessment compared to 4,199 Black, Hispanic, and mixed-race students. The College Board's AP Calculus and AP Statistics exams were administered to 31.27% non-White students. The College Board is designed to increase the accessibility to higher education, and the AP program is one of its vehicles to facilitate passage to college (College Board, 2021). Advanced mathematics classes empower learners to explore concepts and theories in an environment where math is spoken, written, and created far more frequently than a traditional secondary math class. Analysts, educationists, and decision makers persist in

conveying great curiosity in understanding math course-taking pathways. Taking higher-level mathematics courses in a secondary setting has powerful, positive results on many postsecondary educational outcomes and is associated with higher remuneration in adulthood (Irizarry, 2021).

Educational spaces must supply every learner with a flourishing curriculum where AP and exceptional curricular choices abound. Academic spaces must also allow for educating our learners about equity. There must be spaces where we inform students how to measure potential and materials to generate an unprejudiced and equitable society (Wolf, 2021). The alternative is segregated learning opportunities predicated on inequities, fostering an oppressive environment. Kohli et al. (2017) analyzed thousands of documents outlining racial inequities in education research. Their analysis speaks to the litany of covert, subliminal acts of racism hindering BIPOC students' academic potential for success. Kohli et al.'s research found a hefty body of literature that acknowledges and challenges systemic oppression's destructive impact.

Understandably, no student can enroll in an AP or honors course without completing the prerequisite courses. There are clear instructional pathways designed to prepare math learners for the academic demands of such studies. AP Calculus AB is an inaugural college-level calculus course. The College Board (2020) has created a space for students to elevate their understanding of differential and integral calculus by participating in real-world scenarios represented graphically, numerically, analytically, and verbally. Students are encouraged to use definitions and theorems to build arguments and justify conclusions by exploring concepts like change, limits, and the analysis of functions. No equitable academic system should place underprepared students into

rigorous courses to provide fair access to all learners. The U.S. could benefit from reimaging how BIPOC students move through secondary mathematics. As it stands now, these students are misled by math tracking (Jones, 2018).

Research Problem

Equity and school culture significantly contribute to the number of BIPOC students enrolled in advanced mathematics courses (St. Amour, 2020). Racial equity is the absence of organizational hurdles and structural barriers experienced by people because of race or color, which obstruct access, opportunities, and outcomes (Cambridge Public Schools, 2020). Social endeavors to conquer the exceedingly harmful biases and differentiation for African Americans have not been powerful enough; inequities endure in almost every facet of life, including education (Bowman et al., 2018). As students mature, their mathematical identities are guided by personal experiences and environmental circumstances. Implementing equitable instructional practices recognizes the development of mathematical identities. These practices are actions schools can take to enhance academic occurrences and increase the possibility of successful scholastic results (Huinker et al., 2020). For years, the U.S. Department of Education (2008) has understood that knowledge of mathematics is regularly used as a factor for intelligence, and entrance to high-level mathematics placement continues to be offered as admission to academic and monetary opportunities connected exceptionally to scientific and technical advancement. Because of its favored ranking, school mathematics has significantly been a place of political argument among mathematicians, mathematics educators, and the populace. This dynamic dispute concerns elite schools' mathematics content; favored pedagogical perspectives; techniques of assessment; and more recently, matters of equity

and inclusion. Gutiérrez (2013) noted that these last considerations reflect that mathematics education is at the center of reproducing or discontinuing race, class, and gender inequities and rankings in school and social conditions through its sentinel and admissions functions.

Joseph et al. (2021) stated that Black, Latinx, Indigenous, female, and poor students had experienced underrepresentation in mathematics and mathematics-related spaces for a long time. Education researchers have long suggested sustained exploration of (a) the systemic features of school districts, (b) teacher mindsets about diverse students, and (c) the studying of mathematics and classroom applications. Martin (2019) noted that equity in mainstream mathematics education often represents little more than a convenient and comfortable intermediate point delaying authentic racial justice. Inclusion is predicated on equity-based conversations, and policy adjustments usually run simultaneously with marginalization and assimilation, ensuring nothing changes (Martin, 2019).

Conceptual Framework

The definition of equity is when educators supply every learner with the individual sustenance they need to reach and eclipse a common standard (Linton, 2011). Singleton and Linton (2006) extended equity synthesized to race:

> Achieving true equity for all students must be a central and essential component of any attempt to close the racial achievement gap. Lacking a focus on equity, educators might experience a widening disparity in achievement among students because the root causes of the gap remain unaddressed. (p. 46)

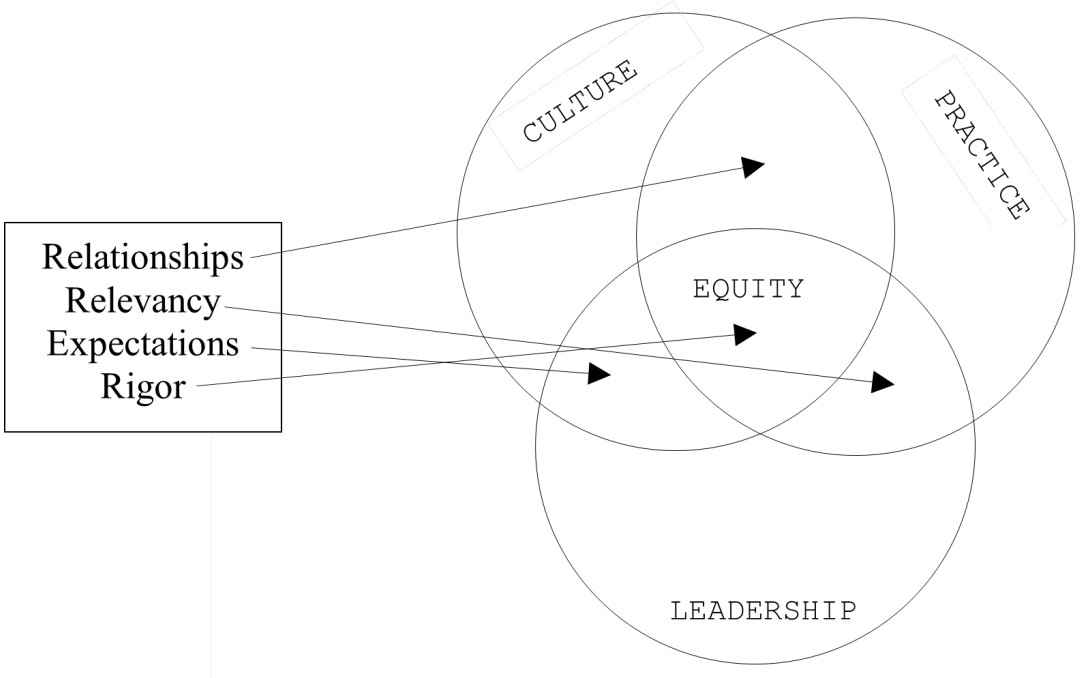
Singleton and Linton further defined educational equity as “raising the achievement of all

students while (1) narrowing the gaps between the highest- and lowest-performing students, and (2) eliminating the racial predictability and disproportionality of which student groups occupy the highest and lowest achievement categories" (p. 46).

Equity is the centerpiece of this framework. Linton (2011) explained that expectations, rigor, relevance, and relationships are the four characteristics that are "key to the ongoing and successful efforts of any equity-minded school" (p. 53). Surrounding these characteristics are three essential strategies paramount to sustaining an equitable learning environment. These characteristics involve leadership, culture, and practice (Linton, 2011). Figure 1 describes the equity framework concerning culture, practice, and leadership.

Figure 1

Equity Framework



Research Setting

This research's uniqueness was that all three schools chronicled in this report were in the southern region of the U.S. in an urban school district. School A was a predominantly White school in one of the more affluent areas of the community. During the 2021–2022 school year, the student population was 12% Black, 5% Hispanic or other, and 83% White; while School B was 83% Black, 16% Hispanic or other, and less than 1% White. School C had a student population of 42% Black, 31% Hispanic or other, and 29% White.

Rationale

All three schools sought to increase the percentage of enrollment of their BIPOC population in higher levels of mathematics with equity in mind. The 2024 Strategic Plan was a district-wide initiative to promote student engagement and allow educators to maintain high expectations for all learners. To create the necessary change in existing educational opportunity gaps among students, the district focused on eradicating academic inequities by improving professional development, instructional support, and culturally responsive teaching pedagogy. The 2024 Strategic Plan's goal was to increase equitable opportunities for every child to improve student outcomes. The district would continue to focus on creating inspiring, inclusive, student-centered surroundings that support the progress of self-sufficient learners to create the necessary change in existing educational gaps among students.

All three schools agreed that the potential for improving their graduates' quality of life is partly attributed to access to rigorous coursework and highly qualified practitioners. The instructional leadership at each site agreed that each school's culture

must continue to evolve. Considerations for entry into advanced mathematics courses must go beyond the Black-and-White data points commonly used during scheduled enrollment periods. The mindset of honors and AP teachers should also continue to move toward becoming culturally responsive practitioners (Hammond, 2015). Prior expectations of what an advanced math student "looked" like and their academic journey had to shift for a school system to accept all learners, particularly the marginalized students.

> For at least three decades, the field of mathematics education has wrestled with issues of equity, particularly concerning Black students. Much of what the field knows about Black education in the U.S. has been learned through traditional empirical analyses that pay little attention to how contemporary issues are situated in broader historical contexts. Mathematics education reform efforts aim to be equitable and inclusive for Black communities, yet Black students and teachers still face the daily reality of violence and exclusion with mathematics. (Frank et al., 2019; Joseph et al., 2019; D. B. Martin, 2019; D. B. Martin et al., 2019). (Joseph et al., 2021, p. 82)

Though mathematics education research broadly ignores how history has affected Black teachers and students, a few Black scholars have highlighted historical perspectives essential to situating a collective Black experience. Berry et al. (2014) and Martin (2019) asserted that improvements in mathematics teaching had been distinguished by standardized and predictable efforts to measure success and surpass previous learning outcomes. These improvements were often symbolic, superficial, and detrimental to Black learners. Professed improvements include the lack of access to advanced

mathematics for the ignored, alienated Black math student (Joseph et al., 2021).

In 1983, the National Commission on Excellence in Education emerged with a report titled, *A Nation at Risk: The Imperative for Educational Reform*. The report implied that improvements in education were necessary because global competitors were passing America's superiority in science, industry, trade, and technology (Bartell et al., 2015). Changes to mathematics pacing invariable included adding Algebra 1 as a national graduation requirement. Civil rights advocates petitioned for fair and equal access to Algebra 1 and geometry courses for marginalized students, particularly Black students. One conclusion from examinations of prior research by Bartell et al. (2015) found that elevated admission in the upper-level mathematics coursework did not affect instructional techniques to match the development in the diverse learning exigencies of adolescents (Porter et al., 1993). For disadvantaged students, learning concentrated first and foremost on acquiring skills.

Furthermore, a great deal of the increase in mathematics course admission came to pass by directly placing students in Algebra I tracks. Research on the Curriculum and Evaluation Standards for School Mathematics found that the NCTM did not consider race, racism, and cultural identity when modifying the curricula. This omission has done little to advance the needs of Black, Latinx, and mixed-race students (Bartell et al., 2015).

Research Questions

The study answered the following questions:

1. To what extent is there a significant difference in the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses compared to their White peers?

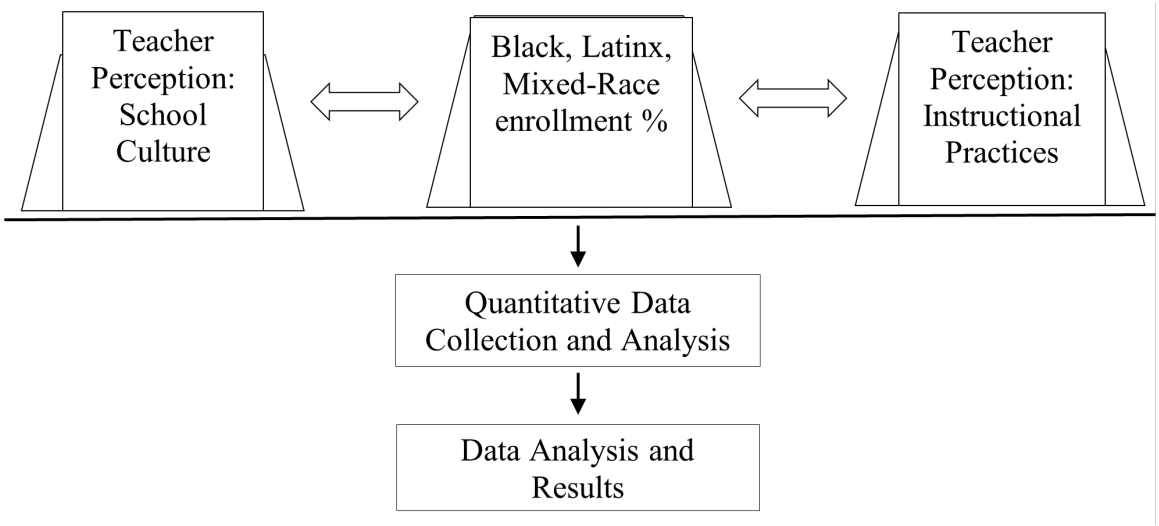
2. To what extent is there a significant difference in the percentage of Black, Latinx, and mixed-race students enrolled by gender in advanced mathematics compared to their White peers?
3. To what extent is there an association between teacher perceptions of school culture and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses?
4. To what extent is there an association between teacher perceptions of instructional practices and supports and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses?

Overview of Methodology

I analyzed the data provided by the three high schools at the center of this study and reported the progression of enrollment percentages before, during, and after the implementation of the equity-based initiatives installed (or enhanced) at each site. I utilized quantitative correlational research to test the hypothesis of whether teacher perceptions are associated with access and enrollment in advanced mathematics courses for non-White students, particularly Black, Latinx, and mixed-race learners. Figure 2 outlines this study's methodology.

Figure 2

Methodology of the Study



Definition of Terms

2024 Strategic Plan

The school district's commitment to providing equitable entrance to extremely effective practitioners and a rigorous curriculum for all learners emphasized closing the achievement gaps attributed to race.

Advanced Mathematics

For this research, the following were considered an advanced mathematics course: Honors North Carolina Math 3, Honors Pre-Calculus, Honors Discrete Mathematics, AP Calculus AB, AP Calculus BC, or AP Statistics (IES, 2021).

AP

An AP course is usually more challenging than standard high school classes. Many AP courses are like first-year college courses, and they offer students demanding coursework and an appetence for college courses (College Board, 2020).

BIPOC

An acronym that stands for Black, Indigenous, and other People of Color. (Garcia, 2020).

College Board

Founded in 1900, the College Board is a mission-driven not-for-profit cooperative that bridges students to college opportunity and success (College Board, 2021).

Equity in Mathematics

Focuses on establishing that all learners accomplish mathematics efficiency and expanding the numbers of learners from all ethnic, racial, linguistic, socioeconomic, and gender groups who acquire the maximum mathematics achievement levels (NCTM, 2020).

Minority Students

For this research, a minority student is an African American/Black student having ancestry in any of the Black racial groupings in Africa; a Latin/Latin American student of Portuguese or Spanish culture with origins in Mexico, Central or South America, or the Caribbean Islands, notwithstanding of race (Illinois Student Assistance Commission, 2020); and a mixed-race student has parents or ancestors from different ethnic backgrounds (Lexico, 2020).

Instructional Practices

Daily activities classroom teachers engage in framed within a strong culture and effective leadership, resulting in the successful education of all students (Linton, 2011).

School Culture

Alludes to the way educators and other stakeholders collaborate and the values,

ideologies, and biases they have in common. A positive school culture and climate advance students' learning potential (Kalkan et al., 2022).

Conclusion

This research sought to establish a correlation between teacher perceptions of school culture and instructional practices while tracking the enrollment percentages of Black, Latinx, and mixed-race students in advanced mathematics classes compared to their White peers. The implication of this research is that if secondary sites can (a) set the bar for high expectations, (b) provide the skills and learning BIPOC learners require to flourish in advanced mathematics courses, and (c) connect this specific population with the instruction and curriculum, the equity gap in mathematics may close (Linton, 2011). BIPOC students will have more opportunities for a better quality of life. Public high schools' honors and AP courses will better reflect the racial makeup of the school, and BIPOC students' sense of belonging will increase. Chapter 2 presents a literature review, starting with the theoretical framework used for this research.

Chapter 2: Literature Review

Introduction

The growing call to dismantle the current education system falls in line, in some regard, with the concept of this research's examination of the enrollment of BIPOC students in advanced mathematics classes. The Public School Forum of North Carolina (2016) released a statement outlining the traumas and crises with which students live. Some students' traumas are exacerbated by structures that allow racial inequities to persist. BIPOC students are underrepresented in honors, AP, and dual-enrollment classes. This lack of presence in the most rigorous classrooms is because gatekeepers subjectively decide that Black, Latinx, and mixed-race students are not well-suited for these curricula. Lack of belief in BIPOC students' academic aptitude leaves them unable to access certain postsecondary outcomes (Public School Forum of North Carolina, 2016).

The National Center for Education Statistics (2022) reported that during the 2017-2018 school year, 13.3% of Black students took at least one advanced mathematics course, compared with 21.5% of Latinx students, 52.9% of White students, 8.4% of Asian students, and 3.3% of mixed-race students. The mere potential to enhance the quality of life for one Black student could positively affect generations. The American school system owes all students the opportunity to realize their highest levels of potential. The intentional practice of placing BIPOC students in advanced classes exposes all learners to ethnically and culturally diverse environments where ignorance can move toward tolerance and tolerance toward acceptance and respect for all. Padilla et al. (2019) noted that humanizing mathematics education of students with disabilities—especially those who are also female, students of color, or communicate through different

languages—requires much more than mathematical curriculum readjustments. It requires merging human and civil rights (Padilla et al., 2019). The implications of this research and others like it are far-reaching. The potential for creating a culture of inclusion and high expectations is realistic and obtainable; however, this type of detailed work will require unmerciful reflection and humility. Many American inhabitants, educators, and policymakers are not prepared to accept the actuality of racism in education, to say nothing of exposing it to investigation and selecting it for direct mediation as a means of enhancing the accomplishment of underachieving students (Howard, 2010).

The purpose of this quantitative research study was to examine the number of Black, Latinx, and mixed-race students enrolled in advanced math classes compared to their White peers. I analyzed teacher perceptions of school culture, instructional practices, and instructional supports in association with the enrollment of BIPOC students in advanced math classes. Key topics appearing in this review are centered on equity and leadership related to accessibility to a rigorous mathematics curriculum for BIPOC students.

Theoretical Framework

The Equity Theory in Education

At its core, the equity theory in education explains how educators' efforts toward effective instructional practices are perceived compared to a particular student outcome. Regarding this research, do educators' work sites provide professional development designed to enhance their ability to meet diverse learners' needs? Does on-site professional development enhance their ability to close the achievement gap between BIPOC and non-BIPOC students? Effectively speaking, do stakeholders think they are

being treated fairly (Educational Research Techniques, 2021)?

The overarching goal of educational equity is to supply all students with academic opportunities through individualized support necessary for success. The pursuit of educational equity encompasses identifying concerns preventing learning from scholastic excellence and achievement. Subsequently, viable solution-based, data-driven programs and resources are provided consistently, ensuring long-term support for marginalized learners (New Jersey School Board Association, 2021).

In theory, equity in education consists of two tiers. One tier is designed to ensure gender, ethnicity, and race are not obstacles to achieving academic goals. The second tier ensures equitable access and opportunity for all students. These tiers address organizational equity and fairness (Organisation for Economic Co-operation and Development, 2008).

This theory identifies underserved students and the differences in resources between them and their peers when applied. To improve, school- and district-based aggregation and disaggregation of data are essential in addressing and measuring the existing accessibility and opportunity gaps. Equally important in applying this theory, schools should identify and provide systematic help for Black, Latinx, and mixed-race students and respond accordingly to their individual needs (Amadeo, 2021).

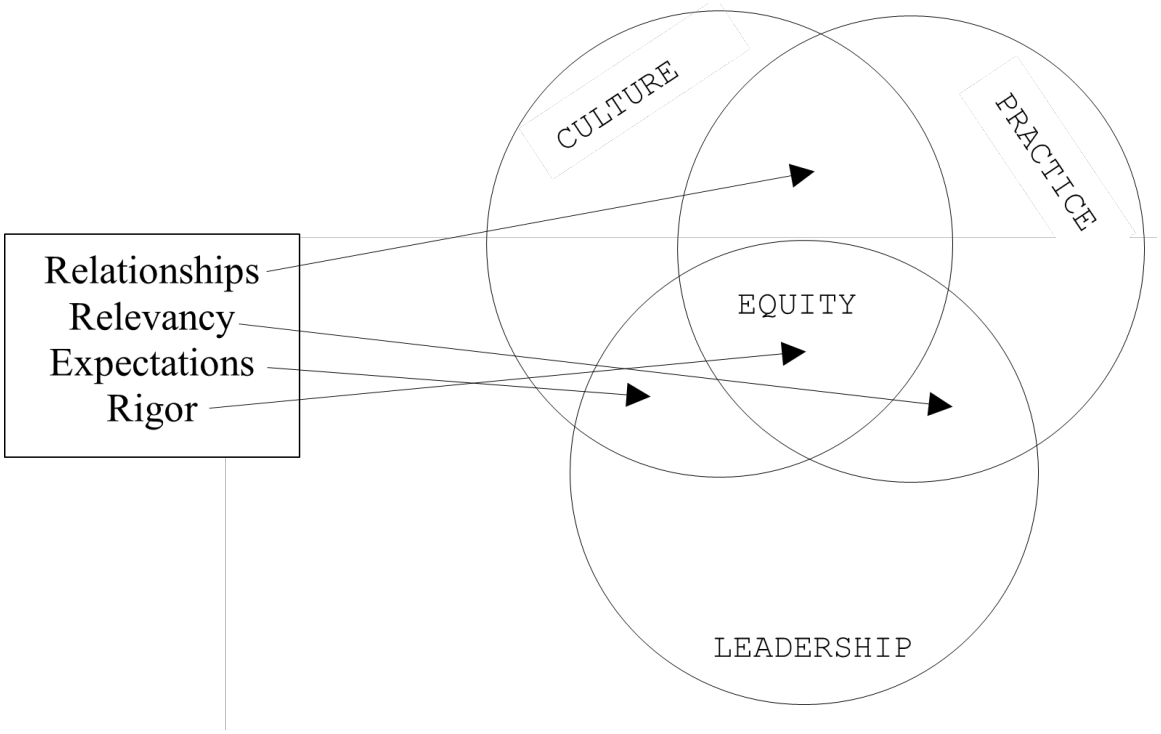
Equity in Education Framework

Linton (2011) described the equity framework as strategies designed to spotlight the learning culture of the school as well as the cultural competency of its educators. Students in strong learning culture spaces are more apt to take risks, learn through failure, and feel supported throughout their learning experiences. Instructional practices are

actionable steps teachers take in order to influence student outcomes. Equitable teaching skills increase the opportunities for classroom teachers to engage and facilitate the learning of all students. Figure 3 describes the equity in education framework.

Figure 3

Equity in Education Framework



The Center for Public Education (2016) believed that "equity is achieved when all students receive the resources they need so they graduate prepared for success after high school" (p. 1). Many marginalized students do not have full access to resource-rich schools, high-quality teaching, a globally competitive curriculum, and nurturing learning environments (U.S. Department of Education, 2021). The Center for Public Education's researchers compiled a historical timeline of (in)equity policies and laws in U.S. public education. This complication also includes implications for local school boards. Details of this timeline are outlined in Table 2.

Table 2

Historical Timeline for Equity in Education

Year	Legal action
1647	Massachusetts establishes religious schools for Puritan students
1827	Massachusetts establishes free public schools for all students
1864	Congress makes it illegal for Indigenous People to learn in their native language. Bureau of Indian Affairs off-reservation boarding schools established
1896	Supreme Court sanctions segregation in Plessy v. Ferguson justifying Jim Crow laws in Southern states; supported by claims of White superiority and Black inferiority
1902	John D. Rockefeller creates General Education Board; the cornerstone for the modern education system
1905	California requires public education for Chinese immigrants
1947	Mendez v. Westminster (involving Mexican American students) rules segregation unconstitutional
1954	Brown v. Board overturns Plessy v. Ferguson declaring separate schools unequal; this is the hallmark for desegregation
1957	Federal troops enforce integration of Little Rock, Arkansas public schools
1964	Civil Rights Act of 1964 (Title IV) promotes the desegregation of public schools and is enforced by the U.S. Attorney General
1968	Supreme Court ruling on Green v. County School Board of New Kent County forces onus of desegregation on school boards
1971	Swann v. Charlotte-Mecklenburg Board of Education ruling upholds busing as a means to facilitate racial integration
1972	Title IX: The Education Amendment Act of 1972 protects against discrimination based on gender
1973	Keyes v. School District 1 (focus on Hispanic and Black students) puts the burden on the school district to prove the system is not segregated
1974	Lau v. Nichols protects non-English speaking students and reinforces the California Education Act Section 601 of the Civil Rights Act of 1964
1991	Desegregation decrees not meant to operate “in perpetuity”1
1992	Freeman v. Pitts rules district courts may relinquish supervision of desegregation plans in incremental stages while keeping segregation in others
2015	Every Student Succeeds Act reestablishes the Elementary and Secondary Education Act of 1964, emphasizing equal access to education

More recently, President Joseph Biden's (2021) administration issued an Executive Order on *Advancing Racial Equity and Support for Underserved Communities Through the Federal Government*. This order became effective January 20, 2021. Section 1 stated that "entrenched disparities in our laws and public policies, and in our public and private institutions, have often denied that equal opportunity to individuals and communities" (Biden, 2021, para. 2). Biden defined equity as,

> The consistent and systematic fair, just, and impartial treatment of all individuals, including individuals who belong to underserved communities that have been denied such treatment, such as Black, Latino, and Indigenous and Native American persons, Asian Americans, and Pacific Islanders, and other persons of color; members of religious minorities; lesbian, gay, bisexual, transgender, and queer (LGBTQ+) persons; persons with disabilities; persons who live in rural areas; and persons otherwise adversely affected by persistent poverty or inequality. (para. 5).

Kamm (2018) explained that the conversation around finding research-based solutions to closing the opportunity gap is ongoing. Researchers are noticing the increase in inconsistent learning opportunities and academic experiences. Disadvantaged, disenfranchised students may have had different lives had their secondary experiences been more equitable and supportive of their academic and personal needs.

Hammond (2015) found these findings necessary if educators are to understand that Black, Latinx, and mixed-race students are intellectually capable of doing without depriving this underrepresented group of meaningful or motivating contexts for learning and practicing higher-order thinking processes. Schools are responsible for supporting

diverse learners and not accepting inequities. Therefore, highly qualified, effective teachers should support students from culturally diverse backgrounds, especially marginalized groups. Awareness of the effect of educators' cultural lenses on illuminating and appraising students' individual or collective practice that might elicit low expectations and underrepresentation in advanced math courses must lend way to introspective reflection (Hammond, 2015).

Students in AP courses are instructed on effective ways to navigate the academic expectations they will encounter in college (Kalkan et al., 2022). Black and Latinx students are sorely absent from such courses. Honest conversation among administrative staff and students will help decrease the equity gap and improve school culture (Epitropoulos, 2019).

Social Systems Model Theory

A school's success is the extent to which the institution is prepared to achieve its agreed-upon goals with a vision of overcoming the complications obstructing the accurate running of the site (Dahiru et al., 2018). Initially, early research on school success centered on learning outcomes. Over time, assumptions were made concerning other components for success. School activities facilitated by highly qualified teachers, access to financial support, teaching pedagogies, and classroom size were seen as key concerns of academic scholars (Dahiru et al., 2018). Effective academic learning spaces are focused on making improvements to school goals at the classroom level. The social systems theory, when applied to education, explains that a student is a byproduct of their social environment. This theory materialized from general systems theory which became popular within the natural sciences and psychology in the first half of the 20th century

(Social Work Degree Center, 2020). School success is associated with the culture and organization of the institution and the ways in which it communicates objectives, practices, and policies in order to support effective learning and teaching (Center on Innovations in Learning, 2019). It encircles the inclusive accomplishments of learners in all three learning domains. With the social systems in education theory in mind, published research documented evidence to support the relationship between educational facilities and society. Findings validate that viable learning spaces motivate substantial discourse centered on the operations, customs, and traditions occurring in the surrounding society (Reddy & Sailakshmi, 2018). These pieces are explored and debated to determine whether they should be maintained or discarded, thereby declaring institutions of learning as a catalyst for social. In this way, schools are the source of societal shifts.

Race in Education

Disparities exist within separate classrooms, beyond grade levels within schools, and across schools inside districts. The confirmation is captivating that students recognized as Black, Latinx, Indigenous, language learners, economically challenged, or with special needs, along with other vulnerable learners, do not have the corresponding chances their peers have to acquire and master in mathematically dynamic spaces (Huinker et al., 2020). Two centuries of U.S. historical data may be interpreted as proof that educational institutions are controlled by White Americans whose dominance is unremarkable and taken for granted (DiAngelo, 2018). DiAngelo (2018) said that White people are disproportionately enriched and privileged because of social institutions such as public schools, government, banking, and the military. DiAngelo posited that this privilege is engrained below the subconscious of White America, thus the slightest

suggestion of its existence is met with denial and rage in some instances. The current social and political climates may be attributed to the hypersensitive reactions and responses garnered whenever White privilege is being broached. Fortunately, this conversation centered on privilege is starting to be facilitated by non-Black people seeking to build an equitable society where all manner of people may flourish and thrive.

Francis and Darity (2021) contended that continuing within-school separation at the secondary level is attributed to the longstanding tradition of racialized tracking resulting from the opposition to the desegregation of schools by race. Following several federal rulings, schools moved towards a magnet school model fabricated to entice White middle-class families to primarily Black, inner-city school communities by presenting improved education outcomes contained inside schools that were actually found in inner cities (Francis & Darity, 2021). One of the three schools at the center of this study is a magnet school.

The consequences of magnet schools, however, were to continue within-school isolation where non-BIPOC middle-class students are mostly placed in classes with advanced and enriched courses of studies, while BIPOC students and those traversing poverty are mostly situated in traditional or foundation-based classes (Francis & Darity, 2021). The researchers concluded that current even today, BIPOC and non-BIPOC students encounter separate and unequal academic circumstances even when they are occupying the same school building(s) (Francis & Darity, 2021).

Race plays a significant part in educational opportunity gaps. Extreme changes to the American landscape, skewed by economic status, has “detrimental effects of inequality on future generations” (Noguero, 2017, p. 131). At the federal level, strides

have been made to address the opportunity gap. Noguero (2017) argued that closing the opportunity gap is not a significant policy agenda item. The Civil Rights Project (2014) reported that Latinx students were more prone to attend majority non-White schools servicing low-income families. Latinx and Indigenous learners are more certain to frequent a racially segregated school where racism is prioritized over opportunity and achievement (The Civil Rights Project, 2014). Educators should never forget that a positive school culture must be in place because equity work will not thrive without an inclusive environment that is socially, emotionally, and academically safe for students. This safe space should be inclusive of all learners and not prevent underrepresented students from engaging in the process of inquiry (The Civil Rights Project, 2014). Prevention of inquiry, particularly when one prevents Black students from being acutely aware of their situation, has been a form of violence and a violation of humanity. The denial of access to inquiry-based, decision-making learning spaces for Black students is unjust, unfair, inequitable, unconstitutional, and immoral (Freire, 1970).

Radical thinking must occur if one intends to embrace the international social-justice movement. The U.S. has embarked on but not necessarily embraced radical thinking before. Ending the torturous, murderous, inhumane, and immoral institution of slavery was radical. Attempting to reconstruct a much broken and divided post-slavery country was revolutionary. Soon after the Civil War, previously enslaved men were elected to the U.S. Congress (Lopez Bunysasi & Watts Smith, 2019). A problem within the education system is that too many educators believe that progress toward racial equality is political, thereby having little or no place in the equity conversations beginning to spill into curriculum and instruction discourse. However, race will always

be a serious matter of education. Bartlett and Brayboy (2005) stated that popular, public addresses and academic discourses reflect continuously on the radical achievement gap in schooling, posing various explanations: intellectual deficits, cultural deficits, cultural differences, resistance, and institutional racism, among others. Bartlett and Brayboy noted Ray McDermott's decades-old observation of how society continually seeks to explain BIPOC school deficiency by questioning what is wrong with “those students” or their family members rather than examining how the structure of academic institutions (and entire communities) are detrimental for particular groups. Bartlett and Brayboy noted other researchers (Ladson-Billings, 1992; Lee, 1991) who have prescribed the need for examination of the ways that race has been perpetuated in society and examined institutional and societal entities’ roles more closely in the educational underachievement of underrepresented students.

Systemic Racism

Despite centuries of evidence that says otherwise, our society's factions believe African Americans do not want a high-quality, globally competitive education. Historians and recorders have said this false perception is so polarizing that policies, practices, and school reform are predicated around this baseless assumption. Chronicled studies on African American learning have concentrated principally and judiciously on the success of public schools. Teaching has been a pretentious battlefield in the BIPOC struggle to acquire equal citizenship rights under the law. The BIPOC struggle to access educational opportunities does not stop at schools. The struggle permeates every corner of the African American experience (Perry et al., 2010). Even with the creators of the Constitution's contention that public schools were the power and design of democracy, racial prejudices

have penetrated and persevered in social, business, and governmental organizations. There has been a widespread evolution to deliver equal and equitable exposure to public education incited by a milestone Supreme Court ruling proclaiming that the separate but equal doctrine was unsuitable in public schools (Smith et al., 2017). Attempts to close the equity gap stretch beyond the bounds of the public school system, but an equitable learning environment is more attainable with the abolishment of systems meant to maintain segregation based on race, ethnicity, and ability levels. Again, the practice of tracking students in remedial and foundation-based classes is just one example of how segregation still exists in many schools across the nation. Education reform/abolition must address the lack of representation for BIPOC students, particularly in advanced mathematics classes through progressive and institutional educational program action initiatives and systemic shifts engineered to survive with the present-day reverberations of a long, painful history of omission and missed opportunities (Smith et al., 2017). These missed opportunities add to the number of Black households led by non-college-educated parents unable to raise their children in a college-going atmosphere, potentially impeding educators' efforts to improve the quality of life for the newest Black population members. Should society realize that the vitality of the nation hinges on the success of all students, not just the privileged, overwhelmingly White learners who often seamlessly find their way into rigorous, rich, academic learning spaces, we might live up to the dream of being a true superpower (Smith et al., 2017). Until that time comes, BIPOC students will continue to be objects and serve as a baseline for public schools. STEM-related fields will continue to recruit and employ from a pool of candidates who do not accurately reflect the demographic of the American people. College-entry assessment scores for

Black students will remain among the lowest. Our most prestigious universities will house predominately White learners who will invariably write and enforce the laws that further oppress enslaved people's descendants (Smith et al., 2017).

The original authors of Critical Race Theory (CRT) highlighted how various elements of marginality are used within the American school system to further distance individuals from the center of strength inside social and legal organizations (Reed, 2021). Complex questions of racial equity are at the center of their claim: What constitutes neutrality or normalcy is not only tremendously conditional but also acutely linked to racial assumptions that often are unjustified (Reed, 2021). As CRT has garnered popularity, its affect stretching, CRT has received a mixed reaction inside the sphere of education (Reed, 2021). Educational intellects have merged the intuitions of CRT with ethnic studies and mixed in their censorious and progressive conventions (Reed, 2021). The ensuing groundwork has in numerous approaches advanced beyond appraisal and formulated particular teaching methods within the policy borders of school systems that bring into play race, ethnicity, and culture to help children learn better (Reed, 2021). Contrary to not confronting racist policies, implementation of culturally responsive pedagogies explicitly invokes and utilizes the racial identities of students to nurture student education (Reed, 2021).

Black spaces for students and educators are sparse and insecure. These spaces can be taken back at any moment and are usually attached to some sort of short-term initiative or weekend program. Political or academic leadership may decide to shift gears or terminate the initiative at any time. With all the resistance to anti-Blackness, oppressed people appear to find solace in temporary spaces (St. Amour, 2020).

The case known as *Brown v. Board of Education* (1954) was a fusion of five distinct cases picked up by the U.S. Supreme Court regarding the matter of segregation in public schools (Office of the U.S. Courts, n.d.). The central theme binding all five cases was the integrity of state-sponsored segregation in public schools (Office of the U.S. Courts, n.d.). When the cases were introduced to the Supreme Court in 1952, the Court merged all five cases under the designation of *Brown v. Board of Education* (Office of the U.S. Courts, n.d.). Thurgood Marshall, arguing the case, consistently referred to the American school system as separate for Blacks and Whites and intrinsically unequal (Office of the U.S. Courts, n.d.). Invariably, this system did not uphold the "equal protection clause" of the 14th Amendment to the U.S. Constitution (Office of the U.S. Courts, n.d.). Additionally, Thurgood Marshall relied upon the figures from various sociological tests to explicitly avow segregated school systems tended to compel Black children to feel insignificant when compared to White children, and thus such a system should not be legally sanctioned (Office of the U.S. Courts, n.d.). Chief Justice Earl Warren delivered the opinion of the court which concluded that in the field of public education, the attitude of "separate but equal" has no place. When the *Brown v. Board of Education* decision was rendered and Black children eventually had a possibility at a reasonable education, White officials did not see children aiming for exceptional schools and freedom to contribute to society completely; they saw only a menace and acted accordingly—closing schools, preempting public money into private repositories, leaving millions of people in educational deterioration, willing even to impede national security amid a major disaster—all to ensure that Blacks did not benefit (Anderson, 2016). Historical injustices are the root cause of the consistent opportunity gaps between BIPOC

and non-BIPOC students. The equity gap is attributable to race predicated by White rage and racism (Love, 2019).

BIPOC Student and Advanced Mathematics Courses

The 2015–2016 Civil Rights Data Collection is a national survey of all public schools and districts. This collection gauges student accessibility to STEM-related courses through an equity and opportunity lens (U.S. Department of Education Office of Civil Rights, 2015). Results from this report concerning advanced mathematics are outlined in Table 3.

Table 3

Number and Percentage of U.S. Students Enrolled in Advanced Mathematics

Race/Ethnicity	Number	Percentage
American Indian/Alaskan Native	14,209	0.7
Asian	179,923	8.2
Hispanic or Latino of any race	413,051	18.9
Black or African American	281,359	12.9
White	1,229,081	56.3
Native Hawaiian or Other Pacific Islander	6,134	0.3
Mixed-race	59,742	2.7
Total students	2,183,499	100

Note. Adapted from data collected by the U.S. Department of Education (2021).

The Center for American Progress (2021) compiled a report outlining the consistent opportunity gaps among AP coursework. This report informs access to the AP curriculum, enrollment in AP classes, taking AP assessments, and passing AP tests. The Center for American Progress identified opportunity and accessibility gaps across racial and ethnic subgroups and suggested a plethora of factors contributing to these inequities.

Patrick et al. (2020) conducted a study and subsequently discovered that Black and Latinx learners across the nation have an inequitable amount of exposure to progressive curriculum. Patrick et al. sought to examine why this particular population missed essential learning opportunities; how common these inequities are; and what state, district, and site-based stakeholders can do to increase access and opportunity.

Patrick et al. (2020) revealed an absence of color prevalent across grade levels. Black students represent 16% of overall enrollment within elementary schools across the nation and 9% of the enrollment in gifted and talented programs; Latinx students constitute 28% of elementary students enrolled, yet 18% of the gifted and talented program is Latinx. Black and Latinx students are not sufficiently enrolled in eighth-grade algebra at the middle school level. Black students make up 15% of all eighth graders, but only 10% are enrolled in eighth-grade Algebra I. Similarly, Latinx students make up 25% of eighth graders and just 18% of eighth graders in the course. Black students make up 15% of secondary students nationwide, but only 9% are enrolled in at least one AP course. Almost 25% of students in the U.S. are Latinx, but only 21% of students enrolled in AP courses are of Latin descent (Patrick et al., 2020).

Research supported by Grant 5 R24 HD042849 awarded to the Population Research Center at The University of Texas at Austin by the Eunice Kennedy Shriver National Institute of Health and Child Development as well as the National Science Foundation Grant ECR-1348819, found that enrollment in early algebra courses predicts advanced mathematics classes taken in a secondary setting (Morton & Riegle-Crumb, 2019). Morton and Riegle-Crumb (2019) found research acknowledging that eighth-grade Black and Latinx students do not have equal access to algebra compared to their non-

BIPOC peers. However, there is insufficient evidence available to understand the cause of this inequity fully. Because of this, Morton and Riegle-Crumb argued that "understanding when inequality is created or exacerbated is critical to disrupting it" (p. 530).

School Leadership

Equitable leadership assembles strategies that support a shared focus, push accountability, encourage transformation, and champion systemic equity (Linton, 2011). Relationships, relevance, rigor, and expectations are necessary to sustain strong leadership. Table 4 outlines the role leadership plays in an equitable system.

Table 4

Leadership Within an Equitable System

Focus	Description
Strong vision and direction	Focus on the goals that address student learning and teacher performance.
Educator accountability	Addresses the high expectations placed on teachers and school leaders. Priorities are focused on students' needs.
Sustaining innovations	Schools develop and deliver timely professional development focusing on coaching, collaboration, and on-demand instructional support.
Systemic equity	Understanding differences guarantee access and opportunity for all students and empower stakeholders with social justice strategies.

Note. Adapted from *The Equity Framework*, by C. Linton, 2011, p. 57-58. Copyright 2011 by Corwin.

Strong school leadership influences all students' favorable outcomes, particularly when these influences focus on achieving equitable outcomes. Research conducted by Choi (2019) described key activities designed to enhance equitable learning spaces for all

students. These leadership activities comprised (a) designing a culture of common insight, (b) establishing a collaborative work system, (c) validating need-based teacher substructures, (d) utilizing data to drive decision-making, and (e) scrutinizing and engaging in policy changes in conjunction with local educational agencies administrators to bring about changes. The end product is equity-based inclusive education that makes learning relevant and engaging for each student, thereby strengthening outcomes (Choi, 2019).

Leathwood (2021) studied school leadership and found equitable opportunities for student growth improvement at secondary sites where principals intentionally initiated a culture of belonging. Strong leadership intuitively understands the need to partner with the community and students to create a prideful learning space. School leadership built a shared vision by encouraging a family culture within the school. Additionally, classroom teachers were cognizant of leadership's high expectations, and teachers felt highly supported as they worked to meet expectations (Leathwood, 2021).

School Culture

School culture applies to the process educators and other stakeholders take when collaborating. School culture also applies to the optimism, assumptions, and values they have in common. A confident school climate and culture promotes the learning potential of students (Kalkan et al., 2022). Relationships, relevancy, expectations, and rigor are the keystones of a school's culture (Linton, 2011). These keystones are supported by equitable practices, strong leadership, and timely professional development (Linton, 2011). Culture develops as a group responds to any environmental problems and can serve as a framework for school officials to investigate irregularities (Gruenert &

Whitaker, 2015).

A collaborative school culture encourages both students and educators to be lifelong learners. Classroom teachers are provided with opportunities to share best practices and chase professional development occasions and are dedicated to bettering their work (Gruenert & Whitaker, 2015). Twelve factors affect a school's culture, as outlined in Table 5.

Table 5

Influential Factors of School Culture

Factor	Concerning question
Student achievement	Do educators significantly consider student achievement?
Collegial awareness	How often do educators devote time to observing one another to better their practice?
Shared values	To what degree are teachers on the same page regarding educational values?
Decision-making	To what degree do teachers value the opportunity to make decisions that affect student achievements?
Trust	To what degree do faculty members exhibit trust in one another?
Risk-taking	To what degree do teachers benefit from the chance to try out new concepts in the classroom?
Openness	If one teacher observes another in the classroom, would they feel free to offer constructive criticism?
Parent relations	To what degree are parents valued for contributing to the education process?
Leadership	Does the culture embrace opportunities to include school leaders, or does it encourage teachers to hide from them?
Communication	To what degree do written or unwritten rules and expectations regulate communication among staff?
Socialization	To what degree do essential faculty train new teachers?
Organizational history	How do former stakeholders influence the present and future?

Note. Adapted from *School Culture Rewired*, by S. Gruenert and T. Whitaker, 2015, pp. 66–74. Copyright 2015 ASCD.

A sincere reflection of a school culture may reveal that many educators believe

Black, Latinx, and mixed-race students are less capable of quality instruction but are concerned and care that diverse students receive good pedagogy in classrooms (Scialabba, 2017). According to the Alliance for Education Solutions (2021), school culture is defined as how activities are performed in a school; the basic criterion and beliefs that form patterns of conduct, ideas, and assumptions between collaborators in the school.

A school's culture is constantly in commission, either aiding or hampering learning. It guides each resolution and deed in a school, from the principal's captaincy to the way teachers decide curriculum materials and engage learners (Alliance for Education Solutions, 2021).

The lack of knowledge and awareness of many teachers regarding diverse groups heightens the key query for educational equity and expectations of expunging the (opportunity) gap. Deficiency-based opinions of Black students' truncated expectations and subpar instructional standards are all possibilities when teachers probe the intellectual capacity of any student. Still, those arguments are most detrimental when student abilities are questioned based wholly on details such as socioeconomic status, race, ethnicity, culture, language, or gender (Howard, 2010).

McClellan et al. (2018) found that school culture commonly appears in fact finding about opportunity and achievement gaps. This W. K. Foundation-funded report stated that professional development is often the answer to strong school culture. The report also found that professional development should become a part of every classroom teacher's life and is often needed to maintain professional licensure (McClellan et al., 2018).

NCTM has long been committed to ensuring opportunities for high-quality mathematics education for each student (NCTM, 2021). When asked what is essential to design, reinforce, and maintain a culture of equity and access in the learning and teaching of mathematics, Padilla et al. (2019), NCTM researchers responded,

> A firm commitment to this work requires that all educators operate on the belief that all students can learn. To increase opportunities to learn, educators at all levels must focus on ensuring that all students have access to high-quality instruction, a challenging curriculum, and the innovative technology that existing advanced mathematics courses have to offer. Secondary sites should provide differentiated supports and enrichment necessary to promote students' success at continually advancing levels. Providing all students with access is not enough; educators must have the knowledge, skills, and disposition necessary to support equitable mathematics teaching and learning. (p. 27)

Instructional Practices and Supports

NCTM offers four key recommendations for strengthening school mathematics, urging stakeholders to critically examine their mathematics programs holistically to take the necessary steps to uproot inequitable structures and ineffective practices, which will engender a catalyst for lasting change. NCTM acknowledges that the status quo is simply unacceptable, and mathematics teaching and learning improvements are far from complete (Huinker et al., 2020). NCTM recommends (a) broadening the purpose for mastering mathematics, (b) designing equitable arrangements in mathematics, (c) implementing equitable mathematics instruction, and (d) developing deep mathematical understanding. At the high school level, each learner would master the necessary

concepts to enlarge professional possibilities; realize and analyze society; and encounter the wonder, joy, and allure of mathematics. NCTM propounds that high school mathematics ought to abandon following teacher practice and tracking learners into comparatively unlike or obscured curriculum routes. By implementing equitable math instruction, classrooms would be in accordance with research-based and unbiased learning routines. High schools offering uninterrupted 4-year mathematics routes, with all learners participating in mathematics every year, including multiple years of mathematics in a commonly allocated route absorbing the indispensable ideas, would provide the highest-quality mathematics education for all learners (Huinker et al., 2020).

NCTM (2020) called for the dismantling of ability groups to understand that these groupings and other tracking systems tend to assign marginalized learners to less-rigorous classes where expectations are pathetically low. Once placed in this environment, the subsequent courses are terminal in that students will not be personally or professionally prepared for their future. NCTM is aware that student placement in foundational courses is often predicated and motivated by race. As mentioned earlier, highly qualified teachers are apt to instruct rigorous, glamorous, high-profile advanced mathematics classes. This assignment leaves newer, less-experienced educators to teach remedial classes to a disenfranchised population. The shift toward equitable practices and the dismantling of systems that use one-dimensional descriptions of teachers and students will decrease the imbalance in mathematics achievement and increase the number and diversity of students enrolled in upper-level mathematics courses in high school (Huinker et al., 2020). School-based conversations must be had if Black students are guaranteed a seat at the advanced mathematics table. NCTM (2020) has provided a set of questions

meant to drive the solution-oriented conversation on diversity and inclusion. Table 6 includes question-based conversation starters.

Table 6

NCTM Equity and Diversity Plan

Goal	Conversation starter
Broaden the purposes of learning mathematics	How can opportunities to understand and critique the world through mathematics be integrated into the mathematics curriculum as part of what teachers bring each day to mathematics instruction?
	What are supports needed to ensure that teachers' ongoing professional learning, teamwork, and planning are focused on implementing the school mathematics curriculum with integrity?
Implement equitable mathematics instruction	To what degree do teachers in the school or district embody equitable mathematics teaching practices?
	What is the quantity and quality of the mathematics-focused collaborative time for teachers and instructional leaders in the school?
Create equitable structures in mathematics	What steps can be taken to identify and eliminate biases that lead to differential learning opportunities in the school for mathematics?
	How can individuals in the school communicate with educators, families, and students about the multiple purposes of learning mathematics and related shifts in instruction?
Develop deep mathematical understanding	To what extent are the mathematical practices and processes prioritized in classrooms in the school or district?
	Why might this be the case?
	What specific school or district structures, policies, and practices support or undermine teaching for deep mathematical understanding?

High school math educators mold the mathematical identities of students through effective use of teaching applications to situate students as mathematically adequate. The

creation of rigorous academic opportunities allows learners to demonstrate command and control frequently seen in advanced mathematics spaces. Teachers of mathematics are to demonstrate mathematics to sharpen understanding. Mathematics targets have two parts: They narrate the mathematical ideas, concepts, or procedures that students will realize because of instruction, and they recognize the mathematical practices that students will be investigating (NCTM, 2021). Teachers are expected to design rules for engaging in mathematics, including generating structures to situate all students as comprehensive contributors to mathematics and discern that involvement creates options (Turner et al., 2013). Inside of this teaching application, practitioners should create classroom engagement rules that allow each learner to become a competent mathematics thinker and valued mathematics contributor. Teachers of mathematics are to carry out assignments that encourage reasoning and problem-solving. Successful implementation of mathematics problems influences learning and supports students as they construct new mathematical awareness through inquiry (NCTM, 2021). Activities that require the development of patterns, cognitive reasoning, and problem-solving result in a balanced orientation toward mathematics and demonstrate that the student is a performer of mathematics (Boaler & Staples, 2008).

Practitioners must use problems to develop constructive temperament toward mathematics and build the mathematical identities of students within this teaching practice. Math teachers should use and associate mathematical depictions. Mathematical depictions are particularly important in helping students strengthen their appreciation of mathematical procedures and concepts, notice problems, and contribute to the mathematical conversation (NCTM, 2021). The use of various descriptions allows

students to draw on various sources of understanding (NCTM, 2021). Employing various sources of understanding acknowledges the mathematical, cultural, and social strengths learners contribute to mathematics. Practitioners who apply this teaching method successfully authenticate the experiences and interests of students. Math teachers clear the way for significant mathematical discourses. Discourse grants learners occasions to share ideas and refine comprehension, build mathematical explanations, expand a vernacular to communicate mathematical reasoning, and comprehend the mathematical viewpoints of a great many (NCTM, 2021). Through conversation, learners grasp that their analytical thought processes provide a predominant part of their mathematical studies, propelling themselves and others as skillful mathematicians (Joseph et al., 2017). In executing this learning procedure, practitioners design systems that situate learners as mathematically accomplished and being able to share their scientific thinking, bond with peers to comprehend a great many mathematical intellects, engage with classmates to respect others' mathematical perspectives, and participate in mathematical reasoning. Mathematics practitioners present purposeful inquiry. Purposeful inquiry motivates learners to describe and contemplate their own and others' thinking. Purposeful inquiry permits practitioners to differentiate why learners understand, recognize, and utilize these perceptions to transform instruction to serve learners (NCTM, 2021). Learners are persistently required to justify their rationale. The genre of inquiry that learners are exposed to can reinforce practical mathematical agency and identity by placing learners as scholars and practitioners of mathematics (Aguirre et al., 2013). Practitioners performing this teaching philosophy present enthusiastic inquiry and are aware of which learners ask which kinds of queries and whose views are selected during the instruction.

Teachers of mathematics build procedural fluency and conceptual understanding. Conceptual understanding and procedural fluency are critical and connect tools in developing mathematical capacity (NCTM, 2020). Mathematics teaching that only centers on memory and application methods benefits learners who are capable of memorizing and deprives learners who are not (Joseph et al., 2017). Accordingly, engaging predominantly in memorizing methods may deliver the sense that mathematics is not about understanding and application but is about memorization. However, teachers who participate in enhancing fluency form conceptual awareness and consistently traverse building fluency from conceptual comprehension. These teachers customarily connect conceptual understanding with procedural fluency so every student can create a context of mathematics and progress towards an optimistic propensity towards mathematics.

Mathematics teachers champion rich encounters in the study of mathematics. Teaching that welcomes prolific struggle allows occasions for learners to investigate profoundly into connections among mathematical objectives and grow a knowledge that guides learners to relate their investigation to new question conditions (NCTM, 2020). This learning application requires permitting learners the opportunity to contend with mathematical concepts (Hiebert & Grouws, 2007). Engaging with ideas allows learners to grow a sense of choice by taking possession of their mathematical logic. Functioning inside of this pedagogical application, practitioners allow learners to capture mathematical concepts and supply support across ambitious examinations to support persistence and character growth.

Equally important, mathematics teachers must obtain and use proof of student

reasoning. Obtaining and using learners' viewpoints obligate practitioners to address more than simply is a solution right or wrong. This learning application demands clarifying similar reasoning and patterns and addressing in what ways learners recognize a task and progressively arrive at conclusions (NCTM, 2020). Whose reasoning is prompted and utilized in a learning environment has powerful connections to mathematical agency and identity. Obtaining mathematical reasoning of learners who are recognized as always arriving at the correct response places faultlessness more important than mathematical reasoning. Hence, learners may not quote their reasoning and may cooperate only when they suspect they could possibly be accurate. By comparison, practitioners who engage in encouraging and using learners' authentic mathematical reasoning place each student as mathematically knowledgeable (NCTM, 2021).

Within any given day, transactional interactions between different student race groups transpire within the confines of a public school building. Through a bare lens, classrooms appear to be segregated concerning race and based on the rigors of the curriculum built around the course description. The lower percentage of Black, Latinx, and mixed-race students who have taken the AP assessments for calculus and statistics serves as a mere glimpse into the inequitable access to college-based learning. In addition to inequitable access to vibrant mathematical discourse, marginalized BIPOC students miss highly qualified teachers. Often, the best teachers deliver advanced lessons. Unfoundedly low expectations keep foundation-based math classes inhabited by Black and Latinx students (Davis & Jett, 2019). Love (2019) argued that the environments that continue dark hurting result from hundreds of years and multiple continents' commitment to creating and maintaining destructive, insidious, racist ideals that uphold White

supremacy and anti-Blackness. Throughout an African American's life, suffering manifests itself in many ways and takes just as many forms. One of the most damaging aspects of this suffering is the sheer lack of preventative measures that could have taken place during the public (mis)education of Black people. This research is designed to provide glimpses into how three large urban schools in the South advocate for African American students in their communities through the purposeful placement of students of color into academically demanding courses. Samuels (2020) explained that "Black and [Latinx] students are not enrolled in gifted and talented courses, Algebra I in 8th grade, or AP courses in numbers that match their representation among students nationally" (para. 1). The Education Trust (2020) found that in some instances, Black and Latinx students frequent a school void of any advanced courses, or they attend a school that places too few learners in advanced coursework completely or one with inequitable course assignments, meaning Black and Latinx learners, in particular, are being refused entrance to courses (The Education Trust, 2020).

All students enrolled in advanced mathematics courses are better positioned to experience mathematical teaching practices to support equitable mathematics teaching. Table 7 represents a bridge linking the eight mathematics teaching practices (NCTM, 2020) and equitable mathematics teaching practices.

Table 7

Eight Equitable Mathematical Teaching Practices

Mathematical practice	Equitable teaching
Establishing mathematics goals to focus learning.	Create learning sequences that shape students' mathematical understanding, magnifies their conviction, and support their mathematical identities as doers of mathematics.
Implement tasks that promote reasoning and problem-solving	Encourage students in performances that allow them to draw on their personal experiences (i.e., the resources that students bring to the classroom, including their home, cultural, and language experiences).
Use and connect mathematical representations.	Use various models to excite knowledge and encounters connected to students' resources to mathematics (culture, contexts, and experiences).
Facilitate meaningful mathematical discourse.	Use discourse as a means to disrupt systems and language that neglect students.
Pose purposeful questions.	Ask deliberate questions and then listen to and understand students' thoughtfulness to signal that their thinking is appreciated and makes sense.
Support productive struggle in learning mathematics	Hold high expectations while offering just enough support and scaffolding to facilitate student progress on challenging work, to communicate caring and confidence in students.
Elicit and use evidence of student thinking	Make student thinking public, and then elevate a student to a more prominent position in the discussion by identifying his or her idea as worth exploring to cultivate a positive mathematical identity.
Build procedural fluency from conceptual understanding.	Connect conceptual understanding with procedural fluency to reduce mathematical anxiety and position students as mathematical knowers and doers.

Note. NCTM. Copyright 2021.

Summary

The literature review describes the specific variables and viewpoints this research

analyzed. It explains the concepts and variables while building knowledge and validating the need to provide equitable access to advanced mathematics courses for Black, Latinx, and mixed-race students. Provided in the review of literature was research related to the theory of equity in education, information on systemic racism, equitable mathematics teaching practices, and factors that influence school culture.

Studies and literature centered on equity, access, and opportunities for BIPOC students were also highlighted in this review, focusing on national mathematics standards and instructional practices intent on closing the opportunity gap between Black, Latinx, and mixed-race students and their White peers. Racial inequity within the public school system is a decades-old topic, so there is no shortage of documentation to support this research. To reach equity, Leading Educators (2020) noted that "people and systems must address root causes of inequalities not just their manifestation. This includes [the] elimination of policies practices, attitudes and cultural messages that reinforce differential outcomes by race or fail to eliminate them" (p. 7).

Chapter 3 explains the methodology I used for this study. The chapter includes a concise history of the research design and a framework. The chapter explains the setting, participants, rationale, research questions, data sources, and analysis.

Chapter 3: Methodology

Introduction

BIPOC students in public high schools do not have equitable access to advanced mathematics courses compared to their White peers. The U.S. Department of Education (2008) believed that mathematical knowledge is often used as a surrogate in determining intelligence and access to high-level mathematics coursework and continues to be utilized as a gateway to academic and economic opportunity. Because of its favored footing, school mathematics has consistently been a site of political contestation among mathematicians, mathematics educators, and the general public regarding its content, preferred pedagogical approaches, methods of assessment, and more recently, issues of equity and inclusion (Martin, 2019). This significant gap in accessibility contributes to why BIPOC students are not entering 4-year colleges and universities at the same rate as their counterparts. In 2018, the National Center for Education Statistics found that Asian students enrolled in college at higher rates than Black, Latinx, or White students (IES, 2021). Apart from 2016, between 2000 and 2018, the enrollment rates of White students were higher than Black and Latinx students (IES, 2021).

This study examined three urban, southern high schools and how each addressed replacing segregated classrooms with inclusive learning environments led by teachers engaged in culturally responsive training.

Chapter 3 outlines the research setting, participants, design, and rationale. This chapter also includes the research questions, instrumentation, reliability, validity, and research procedures for recruitment and participation. Lastly, this chapter explains the research procedures, data collection and analysis, limitations, delimitations, ethical

considerations, and a summary.

Purpose

The purpose of this quantitative research study was to examine the number of Black, Latinx, and mixed-race students enrolled in advanced mathematics classes in association with teacher perceptions of school culture and instructional practices and supports. At the center of this research, three secondary sites were part of a district providing academic instruction, rigor, and support to over 145,000 students in kindergarten through 12th grade. The district maintains 176 schools in several towns and cities. The district boasts a diverse mix of students representing over 150 countries and who speak 175 languages and dialects. The academic community offers extensive magnet programs in 50+ schools to nurture students with interests and abilities in specific areas. The district also educates, supports, and meets the needs of students with learning and physical disabilities. It is the largest employer in its county, with more than 19,000 teachers, support staff, and administrators. It is fortunate to have tremendous support from various corporate, faith, and business communities and more than 90,000 mentors and volunteers who foster learning and instruction within its schools. The district's vision is to supply all learners with the finest education accessible anywhere, developing every child to lead a prosperous and dynamic life. Its mission is to optimize the academic performance of every student in every school.

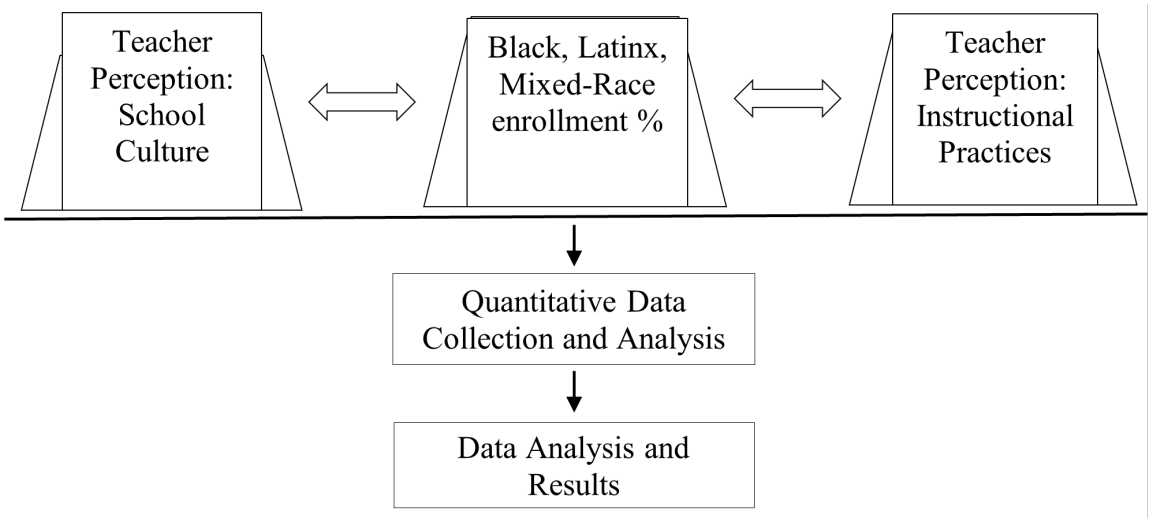
Research Design

I used a quantitative research design to examine differences in enrollment between non-White and White students in advanced math classes. I determined whether there was a relationship between school culture, teacher instructional practices, and

enrollment percentages of Black, Latinx, and mixed-race students in advanced mathematics courses. Correlation research is a procedure involving two measured variables (school culture and instructional practices), without any manipulation, to determine whether there was a relationship (Creswell, 2014). The examination of this relationship happened concurrently with analyzing enrollment percentages of Black, Latinx, and mixed-race students. I noted the relationship between school culture and instructional practices and explained the outcomes. This correlational research was a non-experimental research method. I measured teacher perceptions of school culture and instructional practices. I came to understand and assess the statistical relationship between them without any extraneous variable (Question Pro Software, 2021). Figure 4 describes the correlational method.

Figure 4

Correlation Methodology



This quantitative research was an approach to an inquiry involving collecting quantitative data, integrating the two forms of data, and using distinct designs involving a theoretical and conceptual framework. Table 8 outlines the procedural steps for this

research.

Table 8

Procedural Steps for Research

Consent to research
Data collection
NCTWC survey results—student enrollment data
Statistical analysis
NCTWC survey results—Pearson's *r*
Student enrollment data— chi-square test
Report findings

Research Questions

This research study sought to answer the following questions:

1. To what extent is there a significant difference in the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses compared to their White peers?
2. To what extent is there a significant difference in the percentage of Black, Latinx, and mixed-race students enrolled by gender in advanced mathematics compared to their White peers?
3. To what extent is there an association between teacher perceptions of school culture and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses?
4. To what extent is there an association between teacher perceptions of instructional practices and supports and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses?

Participants

There were no active participants in this study, meaning no interviews were required. An urban K-12 district contains the three schools of focus, supporting 32 high schools and three specialty sites. There are approximately 2,500 high school teachers and 5,380 students within this district whose experiences were chronicled by me.

I was familiar with the school district's equity initiative and chose three different secondary sites for this study. School A was selected because it had consistently served a predominately non-Black population. School B is one of the more racially diverse high schools in the area, and School C is a predominately Black learning space. In total, the North Carolina Teacher Working Conditions (NCTWC) survey invitations were sent to 361,481 North Carolina teachers during the following years: 2016, 2018, and 2022. Teachers recorded and returned 313,844 responses. I focused on 712 survey responses from the three focus schools over the span mentioned earlier. Table 9 provides a detailed description of each school's racial dynamics.

Table 9

Student Diversity

	School A	School B	School C
Student Population	3,315	2,068	1,305
% Black	11	42	58
% White	56	19	6
% Hispanic	10	28	25
% Indigenous	.1	.2	.2
% Mixed Race	3	3	4

Note. This table includes the demographics (based on race) of the three schools at the center of this study. Of these schools, School A has the lowest percentage of BIPOC students, School B has the most diverse representation of BIPOC and non-BIPOC students, and School C has the largest number of BIPOC students.

Instrumentation

The NCTWC is a quantitatively reasonable and dependable apparatus designed to assess whether educators have working conditions in their schools that support effective teaching (Martin & Kline, 2018). The NCTWC survey is an online, unidentifiable survey that appraises teacher working conditions in several significant areas. Among other areas, responses highlight professional development opportunities and instructional practices and supports (North Carolina Department of Public Instruction, 2020). The NCTWC survey questions are outlined in Table 10 and determined teacher perceptions of school culture and instruction practices and supports.

Table 10

NCTWC Responses to be Considered

Professional Learning Opportunities Q8.1. Please rate how strongly you agree or disagree with statements about professional development in your school.
l. Professional development enhances teachers' ability to implement instructional strategies that meet diverse student learning needs. m. Professional development enhances teachers' abilities to improve student learning. h. Closing the Achievement Gap
Q8.3. In the past 2 years, have you had 10 clock hours or more of professional development in any of the following areas? Yes/No Response h. Closing the Achievement Gap
Instructional Practices and Supports Q9.1. Please rate how strongly you agree or disagree with the following statements about instructional practices and support in your school. Strongly Disagree, Disagree, Agree, Strongly Agree Response i. Teachers believe almost every student has the potential to do well on assignments.
Q10.6. Overall, my school is a good place to work and learn. Strongly Disagree, Disagree, Agree, Strongly Agree Response

The overall goal of this quantitative research was to expand and strengthen the study's conclusions and therefore contribute to conversations on teacher perceptions and opportunities for BIPOC students in secondary mathematics. The use of correlational research methods contributed to answering the research questions. Ultimately, quantitative research is about heightened knowledge and validity.

The NCTWC is one of the most efficient ways to understand the mindset of hundreds of teachers across the three sites and thousands of educators across the state

(North Carolina Department of Public Instruction, 2020). Local and state mandates relating to access to technology only increase the likelihood of surveyors revealing their perceptions of rigor, equity, accessibility, and the capability of all students to succeed given an adequate and sustainable support system by which to utilize. Anonymity and confidentiality are guaranteed.

Validity and Reliability

According to the North Carolina Department of Public Instruction (2020), the state superintendent believes the survey plays a significant role in improving the educational quality in classrooms across the state. The NCTWC survey is an anonymous, electronic survey that assesses teacher working conditions in key areas. Questions focus on various topics, including facilities and resources, professional development, and instructional practices and support. The NCTWC survey is a reliable and valid instrument intended to evaluate educator perceptions about various topics that research has shown to increase teacher retention and student engagement (North Carolina Department of Public Instruction, 2020).

Data Collection

A quantitative analysis of student enrollment in advanced classes and teacher perceptions was conducted. Student enrollment in advanced classes was collected from archived numerical records of Black, Latinx, and mixed-race students in several advanced mathematics courses. These records were located on publicly accessible websites. I collected responses from the NCTWC surveys over 3 school years. The responses from the NCTWC surveys described teacher perceptions as they relate to (a) professional learning opportunities, (b) instructional practices and supports, and (c)

overall site perceptions.

Data Analysis

Pearson's correlation coefficient is the test I used to measure the association between teacher perceptions and the enrollment amount of BIPOC students in advanced mathematics courses. In order to analyze the Likert scale data from the NCTWC survey, I used chi-square statistics to compare survey responses to questions with expected answers in order to assess the statistical significance of the null hypothesis.

Table 11 describes the methods used to analyze the data.

Table 11

Data Collection and Analysis Plan Including Research Questions

Research question	Instrument	Data collected	Method of analysis
To what extent is there a significant difference in the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses compared to their White peers?	Course enrollment numbers	Quantitative values	Chi-square test
To what extent is there a significant difference in the percentage of Black, Latinx, and mixed-race students enrolled by gender in advanced mathematics compared to their White peers?	Course enrollment numbers	Quantitative values	Chi-square test
To what extent is there an association between teacher perceptions of school culture and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses?	North Carolina Teacher Working Conditions Survey response	Likert responses from NCTWC survey ranging from strongly disagree to strongly agree	Pearson's *r*
To what extent is there an association between teacher perceptions of instructional practices and supports and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses?	North Carolina Teacher Working Conditions Survey response	Likert responses from NCTWC survey ranging from strongly disagree to strongly agree; non-Likert response–yes/no	Pearson's *r*

I used inferential statistics to test the correlation between teacher perceptions and enrollment numbers of Black, Latinx, and mixed-race student in advanced mathematics

courses. Most of the teacher perceptions from the NCTWC were reported on a Likert-type scale. The mean of the survey results was correlated with the advanced math enrollment percentages of BIPOC students using a Pearson's *r*. Table 12 describes the NCTWC Likert-type scale.

Table 12

NCTWC and Likert-Type Scale

Survey statement	Strongly disagree	Disagree	Agree	Strongly disagree
Q8.l.l: Professional development enhances teachers' ability to implement instructional strategies that meet diverse student learning needs.	◯	◯	◯	◯
Q8.m: Professional development enhances teachers' abilities to improve student learning.	◯	◯	◯	◯
Q8.1.h: Professional development enhances teachers' ability to Close the Achievement Gap.	◯	◯	◯	◯
Q9.1.i: Teachers believe almost every student has the potential to do well on assignments.	◯	◯	◯	◯
Q10.6: Overall, my school is a good place to work and learn.	◯	◯	◯	◯

Survey question	Yes	No
In the past 2 years, have you had 10 clock hours or more of professional development in Closing the Achievement Gap?	◯	◯

Limitations

The number of teachers who participated in the survey was a limitation as well as

any biases they may have had when completing the survey. I did not control the email distribution list used to disseminate access to the survey. The level of awareness of the NCTWC survey and its implications on learning and teaching is a limitation. Student enrollment in advanced mathematics courses and completion of any applicable North Carolina Final Exam or AP assessment is a limitation.

Delimitations

An online survey collected information from classroom teachers who may have responded electronically. Online surveys have several advantages. They are straightforward and easy to conduct. The survey was already created and distributed throughout the state with a global reach. This availability is important when information is urgently sought, such as in the current COVID-19 pandemic. I chose to use the NCTWC survey because the state routinely asks classroom teachers their perspectives every 2 years. The results are free, and access is granted to the public within a relatively short period (Andrade, 2020).

Ethical Considerations

Per Creswell (2014), prior to conducting the study, I addressed all ethical issues by doing the following:

- consulted the code of ethics for professional associations in the local area
- submitted a research proposal for institutional review board approval
- identified and went through local approvals
- selected sites that would not raise power issues with the me
- gave credit for work done on the project

Summary

A quantitative research design was used to examine the types of students by race in advanced math classes and teacher perceptions of culture and instructional practices at three different schools in an urban setting. The mean of the survey results was correlated with the advanced math enrollment percentages of Black, Latinx, and mixed-race students using a Pearson's *r*. The least-squares method helped curtail the error of the calculated relationship compared to actuality. Chapter 4 describes the results of this research.

Chapter 4: Results

Introduction

The purpose of this quantitative research study was to examine the number of Black, Latinx, and mixed-race students enrolled in advanced mathematics classes in association with teacher perceptions of school culture and instructional practices and supports. This quantitative research study focused on three urban, southern schools and used survey responses to gauge teachers' discernment of school culture and instructional practices and supports in relation to a district-mandated equity initiative. I sought to answer the following research questions:

1. To what extent is there a significant difference in the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses compared to their White peers?
2. To what extent is there a significant difference in the percentage of Black, Latinx, and mixed-race students enrolled by gender in advanced mathematics compared to their White peers?
3. To what extent is there an association between teacher perceptions of school culture and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses?
4. To what extent is there an association between teacher perceptions of instructional practices and supports and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses?

The number of Black, Latinx, and mixed-race AP exam takers in the district's public schools decreased 6.2% from 2019 to 2020, in comparison to a 17.1% decrease in

Black, Latinx, and mixed-race AP exam takers in public schools nationwide (State Board of Education, 2020). Engagement in AP coursework for Latinx students within the same school district continued to exceed the involvement and performance of Latinx students nationally. The quantity of Latinx AP exam takers in the southern states' public schools decreased 4.4% from 2019 to 2020, in comparison to a 14.2 % decrease in Latinx AP exam takers in public schools nationwide (State Board of Education, 2020).

Table 13 captures the AP enrollment data for the district at the center of this study.

Table 13

Number and Percentage of U.S. Students Enrolled in Advanced Mathematics

Race/ethnicity	Number	Percentage
American Indian/Alaskan Native	14,209	0.7
Asian	179,923	8.2
Hispanic or Latino of any race	413,051	18.9
Black or African American	281,359	12.9
White	1,229,081	56.3
Native Hawaiian or Other Pacific Islander	6,134	0.3
Mixed-race	59,742	2.7
Total students	2,183,499	100

Note. Adapted from data collected by the U.S. Department of Education (2021).

This chapter scrutinizes the analysis and results of the quantitative data used in this research. The discoveries were also considered in the view of previous investigatory findings and accessible literature to relate differences and similarities between previous studies and this study. A thorough account of the research methodology was given with each research question's findings.

Results

Research Question 1

To what extent is there a significant difference in the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses compared to their White peers? For Research Question 1, a chi-square test of independence was run to measure the difference between the observed and expected frequencies of the outcomes of the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses compared to their White peers. Table 14 provides the observed, expected, and $\frac{(0-E)^2}{E}$ values for School A.

Table 14

School A's Observed, Expected, and Chi-Square Values

	2016	2018	2021	Totals
School A Observed Values (O)				
Black, Latinx, Mixed-race	12	21	8	41
White	131	119	141	391
Totals	143	140	149	432
School A Expected Values (E)				
Black, Latinx, Mixed-race	13.57	11.29	14.14	41
White	129.43	126.71	134.86	391
Totals	143	140	149	432
School A $\frac{(0-E)^2}{E}$ Values				
Black, Latinx, Mixed-race	0.182	8.341	2.667	41
White	0.019	0.469	0.280	391
Totals	143	140	149	432

Using Microsoft Excel, I ran a chi-square test of independence to determine to what extent there was a significant difference in the percentage of Black, Latinx, and mixed-race students in advanced mathematics courses between 2018 and 2022. A *p* value

calculates the probability of acquiring the observed outcomes, presupposing the null hypothesis is true. The greater statistical significance, as it relates to the observed difference, comes with a lesser *p* value (Beers, 2022). A *p* value of .05 or smaller is often thought of as statistically significant (Beers, 2022). With respect to School A, I found there to be a significant relationship between enrollment differences and implementation year, $X^2(4, N=432) = 11.96$, $p = .021$; therefore, the null hypothesis is rejected.

Table 15 provides the observed, expected, and $\frac{(0-E)^2}{E}$ values for School B.

Table 15

School B's Observed, Expected, and Chi-Square Values

	2016	2018	2022	Totals
School B Observed Values				
Black, Latinx, Mixed-race	8	8	8	24
White	78	81	54	213
Totals	86	89	62	237
School B Expected Values				
Black, Latinx, Mixed-race	8.71	8.20	6.28	24
White	77.29	79.99	55.72	213
Totals	143	140	149	237
School B $\frac{(0-E)^2}{E}$ Values				
Black, Latinx, Mixed-race	0.058	0.005	0.472	24
White	0.007	0.013	0.053	213
Totals	143	140	149	237

Using Microsoft Excel, I ran a chi-square test of independence for School B to determine to what extent there was a significant difference in the percentage of Black, Latinx, and mixed-race students in advanced mathematics courses between 2018 and 2022 compared to their White peers. With respect to School B, I found there to be evidence to indicate there is not strong enough information to suggest an effect exists in

the population. There is nothing to support a significant relationship between enrollment differences and implementation year, $X^2(4, N=237) = 0.61$, $p = .963$; therefore, the high p values might present as an alert against making careless conclusions situated on differences that look meaningful but might be inaccurate. Therefore, I fail to reject the null hypothesis.

Table 16 provides the observed, expected, and $\frac{(0-E)^2}{E}$ values for School C.

Table 16

School C's Observed, Expected, and Chi-Square Values

	2016	2018	2022	Totals
School C Observed Values				
Black, Latinx, Mixed-race	21	25	44	90
White	7	5	17	29
Totals	28	30	61	119
School C Expected Values				
Black, Latinx, Mixed-race	21.18	3.78	46.13	90
White	6.82	7.31	14.87	29
Totals	28	30	61	119
School C $\frac{(0-E)^2}{E}$ Values				
Black, Latinx, Mixed-race	0.001	119.059	0.099	90
White	0.004	0.730	0.306	29
Totals	28	30	61	119

Using Microsoft Excel, I ran a chi-square test of independence for School C to determine to what extent there was a significant difference in the percentage of Black, Latinx, and mixed-race students in advanced mathematics courses between 2018 and 2022 compared to their White peers. With respect to School C, I found there to be evidence to indicate there is a strong relationship between the two variables, $X^2(4, N = 119) = 120.20$, $p < .001$; therefore, the null hypothesis is rejected.

Research Question 2

To what extent is there a significant difference in the percentage of Black, Latinx, and mixed-race students enrolled by gender in advanced mathematics compared to their White peers? For Research Question 2, a chi-square test of independence was run to measure the difference between the observed and expected frequencies of the outcomes of the percentage of Black, Latinx, and mixed-race students enrolled by gender in advanced mathematics courses compared to their White peers. To determine if the number of Black, Latinx, and mixed-race males and females is significantly different, I compared observed data with a hypothesis. The chi-square test of independence tested whether there was a relationship between the difference in the observed percentage of Black, Latinx, and mixed-race students enrolled by gender in advanced mathematics compared to their White peers.

Table 17 provides the observed cell data for School A.

Table 17

Observed Cell Data for School A

	2016		2018		2021			
	M	F	M	F	M	F	Total M	Total F
School A Observed Data (O) Based on Gender								
Black, Latinx, Mixed-race	8	4	10	9	5	5	23	18
White	91	59	76	60	39	31	206	150
Totals	99	63	86	69	44	36	229	168
School A Expected Data (E) Based on Gender								
Black, Latinx, Mixed-race	9.94	6.75	8.64	6.02	4.42	3.86	23	18
White	89.06	52.68	86	69	39.58	36	260	150
Totals	44	42	38	23	43	35	229	168
School A $\frac{(0-E)^2}{E}$ Values Based on Gender								
Black, Latinx, Mixed-race	0.380	1.120	0.215	1.470	0.076	0.339	23	18
White	0.042	0.759	1.163	1.174	0.009	2.310	206	150
Totals	44	42	38	23	43	35	229	168

Note. M=Male, F=Female.

Using Microsoft Excel, I ran a chi-square test of independence to determine to what extent there was a significant difference in the percentage of Black, Latinx, and mixed-race students enrolled by gender in advanced mathematics courses compared to their White peers between 2018 and 2021. A *p* value calculates the probability of acquiring the observed outcomes, presupposing the null hypothesis is true. The greater statistical significance, as it relates to the observed difference, comes with a lesser *p* value (Beers, 2022). In general, a *p* value of 0.05 or greater is considered critical. With respect to School A, I found there to be no significant relationship between enrollment

differences and implementation year, $X^2(5, N = 168) = 9.06$, $p = .106$; therefore, deviation from the null hypothesis is not statistically significant, and the null hypothesis is not rejected.

Table 18 provides the observed cell data for School B.

Table 18

Observed Cell Data for School B

	2016		2018		2021			
	M	F	M	F	M	F	Total M	Total F
School B Observed Data (O) Based on Gender								
Black, Latinx, Mixed-race	3	5	6	2	4	4	13	11
White	41	37	32	21	39	31	112	89
Totals	44	42	38	23	43	35	125	100
School B Expected Data (E) Based on Gender								
Black, Latinx, Mixed-race	4.58	4.62	3.952	5.59	4.47	3.85	13	11
White	39.42	32.93	38	23	38.53	35	112	89
Totals	44	42	38	23	43	35	125	100
School B $\frac{(0-E)^2}{E}$ Values								
Black, Latinx, Mixed-race	0.543	0.031	1.061	2.306	0.050	0.006	13	11
White	0.063	0.503	0.948	0.174	0.006	1.352	112	89
Totals	44	42	38	23	43	35	125	100

Note. M=Male, F=Female.

With respect to School B, I found there to be no significant relationship between enrollment differences and implementation year, $X^2(5, N = 237) = 7.04$, $p = .218$; therefore, deviation from the null hypothesis is not statistically significant, and the null hypothesis is not rejected.

Table 19 provides the observed cell data for School C.

Table 19

Observed Cell Data for School C

	2016		2018		2021			
	M	F	M	F	M	F	Total M	Total F
School C Observed Data (O) Based on Gender								
Black, Latinx, Mixed-race	11	10	18	7	24	20	53	37
White	4	3	3	2	7	10	14	15
Totals	15	13	21	9	31	30	67	52
School C Expected Data (E) Based on Gender								
Black, Latinx, Mixed-race	11.87	9.25	16.61	31.60	24.52	21.35	53	37
White	3.13	.87	21	9	6.48	30	14	15
Totals	44	42	38	23	43	35	67	52
School C $\frac{(0-E)^2}{E}$ Values								
Black, Latinx, Mixed-race	0.063	0.061	0.116	19.147	0.011	0.085	53	37
White	0.239	5.265	15.428	5.444	0.042	41.925	14	15
Totals	44	42	38	23	43	35	67	52

Note. M=Male, F=Female.

With respect to School C, I found there to be a significant relationship between enrollment differences and implementation year, $X^2(5, N=119) = 87.84$, $p < .001$; therefore, deviation from the null hypothesis is not statistically significant, and the null hypothesis is not rejected.

Research Question 3

To what extent is there an association between teacher perceptions of school culture and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses? Pearson's correlation coefficient is the test statistics that measured the statistical association between Black, Latinx, and mixed-race enrollment percentages and teacher perceptions of school culture. It is known as the foremost

procedure for calculating the association between variables of interest since it is predicated on the method of covariance. Pearson's correlation coefficient gave information about the magnitude of the association, as well as the trajectory of the relationship (Statistics Solutions, 2022). The two variables, teacher perceptions of school culture and Black, Latinx, and mixed-race students enrolled in advanced mathematics courses, were linearly related to each other. I plotted the values of the variables on a scatter diagram and verified whether the plot yielded a relatively straight line.

For School A, a Pearson correlation coefficient was computed to assess the linear relationship between teacher perceptions of school culture and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics. There was a nonsignificant, small positive correlation between the two variables, $r(2) = .05$, $p = .933$.

For School B, a Pearson correlation coefficient was computed to assess the linear relationship between teacher perceptions of school culture and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics. There was a significant, small negative correlation between the two variables, $r(2) = -.09$, $p < .001$.

For School C, a Pearson correlation coefficient was computed to assess the linear relationship between teacher perceptions of school culture and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics. There was a nonsignificant, medium-sized positive correlation between the two variables, $r(2) = .40$, $p = .313$.

Table 20 describes the results of the statistical test.

Table 20

Pearson Correlation Coefficient Test Results

	Research Question 3		
	School A	School B	School C
Pearson's *r*	.05	-.09	.40
p value	.933	<.001	.313

Research Question 4

To what extent is there an association between teacher perceptions of instructional practices and supports and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses? Pearson's correlation coefficient is the test statistics that measured the statistical association between Black, Latinx, and mixed-race enrollment percentages and teacher perceptions of instructional support. Like Research Question 3, a Pearson's correlation coefficient gave information about the magnitude of the association, as well as the trajectory of the relationship (Statistics Solutions, 2022). The two variables, teacher perceptions of instructional practices and supports and Black, Latinx, and mixed-race students enrolled in advanced mathematics courses, could possibly be linearly related to each other. I plotted the values of the variables on a scatter diagram and verified the plot yielded a relatively straight line.

For School A, a Pearson correlation coefficient was computed to assess the linear relationship between the two variables. There was a nonsignificant, large-size positive correlation between the two variables, $r(2) = .69$, $p = .083$. For School B, a Pearson correlation coefficient was computed to assess the linear relationship between the two variables. There was a significant positive correlation between the two variables, $r(2) = .69$, $p = .047$. For School C, a Pearson correlation coefficient was computed to assess the

linear relationship between the two variables. There was a significant slight negative correlation between the two variables, $r(2) = -.02$, $p < .001$. There is not a linear relationship between teacher perceptions of instructional supports and percentage enrollment numbers of Black, Latinx, and mixed-race students.

Table 21 describes the results of the statistical test.

Table 21

Pearson Correlation Coefficient Test Results

	Research Question 4		
	School A	School B	School C
Pearson's *r*	.69	.69	-.02
p value	.083	.047	<.001

Interpretation of Results

In two of the three schools, I found there to be a significant difference in the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses compared to their White peers. One school, School B, did not show a significant difference in the percentage of Black, Latinx, and mixed-race students compared to their White peers. All three schools exhibited a significant difference in the percentage of Black, Latinx, and mixed-race students enrolled by gender in advanced mathematics compared to their White peers.

In School A, there was a nonsignificant, small positive relationship between the percentage of Black, Latinx, and mixed-race students in advanced mathematics classes and teacher perceptions of school culture. At School B, there was a significant, small negative relationship between the percentage of Black, Latinx, and mixed-race students

in advanced mathematics classes and teacher perceptions of school culture. School C exhibited a nonsignificant, medium positive relationship between Black, Latinx, and mixed-race students in highly rigorous mathematics coursework and teacher perceptions of school culture.

Regarding instructional practices and supports, School A displayed a nonsignificant relationship between teacher perceptions and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses. School B showed a significant, positive relationship between perceptions and supports; while School C carried a significant, slightly negative, non-linear relationship between supports and perceptions.

Similarities

Schools A and C saw a significant difference in the percentage of Black, Latinx, and mixed-race students compared to their White peers enrolled in advanced mathematics. All three schools saw a significant difference in the percentage of Black, Latinx, and mixed-race students enrolled by gender in advanced mathematics compared to their White peers.

Several researchers conducted cross-national meta-analyses of mathematics trends. Their findings suggested that notwithstanding the irregularity of the magnitude and direction of gender differences in mathematic affect, male and female noncognitive mannerisms are the same (Ghasemi & Burley, 2019). Ghasemi and Burley (2019) found that sociocultural, international, educational, and political fairness of adults is not an indicator of a positive influence on male or female students. According to the National Center for Educational Statistics, the gender gap in the attainment of mathematics

degrees has remained consistent, while the gender gap in college degree conferment no longer exists (Glazer, 2019). Consistent with the results of this and other studies, gender-based equity gaps in mathematics achievement may emulate a variety of influences. A key influence of gender equality centers on pervasive societal gender stereotypes (Glazer, 2019). Glazer (2019) stated that gender-equal nations tend to have smaller gender-equity gaps in secondary mathematics. Nations with larger gender inequalities tend to have societal stereotypes persuasive enough to make an individual too afraid of corroborating the pessimistic stereotype associated with their grouping. These persuasive stereotypes, known as stereotype threats, have been attributed to math classes with substantial gender inequality. One of the possible sources of the gender gap in mathematics is "stereotype threat." Stereotype threat is when a person perceives the possibility of validating the pessimistic stereotypes about the group with which they are associated. Stereotype threat can cause females to be in conformance with the stereotypes and produce inadequate results on performative assessments (Glazer, 2019). Glazer found that stereotype threat was associated with the decline in attentiveness to STEM exploration in females.

School C saw a nonsignificant association between teacher perceptions of school culture and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses. Schools A and C saw a significant association between teacher perceptions of instructional practices and supports and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses.

Differences

School B was the only school to see no significant difference in the percentage of Black, Latinx, and mixed-race students compared to their White peers. School B was also

the only school to see a significant, small, negative association between teacher perceptions of school culture and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses. While Schools A and C saw no significant association, there were still clear differences with regard to school culture. School A saw a nonsignificant, small, positive association between teacher perceptions and enrollment percentages. School C saw a nonsignificant, medium, positive association between teacher perceptions of school culture and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses.

School A was the only school to have a nonsignificant relationship between teacher perceptions of instructional practices and supports and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses. More specifically, School A had a large, positive, nonsignificant association between teacher perceptions and enrollment percentages, whereas School B experienced a significant, positive relationship between teacher perceptions of instructional practices and supports and enrollment percentages of Black, Latinx, and mixed-race students. School C experienced a significant, non-linear, slightly negative association between teacher perceptions of instructional practices and supports and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses.

Summary

Results by School

School A. School A was found to have a significant difference in the percentage of Black, Latinx, and mixed-race students compared to their White peers in advanced mathematics courses. School A had a significant difference in the percentage of Black,

Latinx, and mixed-race students enrolled by gender compared to their White peers. School A had a nonsignificant, small, positive association between teacher perceptions of school culture and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses. School A had a nonsignificant, large, positive association between teacher perceptions of instructional practices and supports and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses.

School B. School B was found to have no significant difference in the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses compared to their White peers. School B had a significant difference in the percentage of Black, Latinx, and mixed-race students enrolled by gender in advanced mathematics courses compared to their White peers. This school had a small, negative, significant association between teacher perceptions of school culture and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses. School B had a significant, positive association between teacher perceptions of instructional practices and supports and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses.

School C. School C had no significant difference in the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses compared to their White peers. School C had a significant difference in the percentage of Black, Latinx, and mixed-race students enrolled by gender in advanced mathematics courses compared to their White peers. School C had a nonsignificant, medium, positive association between teacher perceptions of school culture and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses. This school

had a significant, slightly negative, non-linear association between teacher perceptions of instructional practices and supports and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses.

This research found that overall, there was a significant association between teacher perceptions of school culture and instructional practices and support and Black, Latinx, and mixed-race students' access to advanced mathematics. There was a strong positive correlation between teacher discernment and difference in the percentages of Black, Latinx, and mixed-race students compared to their White peers. School B, the most diverse of the three schools, had a smaller difference in enrollment percentages, and a higher percentage of their teachers perceived their work site to be a good place to work and learn. The *p* value was greater than the significance level of 5%; therefore, the null hypothesis for Research Question 2 was not rejected. For each of the three schools, there was no significant relationship between gender and Black, Latinx, and mixed-race enrollment. Table 22 displays the research question and the significance value by school.

Table 22

Significance Results by School

Research Question 1: To what extent is there a significant difference in the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses compared to their White peers?	
School	*p* value
A	.021
B	.963
C	<.001

Research Question 2: To what extent is there a significant difference in the percentage of Black, Latinx, and mixed-race students enrolled by gender in advanced mathematics courses compared to their White peers?	
School	*p* value
A	.106
B	.218
C	<.001

Research Question 3: To what extent is there an association between teacher perceptions of school culture and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses?	
School	*p* value
A	.933
B	<.001
C	.313

Research Question 4: To what extent is there an association between teacher perceptions of instructional practices and supports and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses?	
School	*p* value
A	.083
B	.047
C	<.001

Chapter 5 is a discussion of the findings by school. This chapter includes an overview, implications of the findings, and a summary.

Chapter 5: Discussion

Overview

This quantitative research study scrutinized the intentionality in which an urban district in the South proposed to address impartial and fair access to advanced mathematics courses. The literature review was focused on the historical implications of inequities in education. It was found that based on the student enrollment data and the NCTWC survey responses, some schools experienced a significant difference in the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses compared to their White peers. All three schools saw a significant difference in Black, Latinx, and mixed-race enrollment by gender in advanced mathematics compared to their White peers. Also, varying types of associations existed between teacher perceptions and enrollment percentages.

The southern district at the center of this research introduced a strategic equity plan designed to achieve success through improving student outcomes. The district's primary goal was to enhance equity, culture, and accessibility through academic accomplishment. This research's findings analyzed data from three schools within the local education agency as they worked to increase opportunities for disenfranchised learners' entrance to abundant, diverse, and attentive instruction.

Education researchers have long suggested sustained exploration of (a) the systemic features of school districts, (b) teacher mindsets about diverse students, and (c) the studying of mathematics and classroom applications. Martin (2019) noted that equity in conventional mathematics learning often represents little more than a convenient and comfortable intermediate point delaying authentic racial justice. Equity-based

conversations of inclusion and adjustments to policy usually moved simultaneously with marginalization and assimilation, resulting in ensuring nothing changes (Martin, 2019). The purpose of this quantitative research study was to examine the number of Black, Latinx, and mixed-race students enrolled in advanced mathematics classes as compared to their White peers. Additionally, teacher perceptions of school culture and instructional practices and supports were analyzed in association with the percentage of BIPOC students in advanced math classes. This quantitative research studied the intentionality in which an urban district in the South proposed to address equitable access to advanced mathematics courses. The literature review was focused on the historical implications of equities in education. A quantitative research design was used to examine the types of students by race in advanced math classes and teacher perceptions of culture and instructional practices at three different schools in an urban setting.

The district worked to first improve the capacity and the perception of classroom teachers; second, it expanded the rigor of the content taught; and third, it changed how learners participated in instruction. The equity initiative focused on exceptional teaching, increased instructional supports, accessibility to intense curriculum, and student wellbeing. At two schools, these focal points lessened the difference in the percentage of Black, Latinx, and mixed-race students in advanced mathematics courses between 2018 and 2021 compared to their White peers, thereby eroding the bond between race and academic opportunity.

This chapter supports the study's conclusions with one or more findings from this research. This chapter states recommendations for how the findings are applicable to teaching and learning. It explains next steps with regard to the teaching profession and

provides a summary of the study, the problem addressed, and the importance of this research.

Discussion of Results: Practical Implications

Results from this research could imply increasing the accessibility to advanced mathematics curriculum for Black, Latinx, and mixed-race students. Targeted exposure to rigorous scientific content for this marginalized group of learners should be in conjunction with instructional practices and supports for all educators. Results from this study could also imply fostering a positive, inclusive, equitable culture of learning for all scholars.

This research found there to be a significant relationship between pedagogical assistance and exposure to high-caliber instruction for Black, Latinx, and mixed-race students. These findings substantiated the equity theory in education which explains how educators' endeavors toward efficacious instructional processes are perceived compared to student outcomes. The enveloped intent of educational equity is to contribute to all students' academic hopes. In due course, manageable, solution-driven, data-enhanced programs and materials are consistently furnished establishing continuing support for underserved students (New Jersey School Board Association, 2021).

Significant to the findings of this research was the intentional district-wide implementation of a fact-finding equity plan. Increased enrollment of Black, Latinx, and mixed-race students learning among a diverse group of scholars could be attributed to such a plan. Results from this study established a relationship between an intentional equity plan and increased access and opportunities for these learners.

Culturally responsive curricula and district-wide teacher support should be

provided to encourage constructive observations and critical feedback. Further implications include professional development for classroom teachers, curriculum specialists, and instructional coaches. School leadership should be consistent with the goal of increasing access and opportunity for advanced coursework for underrepresented students of color. Classroom walkthroughs would help in the establishment of equity guidelines and positive school culture. Researchers have found that when students feel safe, brain development thrives (Prothero, 2020). Prothero (2020) stated that a reaffirming school culture can increase positive student outcomes, increase engagement, and affirm teacher perceptions. Schools in the habit of fostering and maintaining a positive school culture increase stakeholder participation and have a better chance of teacher retention.

School A and School C saw a significant difference in the percentage of Black, Latinx, and mixed-race students compared to their White peers enrolled in advanced mathematics. Implementations that bolster equity and access are predicated on thorough comprehension (NCTM, 2022). NCTM (2022) believed these implementations should guarantee full access to rich, exceptional mathematics programs of study for all learners. NCTM researchers have found that making intentional, calculated use of all available resources will help sustain a culture of access and equity in the learning and teaching of mathematics. To ensure the percentage of enrollment between Black, Latinx, and mixed-race students continues to close, educators must endeavor to achieve equity regarding student learning outcomes (NCTM, 2022). Equitable learning outcomes require a comprehensive dedication that teachers and administration are guided by the belief that all students can grasp mathematical content. NCTM (2022) also believed that to increase

learning opportunities, educators must concentrate on ensuring that all learners have entry to high-quality lessons, stimulating curriculum, contemporary technology, exhilarating extracurricular opportunities, and transformative supports. Students' continual success at advanced levels of mathematics requires educators to enhance their content knowledge and pedagogical practices (NCTM, 2022).

School A and School C saw a significant association between teacher perceptions of instructional practices and supports and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses. Research from two urban schools in a northeastern city sought to find solutions that actively addressed the task of supporting educators as they create equitable learning environments for all students (Riordan et al., 2019). Riordan et al. (2019) investigated what equity-driven professional development looked like in relation to equity concerns and critical teaching. Their review of literature led to the conclusion that strong professional development opportunities spanning an extended period supply educators with collaborative experiences for dynamic learning and are applicable to classroom application. Riordan et al. sought to understand how honing in on championing students' extensive equity and learning affected the arrangement and characteristics of professional development.

Riordan et al. (2019) pursued the rationalization of equity for professional development purposes. Riordan et al. contextualized their study within the wide-ranging critical pedagogy literature conveying students' cultures in teaching in addition to teacher professional development encounters. This background included what the literature about culturally responsive teaching lends to teaching and learning. A proportionate amount of literature focused on professional development for equity; therefore, the researchers

focused on culturally responsive and culturally enduring pedagogy and teaching (Riordan et al., 2019). One of their conclusions found that culturally responsive teachers understood the relationship between the students and the learning. This relationship is essential for framing the work about professional development for equity.

Riordan et al. (2019) revealed a number of results pertaining to the organizational structure of teacher professional development plans. Across both sites of their investigation, Riordan et al. were able to recognize four essential components to support the execution of intense learning and equity that have the capacity to positively influence students' and teachers' learning experiences: Teacher instructional practices and supports should (a) be focused on content associated with equity and critical pedagogy; (b) replicate instructional strategies that advance equity; (c) design a culture of investigation and student agency to facilitate a school-wide culture where equity and deeper learning flourish; and (d) encourage learners' voices to be included in the discourse to understand the effects of teacher professional development.

Connections between the three schools and the four research questions yielded a variety of similarities and differences. As key significant findings arise to the forefront of this research, I think it is critical to view the most recent racial demographics of these schools. Table 23 outlines the 2022 student body makeup by school.

Table 23

2022 Racial Demographics by School (*%*)

	White	Black	Latinx	Mixed-Race
School A	50.7	12.7	10.5	2.2
School B	19.8	38.1	32.8	1.9
School C	4.0	55.8	32.6	2.4

The majority White school (School A) and the majority Black and Latinx school (School B) saw a significant difference in the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses compared to their White peers, yet the most diverse school saw no difference. The most diverse school saw a small negative, significant relationship between teacher perceptions of school culture and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses. Therefore, the implications of this research reveal the following:

- Racially diverse schools should engage in positive school culture work.
- Predominately Black and Latinx schools should consider how they are supporting equity and inclusion work through instructional practices and supports.
- AP mathematics courses at racially diverse schools do not represent the school's racial dynamics.

Regarding instructional supports, I found literature to bolster the design of integrating culturally responsive teaching, culturally relevant pedagogy, and culturally sustaining pedagogy as marked approaches for secondary educators (Castro, 2022). Castro (2022) researched student outcomes associated with an educator engrossed in

these resource pedagogies and found a need for teacher-centered reflective introspection. Similar research-based literature highlighted teacher perceptions in relation to instructional preparedness. Teachers' feelings of contentment were relational to their assessment of planning (Sutherland et al., 2021). Sutherland et al. (2021) found a relationship to teachers' instructional supports similar to this study's conclusions. Schools at the center of this research that allowed adequate time for planning lessened the accessibility gap that existed between Black, Latinx, and mixed-race students and their White peers.

The Barr Foundation is a collective of educators who believe each learner merits a high-caliber secondary institution. Their research supports academic spaces where all scholars are prepared to face the rigors of college and career (Barr Foundation, 2022). A high school consistent with the Barr Foundation's four elements of equity had established a distinctly determined mission to develop underrepresented students for STEM careers (Sudderth, 2022). The school was determined to prepare Black, Latinx, and low-income students for the high-level challenges associated with STEM-based professions. The institution's distinct intentionality to focus on these students allowed for movement towards equitable outcomes for all learners. State standardized test scores in English and mathematics surpassed all other high schools in their district (Sudderth, 2022). Their evidence supported the findings of this research's response to closing the equity gap while engaged in an equity initiative centered on access and opportunity for BIPOC scholars.

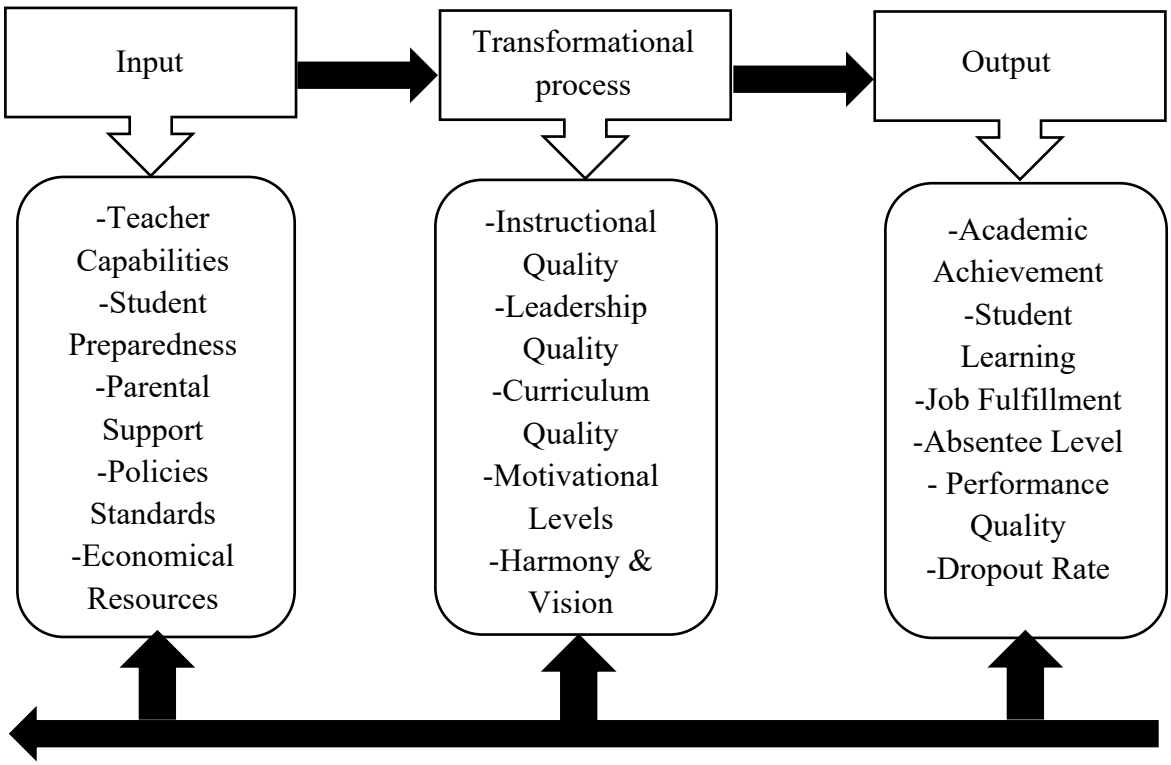
Discussion of Results: Theoretical Implications

The social system model for schools supports the results of some of the findings

associated with this research. The success of a school can be determined by its ability to achieve a preestablished set of goals with the intent of resolving issues that might impede organizational effectiveness (Dahiru, et al., 2018). The significant relationship between the equity initiative and the increase in enrollment of Black, Latinx, and mixed-race students at two of the schools was theoretically achieved based on the rationalization of the social system theory (Dahiru, et al., 2018). Similarly, the capacity of all three schools to improve the accessibility of advanced mathematics courses for female learners can be explained by the circumstances surrounding this theory. Figure 5 describes the social system for education model.

Figure 5

Social Systems for Education



Source: Dahiru, et al., 2018.

Efficacious leadership, quality teaching, considerations for learning, cultivating a positive school culture, high expectations for all learners, rigorous coursework, and equity-centered staff development are concepts bound by the theoretical framework that supported this research study. School B was the only school to have a significant relationship between teacher perceptions of school culture and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses at any of the schools in this study. Findings from this study found School A to have a nonsignificant, large, positive relationship between teacher perceptions of instructional practices and

supports and enrollment percentages. There was a significant positive relationship between enrollment numbers and teacher perceptions of instructional practices and supports. School C's findings resulted in a slightly negative, non-linear, significant relationship between how teachers viewed professional development opportunities at their school and enrollment numbers for their marginalized population.

The equity theory in education theoretical framework supports the results of this study in relation to the research questions. Within this theory, inputs are believed to contribute to the well-being of the educational institution. The 2024 Strategic Plan was a system put in place (input) designed to improve the equitable outcomes of its Black, Latinx, and mixed-race students. Outputs in the equity theory of education involved increased access to college and career preparatory mathematics classes. School A and School C saw an increase in advanced mathematics opportunities for their Black, Latinx, and mixed-race populations, and this increase was relational to the strategic equity initiative plan put in place. In accordance with the equity theory, the school district did a comparative analysis of its Black, Latinx, and mixed-race student populations' access to AP courses and found areas of concern. Black and Latinx students were not enrolled in AP courses at the same rate as their White peers; therefore, a policy was enacted to increase the accessibility to rigorous mathematics content for underrepresented students.

Conclusions

Connections between the three schools and the four research questions yielded a variety of similarities and differences. As key significant findings arise to the forefront of this research, I think it is important to look at the latest racial demographics of these schools. Table 23 outlines the 2022 student body makeup by school.

Table 23

2022 Racial Demographics by School (*%*)

	White	Black	Latinx	Mixed-Race
School A	50.7	12.7	10.5	2.2
School B	19.8	38.1	32.8	1.9
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The majority White school (School A) and the majority Black and Latinx school (School B) saw a significant difference in the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses compared to their White peers, yet the most diverse school saw no difference. The most diverse school saw a small negative, significant relationship between teacher perceptions of school culture and the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses. Therefore, the implications of this research reveal the following:

- Racially diverse schools should engage in positive school culture work.
- Predominately Black and Latinx schools should consider how they are supporting equity and inclusion work through instructional practices and supports.
- AP mathematics courses at racially diverse schools do not represent the school's racial dynamics.

Regarding instructional supports, I found literature to bolster the design of integrating culturally sustaining pedagogy, culturally relevant pedagogy, and culturally responsive teaching as marked approaches for secondary educators (Castro, 2022). Castro (2022) researched student outcomes associated with an educator engrossed in these

resource pedagogies and found a need for teacher-centered reflective introspection. Similar research-based literature highlighted teacher perceptions in relation to instructional preparedness. Teachers' feelings of contentment were relational to their assessment of planning (Sutherland et al., 2021). Sutherland et al. (2021) found a relationship to teachers' instructional supports similar to the results of this research. Schools at the center of this research that allowed adequate time for planning lessened the accessibility gap that existed between Black, Latinx, and mixed-race students and their White peers.

The Barr Foundation is a collective of educators who believe each learner merits a high-caliber secondary institution. Their research supports academic spaces where all scholars are prepared to face the rigors of college and career (Barr Foundation, 2022). A high school consistent with the Barr Foundation's four elements of equity had established a distinctly determined mission to develop underrepresented students for STEM careers (Sudderth, 2022). The school was determined to prepare Black, Latinx, and low-income students for the high-level challenges associated with STEM-based professions. The institution's destinct intentionality to focus on these students allowed for movement towards equitable outcomes for all learners. State standardized test scores in English and mathematics surpassed all other high schools in their district (Sudderth, 2022). Their evidence supported the findings of this research's response to closing the equity gap while engaged in an equity initiative centered on access and opportunity for BIPOC scholars.

Recommendations for Practice

Based on the equity framework and findings supporting teacher perceptions of

school culture and instructional support, I recommend more racially diverse schools incorporate systems designed to actively encourage Black, Latinx, and mixed-race enrollment in advanced mathematics courses. Encouragement should include a viable plan of action that considers building student agency, college and career preparedness, and social and emotional supports. I recommend schools engage family members in conversations centered on the benefits of their students participating in a high-quality AP curriculum, particularly academic paths with a STEM focus.

The Institute for the Study of Race and Culture provided practical guidance about teaching and applying interventions designed to encourage ethnic, cultural, and racial diversity in academic settings (Trustees of Boston College, 2022). In 2018, the institute concentrated on racial and ethnic macroaggressions and microaggressions in STEM professions and education. It was determined that BIPOC and/or disenfranchised communities were underrepresented in the specialization of science, technology, engineering, and mathematics even though these were highly sought-after professions (Trustees of Boston College, 2022). The institute offered community collaborations through workshops and presentations to help educators discover the ways in which marginalized populations become discouraged.

In addition, many study results, seminars, and lectures encouraged educators to consider changing STEM rather than attempting to make everyone fit the same blueprint of STEM (Trustees of Boston College, 2022). Because of this, I propose secondary urban settings also consider changing how they approach science, technology, engineering, and mathematics courses for Black, Latinx, and mixed-race students. STEM education should go beyond the bounds of traditional school subjects (Study in the USA, 2022). STEM

courses provide an aptitude that guides how learners perform and ruminate (Study in the USA, 2022). I propose presenting science, technology, engineering, and mathematics education content in such a way as to enable learners to become a part of a highly functioning collaborative team. Building collaborative study skills would allow all learners an opportunity to participate in an academic environment, putting more reliance on soft skills. Mathematicians analyze data to remove error and yield accurate information. Collaborative encounters moreover assist in expanding the influence of STEM education. Because our communities are constantly evolving, we must enhance our mathematics students' collaboration and communication skills (DiNapoli, 2018).

School A, a school with a high percentage of White students, saw an increase in accessibility to mathematics courses for their BIPOC learners. I recommend exploring how equity work at one site compares to the next based on the racial makeup of the student population. School C, a majority Black, Latinx, and mixed-race setting, saw a significant relationship between the equity policy and increased enrollment. School C had a similarly significant relationship between the equity initiative and the enrollment numbers for their non-White population. School B, populated with the most racially diverse group of students, saw no significant relationship between the enrollment percentages and the established equity-focused initiatives.

Contemporary research found that by 2024, BIPOC students are anticipated to comprise 56% of the public school population; however, 82% of K–12 public school employees will be White (Toms, 2018). Future research to support this study could include adequate preparation of preservice educators on matters concerning gender, ethnicity, race, inequity in education, and class. Toms (2018) concluded that teachers new

to the profession must be able to adjust to the ever-changing diverse landscape of the school system. In this same vein, future research could explore recruiting more BIPOC educators to instruct advanced secondary mathematics courses.

Throughout the period succeeding the Civil War, Black educators set the understructure for Southern public education (Hines & Hines, 2020). In the early 1900s, these educators, many of whom were formerly enslaved people, were the grassroots of institutions such as the National Association for the Advancement of Colored People and the National Urban League (Hines & Hines, 2020). The teaching profession for people of color was more than a job, it served as a greater collective and policy-making opportunity for freedom and social justice (Hines & Hines, 2020). School A had a majority White student population, and less than 15% of its instructional staff identified as BIPOC. This school showed a significant relationship between the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses compared to their White peers. Future research could focus on the relationship between the racial identity of STEM teachers and the racial demographics of their classrooms. Is there a significant relationship, predicated on race, between who is enrolled in an advanced mathematics course compared to the racial identity of the instructor? What role does unconscious bias play in a counselor's perception and student placement? Do BIPOC math teachers have more non-White students compared to their White peers?

Recent research found that approximately 20% of public school educators in the U. S. school system identify as people of color; concurrently, 7% of practitioners identify as Black (Carr, 2022). More specifically, what can be done to encourage Black, Latinx, and mixed-race people to pursue a career in advanced secondary mathematics? Carr

(2022) wrote that years' worth of research has shown that many public schools grappled with retaining BIPOC educators: From 1988 to 2018, teachers of color were hired at a faster rate than their White peers; however, those BIPOC educators left the profession at a brisker rate. Black and Latinx educators and the BIPOC learners who depend on them shoulder the greatest burden attributed to the teacher shortage sweeping through parts of the U.S. (Carr, 2022). Retention of non-White educators is a viable next logical step in this line of research.

School A exhibited a nonsignificant, large, positive relationship between teacher perceptions of instructional practices and supports and the enrollment percentage of Black, Latinx, and mixed-race students in advanced mathematics. Future research could include increasing professional development opportunities for teachers with a racially diverse group of students in mind. To what extent does culturally relevant instructional planning and supports influence the equity gap? As more opportunities for diversity-focused pedogeological practices increase at a site, do the enrollment percentages for students of color increase at the same rate? Will more planning time intentionally grounded in equity work signify an increase in advanced mathematics opportunities for disenfranchised learners? Similarly, what type of impact would an increase in equity-driven professional development have on a racially diverse school like School B? School B was found to have a significant positive relationship between teacher perceptions of instructional planning and support and the increase in enrollment percentages for Black, Latinx, and mixed-race students; whereas the predominantly Black and Latinx school, School C, experienced a significant, slightly negative, non-linear relationship between instructional practices and enrollment opportunities for Black, Latinx, and mixed-race

students. Future research could include identifying best instructional supports for teachers engaged in learning at a majority BIPOC school. Do racial groups require distinct instructional strategies? Is there a correlation between Black, Latinx, and mixed-race student access to advanced mathematics courses and race-based teaching strategies? Is there a relationship between the racial demographics of a school and instructional supports for teachers?

Regarding school culture, School A had a small, positive, nonsignificant relationship between teacher perceptions and enrollment percentages. I recommend exploring what type of correlation exists between teacher perceptions of school culture and student race-based demographics. Is there a relationship between a racially diverse student population and teacher perceptions of school culture? Keeping equity in mind, how do teachers at a majority BIPOC learning environment perceive their school's culture compared to their peers at majority White schools?

School B was the only site to acquire a significant relationship between teacher perceptions of school culture as well as instructional supports. It did not have a significant relationship between enrollment percentages of Black, Latinx, and mixed-race learners compared to their White peers. Future research could include a case study designed to explore how racially diverse schools increase access and opportunity for BIPOC students in advanced mathematics courses. Established in the discoveries of this research, a district-wide initiative with equity in mind could increase the enrollment percentages of Black, Latinx, and mixed-race students in advanced mathematics courses. At multicultural schools that have achieved equitable access to advanced levels of learning for all, what types of systems are in place to ensure equity is sustained?

Recommendations for Further Research

Two of the three schools at the center of this study saw a significant difference in the percentage of Black, Latinx, and mixed-race students enrolled in advanced mathematics courses compared to their White peers. These differences came while each site participated in a district-wide equity initiative. I recommend urban school districts seek out similar equity initiatives designed to address the accessibility and opportunity gaps linking Black, Latinx, and mixed-race students to their White peers. District leaders should consider the racial demographics of each school and meet the needs of those being served accordingly.

Further research could also include investigating secondary sites outside of urban settings. Suburban school districts in the U.S. have recently undergone significant demographic changes in their student populations (Diamond & Posey-Maddox, 2020). Upwards of 50% of Latinx, Black, and Asian learners in substantial metropolitan spaces attend suburban schools, and more immigrants are choosing the suburbs as their primary destination (Diamond & Posey-Maddox, 2020). Suburban learning spaces provide the opportunity for researchers to examine the convergence of ethnicity, class, immigration, and race in education (Diamond & Posey-Maddox, 2020).

An extension of this research could include increasing the number of sites to be investigated. I intentionally selected a predominantly White school, a racially diverse school, and a predominately Black and Latinx school. Future research could increase the number of schools observed to determine the difference in enrollment percentages between Black, Latinx, and mixed-race students in advanced mathematics courses compared to their White peers. The increased number of observed schools should be

predicated on racial demographics. The primary purpose of having a larger number of schools used will aid in the interpretation of the significance. A more precise account of the difference in enrollment percentages between Black, Latinx, and mixed-race students in advanced mathematics courses compared to their White peers could encourage deeper conversations among the academic community.

An extension of this research could also include a survey instrument measuring student perceptions of race and gender relative to equity and inclusion. For example, do male students believe their female peers can excel in mathematics at the same rate? Do White learners believe Black, Latinx, or mixed-race learners can be coequals in an advanced mathematics course? A survey could also include student perceptions of their school's culture and their views of teacher preparedness. Student surveys allow learning communities the ability to comprehend student experiences during various stages of their academic careers. Surveys can ascertain feelings and perceptions. Student perceptions of educators, peers, and family members could be correlated with equity initiatives designed to close the opportunity gaps that exist in some mathematics courses (NCTM, 2022). Collected data can then be analyzed and aggregated in such a way that positive change may occur.

I would have also liked to have added a leadership component to this study. Equity-centered leadership makes issues of class, sex, gender identity, race, sexual identity, and disability a focal point of a school's mission and vision (Syracuse University, 2019). Are institutional inequities indicators of disparities in access and opportunities for all learners, particularly Black, Latinx, and mixed-race students? What systems are in place to reduce marginalization in schools? Are school leaders actively

engaged in equity conversations? What school-based equity initiatives are in place? What role does the principal play? How are instructional coaches supporting culturally responsive teaching and learning? How are department chairs supporting Black, Latinx, and mixed-race students in the mathematics classroom? Are equity-focused professional learning communities using student outcomes to build fluid lesson plans? How influential are guidance counselors in the placement of Black, Latinx, and mixed-race students in advanced mathematics courses? The way in which secondary schools are managed could strengthen the findings of equity-based research.

More recently, federal and state legislators have funded the expansion of AP coursework with an intent to activate equity in education (Kim, 2021). This study considered AP Calculus and AP Statistics as two qualifying advanced mathematics courses. Future researchers can improve upon this study by considering the successful completion of stem-based AP exams by Black, Latinx, and mixed-race students. Researchers might consider investigating the pre-AP coursework accessibility and access with respect to Black, Latinx, and mixed-race students as well as the mindsets of the teachers facilitating the learning within these classes. Subsequent studies might also consider the accessibility of dual enrollment coursework for marginalized students. Dual enrollment incorporates college and high school initiatives, allowing school districts and institutions of higher education to cooperate, thus allowing high school learners to participate in postsecondary courses and receive interchangeable college credits (The Education Trust, 2022). I did not have access to dual enrollment data for the three schools at the center of this study. Dual enrollment mathematics classes would have been considered an advanced mathematics course, and not having those enrollment numbers is

considered a limitation of this research study.

Summary

Under an intentional district-centered equity initiative, School B, the most racially diverse of the three schools at the center of this study, had no significant difference in Black, Latinx, and mixed-race enrollment compared to their White peers. This school also saw a negative, non-linear correlation between teacher perceptions of school culture and enrollment percentages of Black, Latinx, and mixed-race students. The school had a strong, linear correlation between teacher perceptions of instructional supports and Black, Latinx, and mixed-race enrollment percentages. The majority White school, School A, showed to have a definite, consequential relationship between the 2024 Strategic Plan equity initiative and the increase in access to rigorous mathematics courses. The majority Black, Latinx, and mixed-race school, School C, showed a positive, linear relationship between teacher perceptions of school culture and enrollment percentages of BIPOC students. The importance of this study presented the possibility of directed solutions based on racial demographic learning spaces. School culture drives access and opportunity in predominately non-White settings. Racial equity initiatives encouraged majority White learning spaces to consider access and opportunity for all. Instructional supports at racially diverse schools contribute to more inclusive advanced mathematics classes. A continuing frailty of pre-K-12 mathematics education analysis in the U.S. has been the absence of contextual and cultural narratives of mathematics development, learning, and contribution among Black learners. The study of Black, Latinx, and mixed-race learners in public school mathematics had predominately been the research of racial achievement gaps, fixed on chronicling how these scholars are different from Asian-

American and White students (Gholson & Martin, 2019). The results of this study supported changing the narrative associated with Black learners. Current narratives suggest Black, Latinx, and mixed-race students are trailing their White peers in essential mathematical competencies and remain anchored in mathematical despair that is dangerous to themselves and the nation's academic world standings (Gholson & Martin, 2019). Practically speaking, this research suggested a modest but applicable approach to increasing the access and opportunity for a rigorous curriculum for disenfranchised students through strong school culture and adequate instructional supports for educators.

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