ABSTRACT

Title of Dissertation: **MATH TEACHER GROWTH MINDSET AND AFRICAN AMERICAN STUDENTS' SENSE OF BELONGING IN MATH**

Kimberly Hopkins Scaife, Doctor of Education, 2025

Dissertation directed by: Christine Neumerski, Ph.D., Center for Educational Innovation and Improvement, College of Education

Persistent opportunity and achievement gaps in mathematics between African American students and their White and Asian peers exist at national, state, and local levels. These gaps are especially evident in access to advanced math pathways, beginning with Algebra I by eighth grade—a gateway course critical to future STEM opportunities — and continuing through high school. This capstone investigates whether a targeted growth mindset professional development (GM PD) series impacts middle school math teachers' growth mindsets and instructional practices, as well as the sense of belonging in the math classroom among African American students, a step predicted to help narrow these persistent gaps.

The study took place at a suburban, high-socioeconomic middle school, where African American students comprised 14% of the population. A nine-month GM PD series was implemented for the entire staff, and the math teachers' data were analyzed to determine its effectiveness. Data were collected from pre- and post-teacher mindset self-assessments, peer walkthroughs, teacher feedback forms, pre- and post-student belonging surveys, and focus groups with African American students. The Theory of Change guiding this work predicted that if math teachers' growth mindsets and use of growth mindset-aligned instructional practices increased, African American students would experience a stronger sense of belonging in math class, with the long-term goal of improving academic outcomes over time.

Initial findings indicate a positive relationship between teacher participation in the GM PD series and growth in teacher mindset, instructional practice, and African American students' reported sense of belonging. In classrooms where teachers showed growth-oriented behaviors, students reported experiencing stronger engagement, increased confidence in their math abilities, and deeper connections with their teachers and fellow students. Although causation cannot be determined, these findings suggest that teacher mindset and classroom culture can have a significant impact on the math experiences of African American students, offering ideas for further studies.

The accompanying impact product—a comprehensive Google site for GM PD—offers schools and districts a low-cost, easy-to-implement option for school and district leaders. Designed by the researcher to be equity-centered, the PD series includes seven structured learning cycles, student belonging surveys, peer walkthrough tools, and protocols for teacher reflection and feedback, as well as for student focus groups. This professional development model provides a replicable framework that can be implemented "right now" for fostering inclusive, growth-

oriented classrooms that support the broader goal of reducing racial disparities in mathematics education through sustainable changes in teacher practice and mindset.

MATH TEACHER GROWTH MINDSET AND AFRICAN AMERICAN STUDENTS' SENSE OF BELONGING IN MATH

by

Kimberly Hopkins Scaife

Dissertation submitted to the Faculty of the Graduate School of the
University of Maryland, College Park, in partial fulfillment
of the requirements for the degree of
EdD in School System
Leadership
2025

Advisory Committee:
Christine Neumerski, Ph.D., Chair
Douglas W. Anthony, Ed.D.
Segun Eubanks, Ed.D
Pamela Shetley, Ph.D
Jean Snell, Ph.D.

Dedication

I dedicate this to my husband, Sam, and my girls, Claire and Emily, whose love and patience kept me going through countless hours of "working on my paper." To my family—thank you for being my foundation and believing in me every step of the way. To my fellow teachers, staff, and school communities, I am honored to stand alongside you, and your commitment to student learning and growth is my daily inspiration. I am also grateful to my cohort (#4life), advisor Christine, and committee for challenging me to grow in the best ways. And, finally, I dedicate this to my students—you are the reason this work exists, and I cannot wait to see all that you will achieve.

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MATH TEACHER GROWTH MINDSET AND AFRICAN AMERICAN STUDENTS' SENSE OF BELONGING IN MATH

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Preface

There are many foundational experiences that led me to this research. In fifth grade, I learned about slavery and the atrocities faced by enslaved people. We watched the movie Roots as part of this unit, and I remember being shocked by the brutality and injustice of the system. When I was in college, working on my master's in education, I read Savage Inequalities by Jonathan Kozol as an assigned text for one of my classes. This book had a profound impact on me, and I clearly remember discussing it in class. I was stunned by Kozol's descriptions of the studied schools' conditions and the environments where students were meant to learn. I was naive and unaware of the conditions in inner-city schools, the lack of funding they received, and the disparities in opportunities for students. To me, this type of school experience was unimaginable. Yet, the reality is that the public education system is structured in a way that supports these types of inequalities, with students simply being innocent bystanders of these harmful practices.

As I enter my nineteenth year in education, and approximately twenty years since I first read Savage Inequalities, I am still struck by the relevance of this text in 2025, even though it was first published in 1991. We still see persistent inequalities between schools, as well as within schools, which limit students', particularly students of color, access to higher-level classes. What is especially important to uplift is that the disparate experiences students have with one another, particularly among students of color or African American students, as compared to White and Asian students, are not limited to inner-city schools.

Ever since I was a graduate student in 2006, I have felt deeply concerned about the gaps in experience that African American students often face in our public education system. My master's project focused on the overrepresentation of African American students in special education, and I also completed a leadership project exploring their sense of belonging in a previous school where I had the privilege of serving as an administrator. At this same middle

school, which was situated in a high socioeconomic area, I noticed that no African American students were enrolled in gifted and talented (GT) classes. After sharing this with my principal, we worked towards bringing awareness to this discrepancy and closing that gap. Throughout my career, I have continually worked to be mindful of how my own biases might influence my interactions with and support for African American students in the school environment.

In my current role as a middle school principal, I work in a high socioeconomic area where most of our students (92%) come to us from well-resourced homes. Only 8% qualify for Free and Reduced Meals (FARMs), and these 8% represented White, Asian, and African American students almost equally. Yet, African American students face barriers in my middle school that other students do not, such as unconscious bias, deficit mindsets, overrepresentation in lower-level classes, and underrepresentation in higher-level courses. In my current school, I observe similar dynamics when analyzing data related to math placement and achievement. The composition of students in higher-level math courses, particularly the GT math courses, is primarily comprised of Asian and White students. In contrast, African American students remain the minority in these classes yet are overrepresented in on-grade-level classes.

My current position has allowed me an opportunity to combine my passion for fighting for equity while also being able to implement something with real-life implications for the African American students I serve. Throughout this capstone, I share current data and how, as the principal, I, along with my professional development team, worked to build teachers' professional capacity to better serve African American students in the math classroom. This initial attempt serves as an exploratory study, using the resources available to me and the data that I collected throughout the professional development process. The hope is that this capstone gives other researchers a variety of starting points for more in-depth studies that will build on my initial conclusions and result in more effective learning environments and teaching of African American students.

Section 1

Introduction

Public education has historically employed organized systems and structures to sort and rank individuals (Dixon & Palmer, 2020; Gross & Hadjar, 2016; Tyack & Cuban, 1995). A student's trajectory can be determined by their school, their courses, and the teachers they encounter daily. This educational system has its advantages for some students, but for others, it perpetuates distinct societal disadvantages (Dewey & Weber, 2021; Dixon & Palmer, 2020; Gross & Hadjar, 2016; Hopper, 1968). These disadvantages haunt African American students in the public education system.

It has been widely noted that African American students are underrepresented in gifted and talented programs and overrepresented in special education and lower-level course tracks (Bankston & Caldas, 1996; Collins, 2008; Kelly, 2009; Leonard, J. & Martin, D.B. (Eds.), 2013; Patrick et al., 2020). This is a consequence of "social reproduction" (Kelly, 2009, p. 534), in which the disparities between student groups and racial stereotypes are continuously maintained and reinforced in the schoolhouse. The embedded prejudice and discrimination provide a breeding ground for tracking and disproportionality that is maintained and reinforced between student groups (Kelly, 2009; Merolla & Jackson, 2019; Morales-Chicas & Graham, 2021; Williams, 2011). Perhaps the most potent example of these systems in practice is the comparison of an African American student's mathematics trajectory to that of a White or Asian student's math trajectory.

In 1988, Harvey and Stiff referred to advanced math classes as "the most segregated places in American society" (p. 190). As the years continued, Moses (Moses & Cobb, 2001; Moses, 1995) argued that participation gaps between student groups in mathematics were a present-day civil rights issue. Diverging math pathways for African American, White, and Asian student groups become most obvious and harmful when these students take Algebra 1 (Heiser et

al., 2023; Kogachi & Graham, 2020). Algebra 1 is a significant course that students must take and pass by the 8th grade to access Calculus by the 12th grade. It is often referred to as a "gatekeeper" because a student's access to and proficiency in Algebra 1 significantly impact their opportunities to participate in advanced-level math courses and college and career readiness preparation in high school and college (Morton & Riegle-Crumb, 2019). Edosomwan et al. (2020) state that "students who took algebra in eighth grade were between three and eleven times more likely to be in the high school honors or college mathematics track" (p.1).

Lower-level math tracks ceiling out at the Algebra I level in high school (Collin et al., 2020; Dougherty et al., 2015; Johnson et al., 2022; Malloy & Malloy, 1998), while higher level math tracks offer Algebra 1 in eighth grade, providing the students in the higher math tracks four more years of advanced level math opportunities. Students who have access to the higher-level math track, in turn, have significantly higher self-concept regarding their abilities in math and school, increased motivation, and a greater sense of belonging in the math class (Bourgaize et al., 2019; Chiu et al., 2008). Taking higher-level math courses strengthens students' math identity, expands their opportunities in higher education, and opens pathways to Science, Technology, Engineering, and Math (STEM) fields and better-paying careers. (Heiser, 2023; Leung et al., 2021).

If access to this higher-level math track is hindered, inequities in opportunity and achievement in math quickly multiply and disproportionately affect students (Barbieri & Miller-Cotto, 2021; Berry 2005b, 2008a, b; Collins et al., 2020; Davis 2014; Domina et al., 2015; Gamoran & Hannigan, 2000; Leonard et al., 2020; Malloy & Malloy, 1998; Stein, M. K. et al., 2011). However, all is not lost. There are promising strategies teachers can use to support African American students in the math classroom. A teacher's mindset has been shown to improve outcomes for African American students and boost students' sense of belonging in math classes. A strong sense of belonging, especially for African American students, can positively influence academic achievement and foster a classroom environment where students

are more willing to take academic risks and challenge themselves. (Dweck, 2016; Blazar, 2021; Canning et al., 2019; Bostwick et al., 2020; Murphy & Zirkel, 2015).

Throughout this capstone, I examine African American student achievement and opportunities in math in comparison to those of Asian and White students (OCR, 2021; MSDE, 2023; NAEP, 2024). I will specifically analyze the possible causal factors that impact the opportunity and achievement gaps in mathematics for African American students and narrow my focus to two primary causal factors based on the research and the setting of my study: (1) Middle school math teachers' level of growth mindset and implementation of growth mindset instructional practices and (2) African American middle school students' sense of belonging in the math classroom.

Literature Review

This literature review will examine the opportunity and achievement gaps present for African American students in secondary mathematics at the national, state, and local levels, and compare this data to that of White and Asian student groups to highlight these significant disparities. Historical context and its impact will be connected to the disparities that African American students experience in the public education system and in the math classroom. Growth mindset and the importance of belonging for students will also be analyzed, with a focus on connecting these concepts to teacher practices in the math classroom and the math access and achievement of African American students.

Opportunity & Achievement of African American Students in Secondary Math Courses

Opportunity

In the United States, middle and high school mathematics pathways include both required and advanced coursework. Placement into higher-level classes can be influenced by factors such as prior academic performance, standardized test scores, teacher

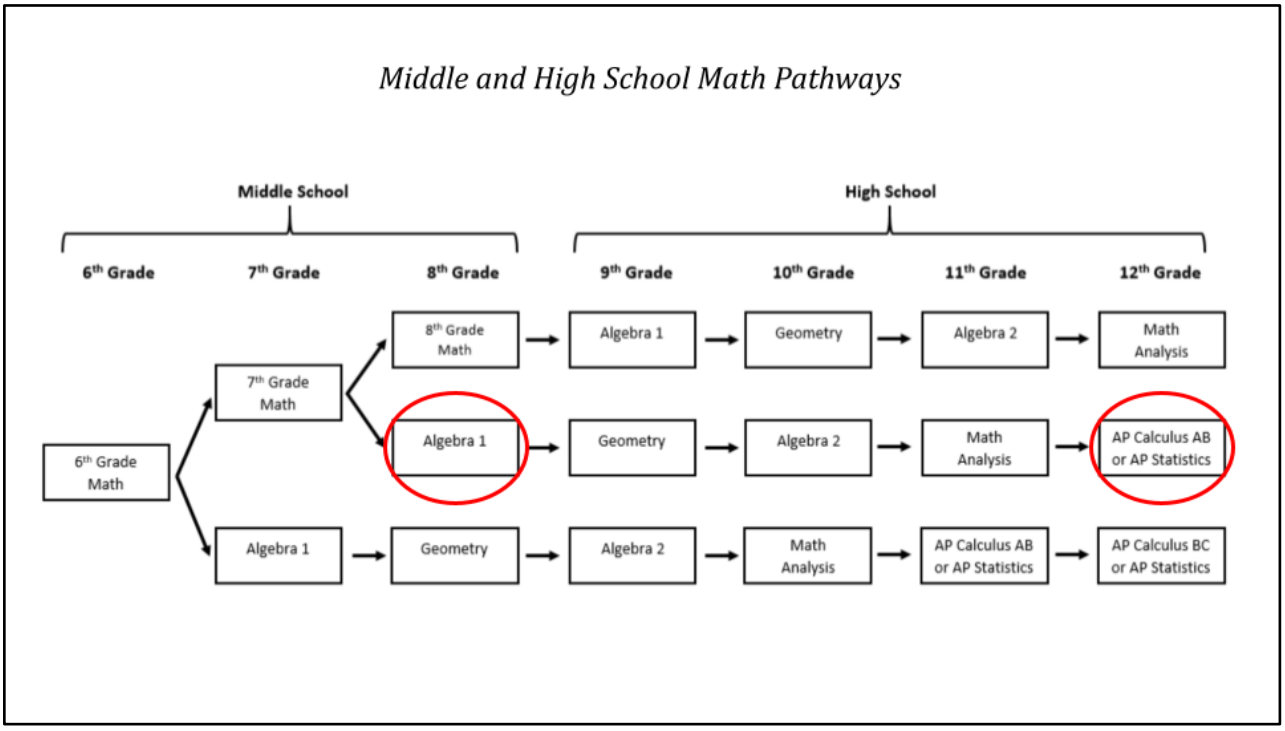
recommendations, school policies, and other relevant considerations (Allen et al., 2018; Dougherty, 2015). A placement decision made in elementary school can have ongoing consequences, both positive and negative, throughout a student's entire school career and beyond (Dougherty, 2015; Murphy & Zirkel, 2015; Barbieri & Miller-Cotto, 2021).

Within the traditional math placement process in the United States, students are either designated to be on an 'on grade level' track, an 'above grade level' track, or an advanced math track, which is typically defined as the gifted and talented (GT) track and will be referred to such throughout the rest of this capstone. For example, in Figure 1 below, a student on the "on-grade" level track, in most K-12 school settings, will proceed through the required math courses designated by grade level, such as the sixth-, seventh-, and eighth-grade math sequences. In high school, these students will then take Algebra 1 in ninth grade, Geometry in tenth grade, and so on.

In contrast, those students who are placed in the above or GT-level math classes have the opportunity to take Algebra I in eighth grade or even earlier. In high school, they begin with Geometry in ninth grade and finish in AP Calculus AB or AP Statistics in twelfth grade (Figure 1). As stated earlier, access to Algebra I in eighth grade is a critical gateway because it opens pathways that those who took Algebra 1 in high school cannot access. Unfortunately, African American students are often the students most impacted by this gatekeeping, while White and Asian students are least likely to experience this dynamic (Domina, 2014; McEachin, 2025).

Figure 1

Sample Middle and High School Math Pathways



Note: A sample math pathway for middle and high school students is provided to illustrate the various classes that students can take once they are placed in a math pathway.

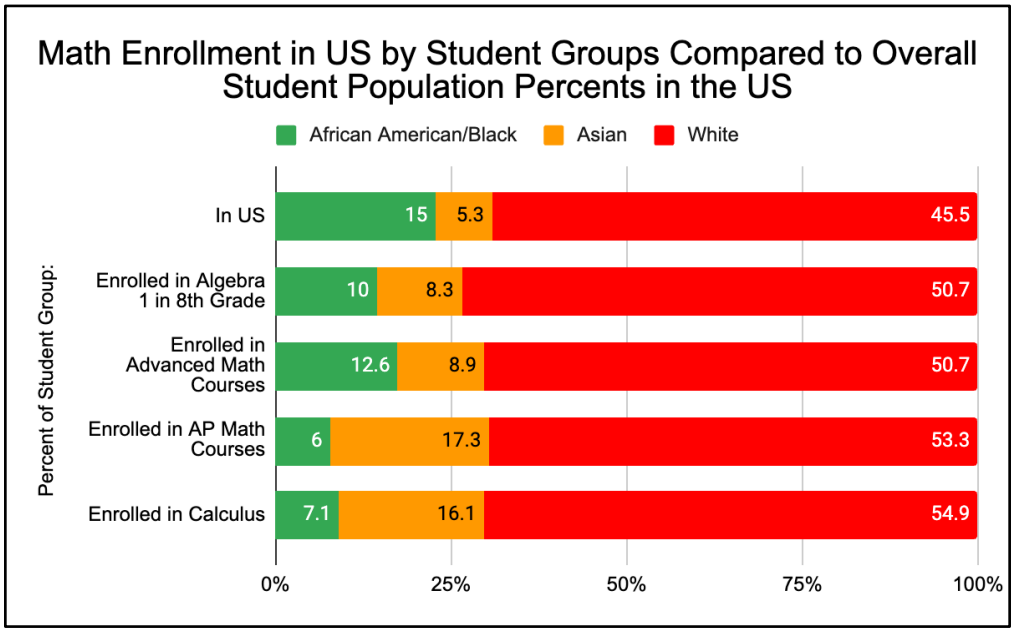
National Level.

Nationwide, the proportion of eighth graders enrolled in Algebra I or higher more than doubled between 1990 and 2015, reaching 43% (Domina, 2014; McEachin, 2025), but since then, the overall enrollment has dropped to 26% (OCR, 2021). African American students remain underrepresented, with only 10% enrolled in eighth-grade Algebra I, despite representing 15% of the student population. By comparison, White students are enrolled in eighth-grade Algebra 1 at a rate of 52% while making up 48% of the population, and Asian students are enrolled at 8.3% while accounting for just 5% of students overall. (OCR, 2021) This disproportionality continues to climb as math levels increase, which coincides with the narrowing window in which African American students can access advanced math in high

school. (Figure 2, OCR, 2021). In congruence with this dynamic, while African American students are initially represented at a proportional level in Algebra 1 in ninth grade, this proportional representation steadily declines as the math level increases, until just 7% of African Americans are enrolled in Calculus during high school (Figure 2, OCR, 2021). On the other hand, overrepresentation persists, as 55% of White students and 16% of Asian students are enrolled in high school Calculus (Domina & Saldana, 2012; Edosomwan et al., 2022; OCR, 2021). The difference between African American students and these two student groups' enrollments in advanced-level math classes is staggering.

Figure 2

Math Enrollment in the US by Student Groups Compared to the Overall Student Population Percents in the US



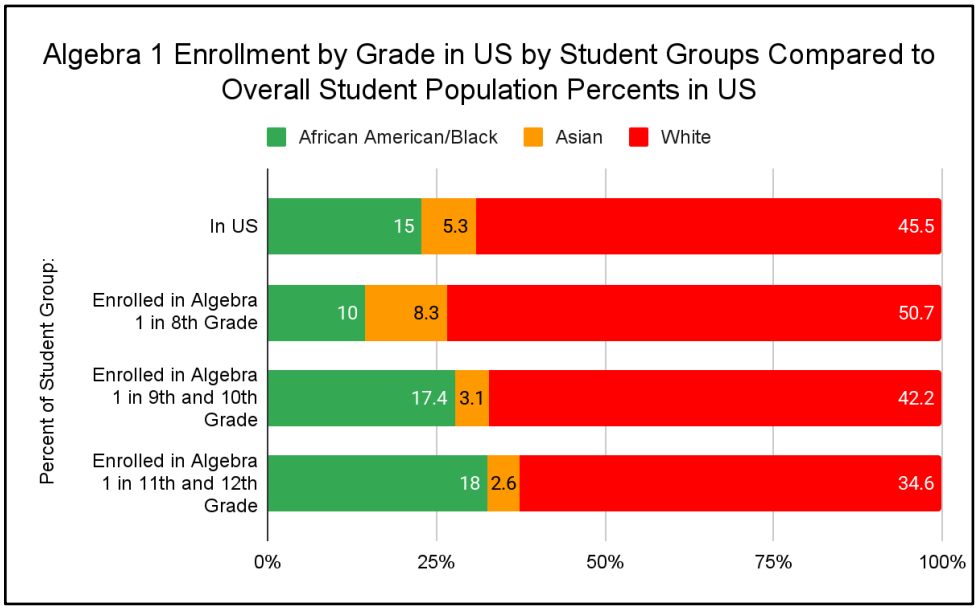
Note: Data derived from the Office of Civil Rights (2021).

Additionally, African American students are overrepresented in Algebra 1 classes in tenth, eleventh, and twelfth grades (Figure 3). This could be an indication that African American students are not achieving mastery in their ninth-grade Algebra I class, thereby necessitating a repeat of the course in their subsequent high school years. In contrast, White and Asian students

are underrepresented in ninth through twelfth grade Algebra I math courses. As referenced earlier, those students who complete and pass Algebra 1 by eighth grade are more likely to take advanced math classes, graduate from high school, and succeed in college. Those students who need to take Algebra 1 in 10th, 11th, or 12th grade are less likely to achieve the same outcomes (Edosomwan et al., 2022; McEachin et al., 2020; Stoelinga & Lynn, 2013; Smith, 1996).

Figure 3

Algebra 1 Enrollment by Grade in the US by Student Groups Compared to Overall Student Population Percents in the US



Note: African American students' enrollment in Algebra becomes increasingly disproportionate as the grade level increases, while Asian and White students' enrollment in Algebra 1 decreases as the grade level increases.

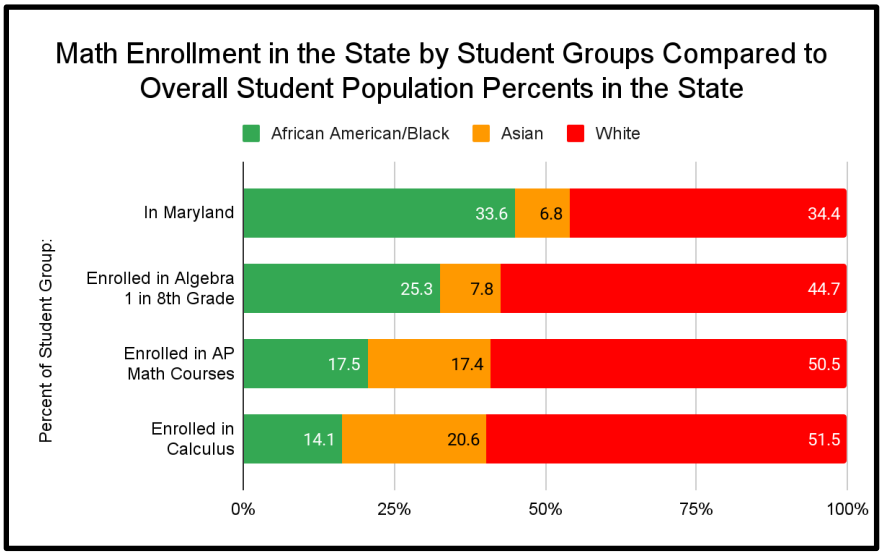
State Level.

This study takes place in a middle school in a mid-Atlantic state in the United States. Like the nationwide data, data at the state level show that Asian and White student groups are overrepresented in advanced math course enrollment, and African American students are underrepresented in advanced math courses (Figure 4; Dougherty, 2015; Edosomwan et al.,

2022; Kaufman et al., 2024; OCR, 2021). While African American students account for a third of the state's student population, by the time calculus is an option, only 14.1% or less than half of the state's total African American student population, are taking this class. Predictably, Asian and White students in the state are overrepresented in Calculus. (Figure 4, OCR, 2021)

Figure 4

State Student Groups' Advanced Math Class Enrollment Compared to the State's Overall Student Group Percents.



Note: Data derived from the Office of Civil Rights (2021).

As stated previously, the reasons for these differences in enrollment are multifaceted. One relevant thing to take into consideration is that the African American poverty rate in this state is four percentage points higher than the overall state poverty rate and approximately seven points higher than that of White and Asian students (KFF, 2023). Research has shown that students from low-income households, regardless of race, face barriers such as under-resourced schools, fewer experienced teachers, and limited access to advanced coursework (Allen et al., 2018; OCR, 2021). It's essential to acknowledge that while there are persistent disparities in mathematics achievement and opportunity for African American students, these disparities cannot be attributed solely to race. Socioeconomic status does play a significant and intertwined role. However, studies also indicate that racial disparities persist even among

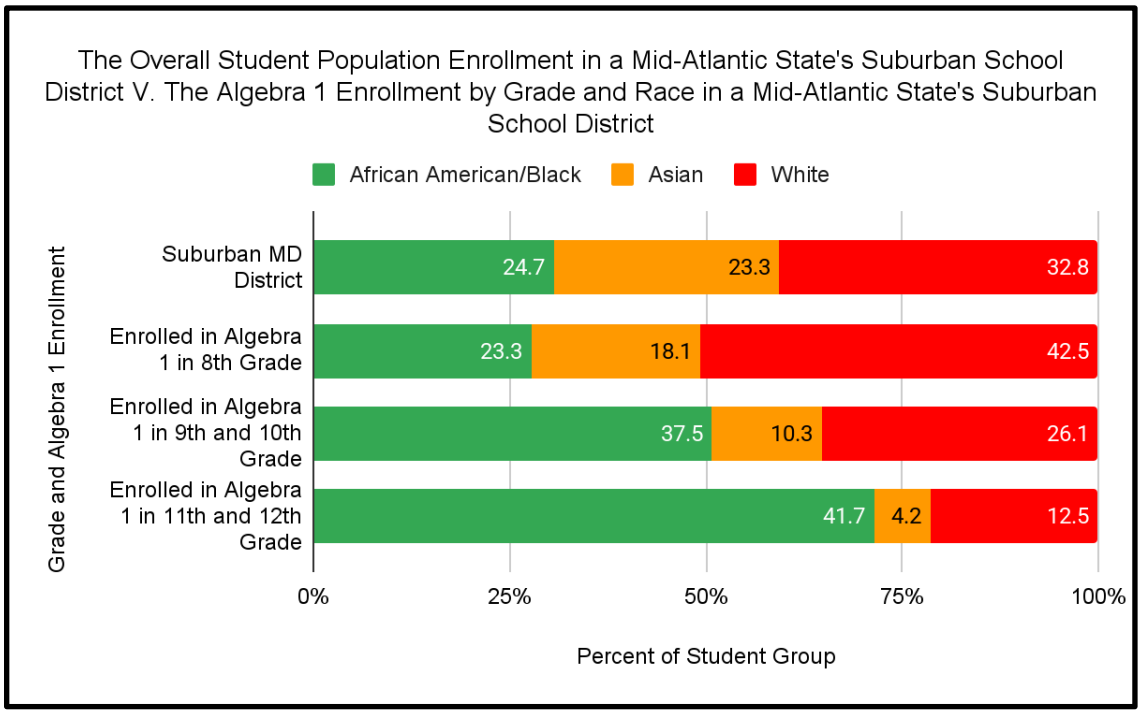
middle- and upper-middle-class African American families (Johnson et al., 2021; Murphy & Zirkel, 2015). For example, African American students from higher socioeconomic backgrounds can still encounter lower teacher expectations, implicit bias, and feelings of isolation in advanced academic spaces, particularly in courses where they are underrepresented (Battey et al., 2018; Barbieri & Miller-Cotto, 2021).

Local Level.

In the school district where my target middle school is located, similar patterns of disparities are observed, mirroring those at the national and state levels. A disproportionate number of African American students struggle to move past the Algebra I course, with an alarming 41.7% of the Algebra I eleventh and twelfth-grade classes consisting of these students, a percentage that is close to double the overall African American student population in the district. Again, we see African American students becoming stuck in an Algebra I loop in high school that they cannot get out of, while Asian and White students continue to advance out of Algebra I into more advanced courses. (Figure 5; OCR, 2021)

Figure 5

The Overall Student Population Enrollment in a Mid-Atlantic State's Suburban School District V. The Algebra 1 Enrollment by Grade and Race in a Mid-Atlantic State's Suburban School District

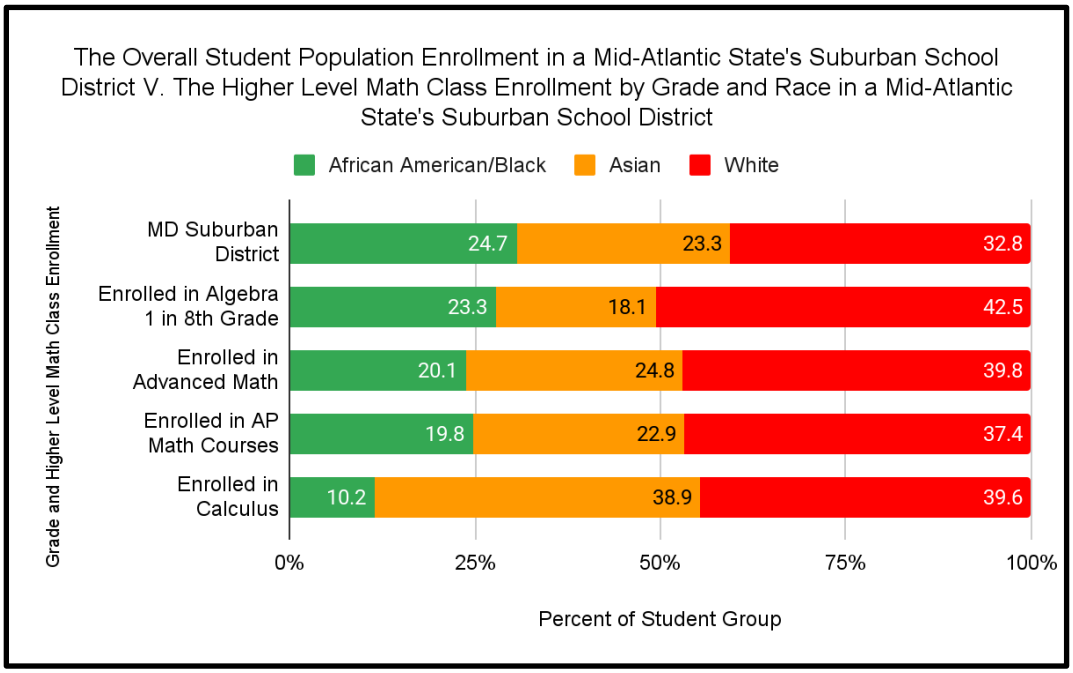


Note: Data derived from the Office of Civil Rights (2021).

The district's data on enrollment in higher-level math classes continues to align with national and state-wide statistics. While 23.3% of African American students in the district are enrolled in Algebra I in eighth grade—a figure roughly proportional to their overall representation in the district—these percentages steadily decline as the level of math increases. African American students' enrollment in advanced and AP math classes hovers around 20%, but then drops to 10.2%, comprising less than half of the African American student population in the district, once calculus is introduced. In contrast, Asian and White students continue to remain overrepresented in Calculus and other advanced math tracks. (OCR, 2021; Figure 6)

Figure 6

The Overall Student Population Enrollment in a Mid-Atlantic State's Suburban School District V. The Higher-Level Math Class Enrollment by Grade and Race in a Mid-Atlantic State's Suburban School District



Note: Data derived from the Office of Civil Rights (2021).

In Summary.

Overall, in national, state, and local data, African American students are underrepresented in higher-level math classes. Although some of the data at the local level is more encouraging, there are still gaps in access for African American children in higher-level math classes, particularly in Calculus.

Achievement

I first want to highlight a passage by Carter G. Woodson written in The Mis-Education of the Negro (1933) that initially raised concerns about the discrepancies between the informal educational skills, effects of poverty, and the lack of opportunities that many African American students had already experienced before entering a classroom as compared to their White peers:

> The children from the homes of white planters and merchants live permanently in the midst of calculations, family budgets, and the like, which enable them sometimes to learn more by contact than the Negro can acquire in school. Instead of teaching such Negro children less arithmetic, they should be taught much more of it than the white children, for the latter attend a graded school consolidated by free transportation when the Negroes go to one-room rented hovels to be taught without equipment and by incompetent teachers educated scarcely beyond the eighth grade. (p. 34)

Although this is a particularly dated version of an African American student's experience, the sentiment remains true. These differences in experiences between African American students and White peers continue to impact the academic achievement of African American students, but the issue is far more profound than that. African American students still must navigate systemic racism, unfair and biased placement practices and processes, and the historical effects of discrimination and low expectations (Ladson-Billings, 2006; Love, 2019; Milner, 2012). Therefore, achievement gaps should be considered within historical and present-day contexts, as exemplified by Woodson. Without the acknowledgement of these very real and impactful barriers, the achievement gap that African American students experience can begin to be taken for granted and framed from a deficit lens, leading to "equity traps" and a failure to address the root causes of the problem (Herbel-Eisenmann et al., 2018; Valencia, 2010; Gutiérrez, 2008).

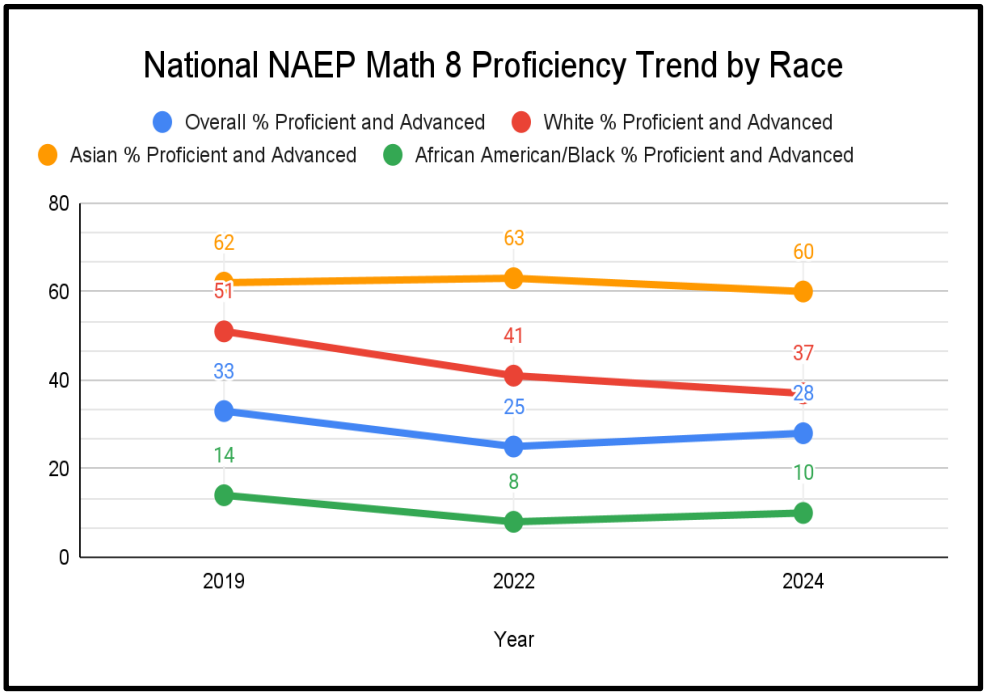
National Level.

Opportunity gaps often translate directly into student outcomes. The 2024 National Assessment of Educational Progress (NAEP) results for Math 8 illustrate persistent disproportionality in math outcomes, as African American students continue to score significantly lower than their White and Asian peers. Fifty-seven percent of Asian students and 37% of White students scored proficient or advanced on the NAEP Grade 8 Math assessment, while only 10% of African American students reached those levels (Morton & Riegle-Crumb, 2019; The Nation's Report Card, 2024; Figure 7). Because Math 8 serves as a gateway to Algebra

1 and higher-level math coursework, these gaps have significant implications for students' long-term academic trajectories.

Figure 7

National NAEP Math 8 Proficiency Trends by Race



Note: Data is derived from NAEP 2013 - 2024 results.

Although this data is striking, it is essential to acknowledge that these figures represent broad national averages and do not fully reflect the variation that exists within racial groups. When data are disaggregated by socioeconomic status, it becomes apparent that income levels have a significant influence on math achievement (Reardon, 2011; National Center for Education Statistics [NCES], 2023). Research indicates that racial disparities persist even when controlling for socioeconomic status, including income. Although African American students from middle- and upper-income households, and those attending well-resourced suburban or private schools, frequently achieve at higher levels and enroll in advanced math and AP courses at greater rates than peers from low-income backgrounds (Johnson et al., 2021; OCR, 2021),

disparities between student groups still persist, as is evident in the middle school where this research takes place.

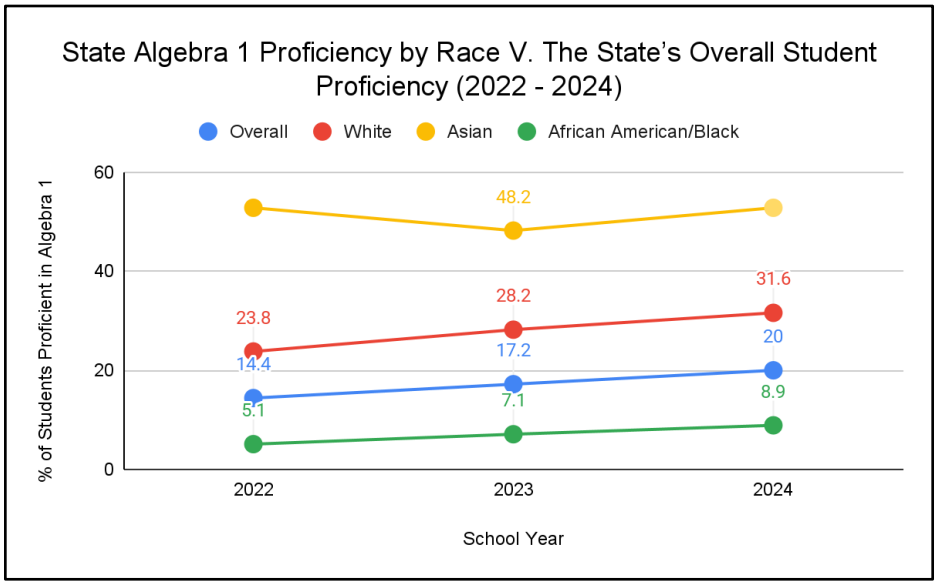
Nonetheless, studies have documented that even in these contexts, African American students sometimes experience lower teacher expectations, subtle biases, and a reduced sense of belonging in advanced math classes compared to their White and Asian peers (Battey et al., 2018; Murphy & Zirkel, 2015; Barbieri & Miller-Cotto, 2021). Therefore, while the disparities reflected in national and state-level data are real and significant, they are neither universal nor purely determined by race alone. My study aims to investigate how teacher growth mindsets and instructional practices may influence African American students' sense of belonging in math classrooms, regardless of their socioeconomic background.

State Level.

Even when African American students' opportunity gaps are addressed and African American students have fair access to advanced-level math classes, their assessment scores do not show consistent mastery of the content. The state NAEP data show that 10% of African American students, 37% of White students, and 60% of Asian students scored proficient or advanced on the NAEP 8th-grade math assessment (The Nation's Report Card: NAEP, 2024). Concurrently, gaps in Algebra 1 proficiency persist in the state between Asian, White, and African American students, even as these scores begin to show an upward trend (Figure 8, MSDE 2024).

Figure 8

State Algebra 1 Proficiency by Race V. The State's Overall Student Proficiency (2022 - 2024)

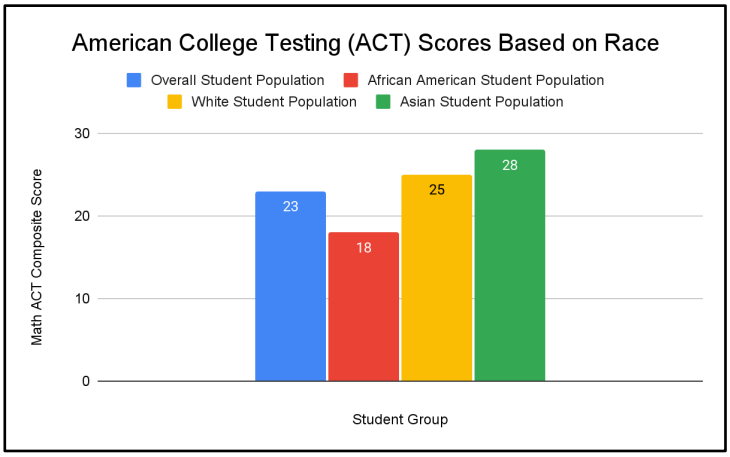


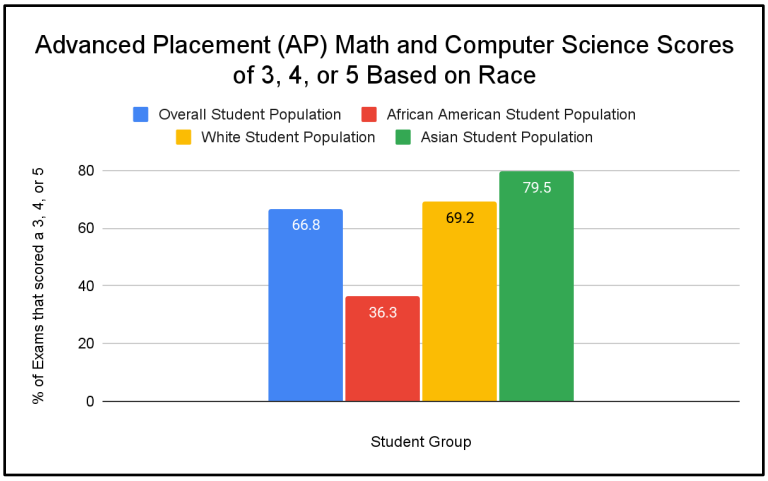
Note: Achievement gaps in Algebra 1 by students' race and the state's overall student population.

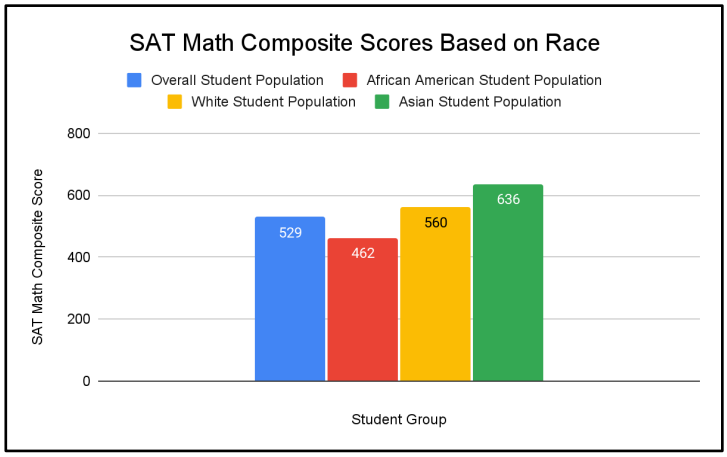
Similar achievement concerns continue as the state's SAT, ACT, and AP Math and Computer Science scores are examined (reported as a combined outcome), with 36.3% of African American students scoring at or above proficiency as compared to 69.2% and 79.5% proficiency for White and Asian students (Figure 9; MSDE, 2023). Moreover, in 2023, the math composite score for African American students on the SATs was 67 points lower than that of the overall student population (MSDE). When this score was compared to those of White and Asian student groups, the gap widened dramatically, with African American students achieving 98 points lower than White students and 174 points lower than Asian students. Similar gaps were also observed when students took the ACT (Figure 9, MSDE, 2023).

Figure 9

SAT / ACT / AP Overall and Math Test Results in the State for the following Student Populations: Overall, African American, White, & Asian







Note: Data is derived from the State Department of Education (MSDE) 2023.

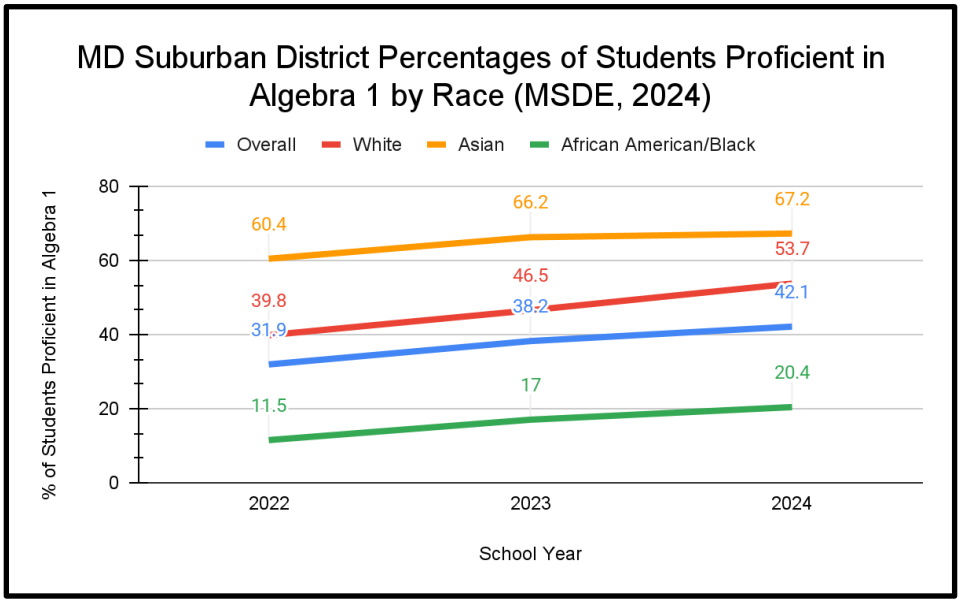
Local Level.

Within the medium-sized public school district, national and state broad trends continue, highlighting the substantial achievement gaps between African American students and the overall White and Asian student groups' math proficiencies. In the case of Algebra 1

outcomes (Figure 10; MSDE, 2023), the proficiency rates have become dire, as the scores of all students have sharply declined in 2022 (MSDE), primarily due to the COVID-19 pandemic (Mahnken, 2025), which has further exacerbated the already existing achievement gaps. In 2019, before the COVID-19 pandemic, the district's achievement data indicated that 55.8% of students were proficient on the Algebra 1 exam (MCAP, 2019). In 2022, the overall proficiency rate dropped to 31.9%. In that same year, 39.8% of White and 60.5% of Asian students were proficient in Algebra 1, while only 11.5% of African American students demonstrated the same level of proficiency (MSDE, 2023). In 2023, although there is some improvement, significant achievement gaps continue to be seen between African American, White, and Asian students. (Figure 10, MSDE, 2023).

Figure 10

Medium-Sized Public School District in a Mid-Atlantic State in the United States' Percentages of Students Proficient in Algebra 1 by Race



Note: Data is derived from the State Department of Education (MSDE) 2023

In Summary.

The achievement gaps between African American, White, and Asian students are pervasive across national, state, and local levels. The repeating pattern of these gaps, both

academic and access, indicates that there are real challenges African American students face in education, particularly in the math classroom. The reasons for these repetitive disparities are complex and multifaceted. They are directly related to the history of African American people in the United States, as well as at the state and local levels.

History of Achievement and Opportunity Gaps in Education for African American Students

African American students have historically faced an educational system designed to discriminate against them. Kershaw (1992) traces this back to slavery, when enslaved people were "educated" solely to operate within an oppressive system for survival. They were generally denied literacy and formal education. This lack of schooling persisted throughout slavery. The end of slavery brought hope during Reconstruction for a fairer life for African Americans (Kershaw, 1992). After abolition, Reconstruction efforts led to the construction of schools for African American children (Anderson, 1988; Williams, 2005), but Jim Crow laws soon ensured these schools were underfunded, in poor condition, and often limited to below high school level courses (Fairclough, 2001).

By the 1870s, Jim Crow legislation swiftly imposed barriers to voting, earnings, and education, deepening systemic racism, and limiting opportunities for African Americans (Banaji et al., 2021; Kershaw, 1992). The institutions accessible to African Americans were vastly inferior to those serving White students (Banaji et al., 2021; Kershaw, 1992). In 1896, Plessy v. Ferguson established the "separate but equal' doctrine, legalizing segregation and perpetuating inadequate school funding, discriminatory housing policies like redlining, and restricting African Americans to low-wage jobs (Baker et al., 2022; Banaji et al., 2021; Kershaw, 1992).

Segregation was declared unconstitutional in 1954 by Brown v. the Board of Education, which led to the integration of African American students into predominantly white schools. Many White families opposed desegregation, delaying progress and creating barriers for African

American students' access to quality education. In the district studied, school desegregation didn't occur until 1963, following advocacy by the NAACP (Bill, 2023).

By 1965, comprehensive high schools had become common, aiming to serve diverse student needs through customized instruction based on standardized test results and individualized recommendations. Tracking systems emerged and categorized students into groups: (1) college-bound, (2) non-college-bound/vocational, (3) gifted, and (4) 'basic" (Kershaw, 1992, p.158). However, these standardized test measures were biased, and African American students—who often lacked preparation for such testing—were more likely to be placed on lower tracks solely based on these results (Kershaw, 1992).

Teachers' negative biases toward African American students further reinforced these disparities, limiting opportunities for these students both inside and outside the school (Kershaw, 1992). Research by Schafer & Olexa (1969) indicated that teacher perceptions significantly influenced students' self-view. Students in lower tracks faced lowered expectations and poorer teaching, affecting their academic performance and self-esteem, sometimes leading to dropout (Schafer & Olexa, 1969; Kershaw, 1992). Unfortunately, such biases and dynamics still persist today, impacting African American students' achievement and access in math pathways.

Math Teacher Mindset and African American Students' Sense of Belonging

This study focuses on two key factors that research suggests significantly influence the mathematics achievement of African American students: teachers' growth mindset and students' sense of belonging in the math classroom (Canning et al., 2019; Good et al., 2012; Walton & Cohen, 2011). The following section outlines how these factors are relevant to the success of African American students in mathematics.

Teacher Mindset.

The teacher mindset, or "teachers' attitudes, beliefs, and practices" (Olson & Wacker, 2019, p. 1), plays a crucial role in creating an inclusive and connected classroom environment (Battey et al., 2018). Teachers who have a growth mindset exhibit a belief that people can "develop their abilities" (Dweck, 2016, p. 215) and that intelligence is malleable rather than fixed (Clark & Soutter, 2022; Dweck, 2016). African American students are more likely to succeed and surpass their peers in mathematics when their teachers demonstrate a caring and growth mindset in math programs (Borman et al., 2000; Domina, 2014; Gandara & Patricia, 2006; Leonard & Martin, 2013; Patrick et al., 2020). Conversely, teachers with a fixed mindset believe that a student's intelligence is unchangeable and static (Bostwick et al., 2020; Dweck, 2016). In instances where students have teachers with more fixed mindsets, they face a higher chance of failing courses, feeling disconnected, and experiencing low self-confidence (Battey et al., 2018). In contrast, teachers whom students describe as "emotionally supportive" are more likely to increase academic achievement and math efficacy for their students (Blazar & Kraft, 2016; Broda et al., 2018; Maloney & Matthews, 2020).

Teachers who have fixed mindsets can also be more harmful to African American students, as these mindsets may trigger in these students "stereotype threat," which is the internalization of negative stereotypes that can hinder academic performance and reduce their likelihood of achieving in advanced-level math courses (Dweck, 2016; Mello et al., 2012; Ogbu, 2003; Stohlmann, 2022). When students encounter negative stereotypes, an environment is created that threatens their sense of belonging, making them less likely to succeed (Murphy & Zirkel, 2015). Stereotype threats often perpetuate social reproduction (Kelly, 2009, p. 534; Merolla & Jackson, 2019; Morales-Chicas & Graham, 2021), exacerbating disparities between student groups (Elin-Saintine, 2021; Kelly, 2009; Mello et al., 2012; Merolla & Jackson, 2019). Students must feel like they are an integral part of the classroom community and see themselves

as mathematicians to take risks in math classrooms (Mahoney & Matthews, 2020; Murphy & Zirkel, 2015).

The teacher in the classroom has a direct influence on the achievement and success of African American students in mathematics (Battey et al., 2018; Kane & Staiger, 2012; Maloney & Matthews, 2020). Teachers' mindsets affect classroom tone, how relationships between teacher and student are built, the nature of instruction and feedback provided, and ultimately, students' academic outcomes (Baldwin et al., 2020; Barbieri & Miller-Cotto, 2021; Battey et al., 2021; Elin-Saintine, 2021; Fashaw, 2024; Padilla et al., 2022; Pyne et al., 2024). In a study of STEM college professors' mindsets, students whose professors had a growth mindset experienced racial achievement gaps that were twice as small as those whose professors held a fixed mindset (Canning et al., 2019). In the National Study of Learning Mindsets (2019), students who received a growth mindset intervention were three percentage points more likely to enroll in an advanced math class the following year, alongside corresponding increases in their math GPAs (Yeager et al., 2019).

Standard practices that promote a growth mindset include teachers encouraging students to focus more on the process rather than the outcome, framing mistakes as opportunities for learning, and allowing students to act on feedback from teachers or peers to improve their work (Dweck, 2016; Ricci, 2020). Many of these growth mindset approaches closely resemble culturally responsive teaching practices; instructional practices that are focused on "promoting authentic engagement and rigor among culturally and linguistically diverse students" that have proved to be effective for students of color, including African American students (Hammond, 2015). For example, in Hammond's 2015 book, Culturally Responsive Teaching in the Classroom, she emphasizes that specific feedback aimed at strengthening students' work is crucial for culturally and linguistically diverse learners, as well as the importance of reframing mistakes for students. Hammond cites Dweck's work, highlighting the link between a growth mindset and an academic mindset, which underpins her approach to

culturally responsive teaching (Hammond, 2015). Hammond also cites the importance of diverse students feeling a sense of belonging in the educational community as key to a successful academic journey (Hammond, 2015).

A classroom steeped in growth mindset practices is one where students feel safe engaging in academic discourse, taking calculated risks, and learning from mistakes. The focus is not only on reaching the right solution but also on valuing the process of problem-solving. Students support one another, sharing strategies and working collaboratively toward solutions, while the teacher provides guidance and scaffolding to help them navigate challenges. Feedback flows in multiple directions—students receive constructive feedback from their peers and their teacher, and they learn to view this feedback as an essential part of growth. Visuals, language, and routines reinforce the idea that intelligence is not fixed but can be developed. For example, both teachers and students use phrases like "You don't understand it *yet*," and effort, perseverance, and strategic thinking are celebrated just as much as the final product. (Dweck, 2006; Yeager & Dweck, 2012; Ricci, 2013)

This type of learning environment is particularly important for African American students. Research demonstrates that African American students are often disproportionately impacted by deficit-based assumptions and fixed-mindset practices in schools, which can undermine their sense of belonging and academic identity (Steele, 2010; Ladson-Billings, 1995). By centering classrooms around growth-oriented practices, teachers communicate high expectations and belief in students' potential, counteracting stereotypes and affirming students' capabilities (Dweck, 2006). When mistakes are framed as opportunities and effort is recognized as the pathway to mastery, African American students are more likely to feel that they are valued contributors in

the classroom community (Canning et al., 2019). Such practices help dismantle the barriers of unconscious bias and low expectations, instead fostering classrooms where all students—especially African American students—see themselves as capable of success in advanced mathematics.

Students' Sense of Belonging.

A student's sense of belonging is defined as acceptance, inclusion, and feeling like a necessary "part of" the school and classroom environments (Goodenow, 1993b). A sense of belonging has been shown to have a greater impact on African American students' feelings of safety in the classroom and academic achievement than on some other racial groups, including White students (Faircloth & Hamm, 2011; Lacoe, 2020; Murphy & Zirkel, 2015; Stroman, 2019). In a study by Barbieri & Miller-Cotto (2021), a sense of belonging was "the only significant predictor of learning," surpassing factors such as prior knowledge, perceptions of and interest in mathematics, socioeconomic status, and math self-concept for African American students' mathematics achievement (Barbieri & Miller-Cotto, 2021). Therefore, a strong sense of belonging increases students' likelihood of success even when socioeconomic status, race, and gender are accounted for (Barbieri & Miller-Cotto, 2021; Hennesy, 2018).

Students' self-confidence and self-perception as math learners increase when they feel a sense of belonging in the classroom (Pyne et al., 2024). Studies show that African American students' connectedness among students, teachers, and classmates have a greater impact on their academic success than for their White counterparts, making belonging foundational for African American students' academic achievement (Bouchard & Berg, 2017; Goodenow & Grady, 1993; Hennesy, 2018; Högberg et al., 2021; Murphy & Zirkel, 2015; Nichols, 2006). Feeling a sense of belonging improves the likelihood that students will enroll in higher-level math courses, achieve at higher levels academically, and engage more deeply in school life (Ennis et al., 2014; Grossman & Portilla, 2022; Keyes, 2019; Hammond et al., 2021; Mahoney & Matthews, 2020).

In contrast, when African American students are enrolled in higher-level math courses but do not feel included or represented in the classroom, their sense of belonging decreases (Mello et al., 2012; Walton & Cohen, 2007). A lack of belonging increases the likelihood of poor performance in math classes, further diminishing opportunities for African American students to participate in advanced-level math courses and Algebra 1 by eighth grade (Barbieri & Miller-Cotto, 2021; Graham et al., 2022; Kokachi & Graham, 2020; Martin, 2000; Walton & Cohen, 2007).

In the secondary classroom, students with a strong sense of belonging "have more positive attitudes about school, are more motivated, and achieve better academic outcomes as feelings of belonging increase" (Graham et al., 2022, p. 2016; Kokachi & Graham, 2020). Students whose teachers actively help them feel a sense of belonging in the classroom are more likely to engage fully in learning, value mathematics, and achieve higher levels of proficiency in math content (Barbieri & Miller-Cotto, 2021; Hennesy, 2018; Hoffman et al., 2021; Mahoney & Matthews, 2020). Strong support networks are also more likely to form, further benefiting students' academic outcomes (Graham et al., 2022).

In summary, research consistently demonstrates that both teachers' growth mindset practices and African American students' sense of belonging are powerful predictors of students' engagement, persistence, and achievement in mathematics. These factors not only shape academic outcomes individually but also interact to create classroom environments that can either promote or hinder African American students' participation and success in mathematics courses. An African American student who has a strong sense of belonging in their mathematics class, paired with a teacher who has a strong growth mindset, has a powerful advantage in the classroom. These two factors can be used to improve African American students' achievement levels and increase their access to upper-level mathematics courses (Canning et al., 2019; Blazar, 2021; Bostwick et al., 2020; Broda et al., 2018; Yeager et al., 2019; Yeager & Dweck, 2020). By focusing on these two interconnected factors — growth mindset and student belonging — this

capstone aims to investigate whether enhancing teachers' growth mindset practices through a professional development series impacts teachers' mindsets and instructional practices and fosters African American students' sense of belonging in mathematics classrooms.

Local Background

The state in which this study has a long history of racist practices. All school districts in this state refused to follow the orders for desegregation when they were first issued, except for one school district that was considered the example for integration during that time (Banaji et al., 2021). Also present within this state were racist housing practices such as redlining, which is explicitly marking a majority African American neighborhood as bad, therefore outlined in red on a real estate map (Banaji et al., 2021). These practices concentrated the African American population into specific geographical, often under-resourced, areas and restricted their access to predominantly white, better-resourced areas (Massey & Denton, 1993; Rothstein, 2017; Owens et al., 2016). Additionally, "sundown" towns were also common across the state—towns or places where African American people were not allowed after sunset (Loewen, 2005). The aftereffects of these practices continue to influence modern-day housing, schooling, and educational opportunities for African American students (Cashin, 2021; Reardon et al., 2019; Rury & Hill, 2012).

In the local district where this suburban middle school is located, the focus of the study, there is a long history of racial prejudice and bias. As mentioned prior, desegregation did not take place in this school system until 1963, under court orders (Bill, 2023). Specific housing practices were implemented within this district's county, creating neighborhoods that were made up of predominantly large, expensive single-family houses. Other, more affordable housing options, such as apartments, townhomes, or condos, were located outside of these areas. Due to historical barriers that were already in place, those neighborhoods with a majority of single-family housing were predominantly white, and those neighborhoods with various and affordable housing options were predominantly African American (Bill, 2023).

Shortly before this study, in 2018- 19, the local school system underwent a redistricting process. The goal of this process was to increase equity between schools based on their FARM student populations and to reduce overcrowding. It was proposed that students from predominantly White and Asian communities attend different middle and high schools that were mostly attended by African American students or students of color. In response to this proposal, these Asian and White parents, specifically those involved with the focused middle school and feeder high school system, and especially Asian parents, responded with outrage, formed a coalition, held demonstrations, and sued the school system to ensure their children would not attend the proposed schools (Bill, 2023). These parents argued that their advocacy was to promote equity for their students (Bill, 2023). However, the result of their efforts led to a more segregated school community, as the superintendent's original proposal was rejected, and the board of education created new plans that ultimately did not affect the middle or high school's community (Bill, 2023). This was considered a win by these parent advocates, but it was a significant setback in the ongoing fight for desegregated schools within the targeted district.

As alluded to above, the targeted middle school is situated in an upper-middle-class suburb that serves a majority of Asian and White families. The average household income within this area is approximately $250,000, and only 8% of families qualify for free or reduced meals (School Profile, 2023). Those students who have received free or reduced meals in the past five years are split almost evenly among White, Asian, and African American students. Between 2019 and 2023, the percentage of African American students in the student population doubled from 7% to 14%. Additionally, the percentage of students receiving free and reduced meals has more than doubled, from 3% to 8% (School Profile 2019, 2023).

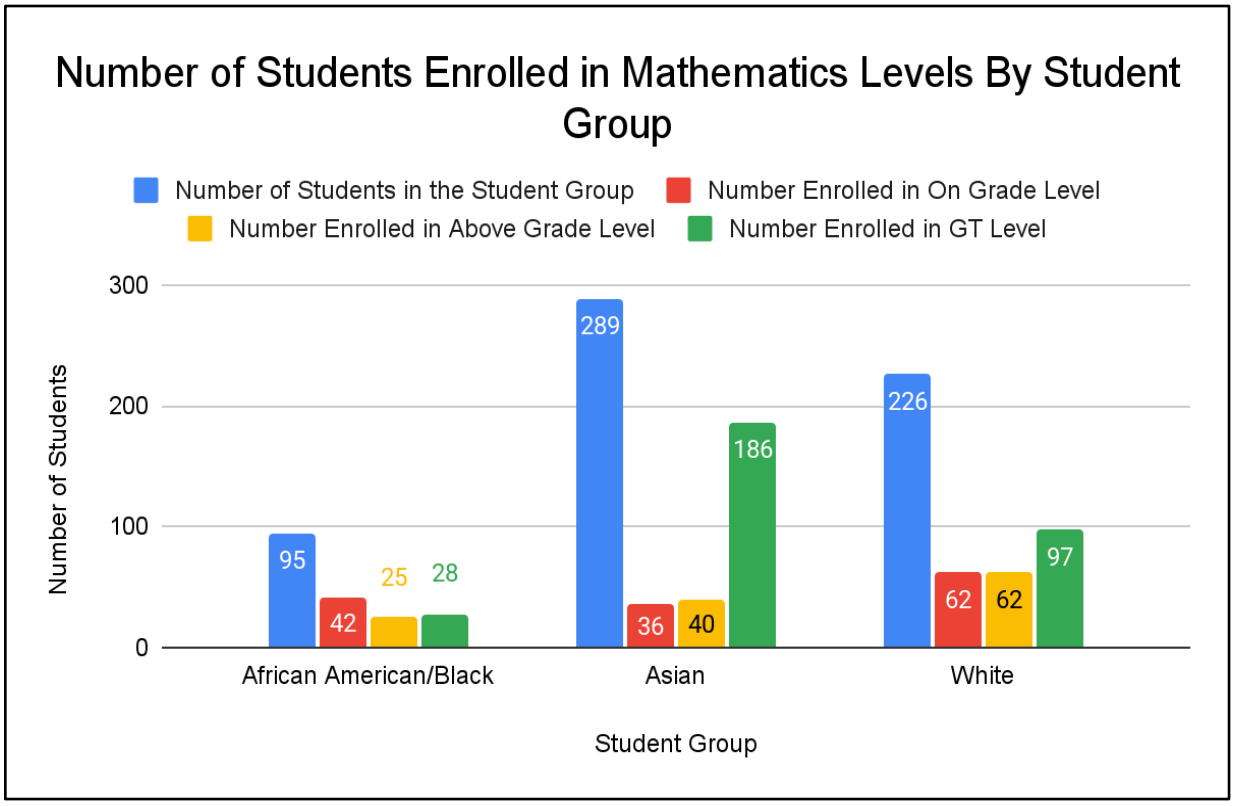
At the time of this study, the staff consisted of forty-four full-time teachers, with experience ranging from one to forty years. There were seven math content teachers, including the math special educator; their data were a focused part of this study. The remainder of the teaching staff consists of approximately fifteen teachers who teach ELA, Social Studies, or Science; the other nineteen teachers are part of the related arts team, special education, or other specialties such as reading specialist and the gifted and talented resource teacher. The demographics of the certified teaching staff were 89% white, 7% Asian, and 4% African American. The seven math teachers cited within this study consist of five white females and two white males.

African American Math Students and Middle School Math Teachers

The targeted middle school, located in a high socio-economic area, provides a microcosm of the achievement and opportunity gaps that African American students face in the mathematics classroom. As previously stated, there are three primary math levels: on-grade level, above-grade level, and gifted and talented (GT). Moving up from each level becomes increasingly complex once a student has been placed in a designated math pathway (Domina, 2014; Kershaw, 1992; McEachin, 2025; Schafer & Olexa, 1969). In 2023-24, the distribution of students across math pathways (Figure 12) at the middle school level mirrored that at the national, state, and local district levels, resulting in an underrepresentation of African American students in GT math and an overrepresentation of African American students in on-grade-level math classes. In contrast, within this middle school, White students are evenly distributed throughout all math levels, and Asian students are overrepresented in the GT math classes (Figure 11).

Figure 11

Number of Students Enrolled in Mathematics Levels by Student Group

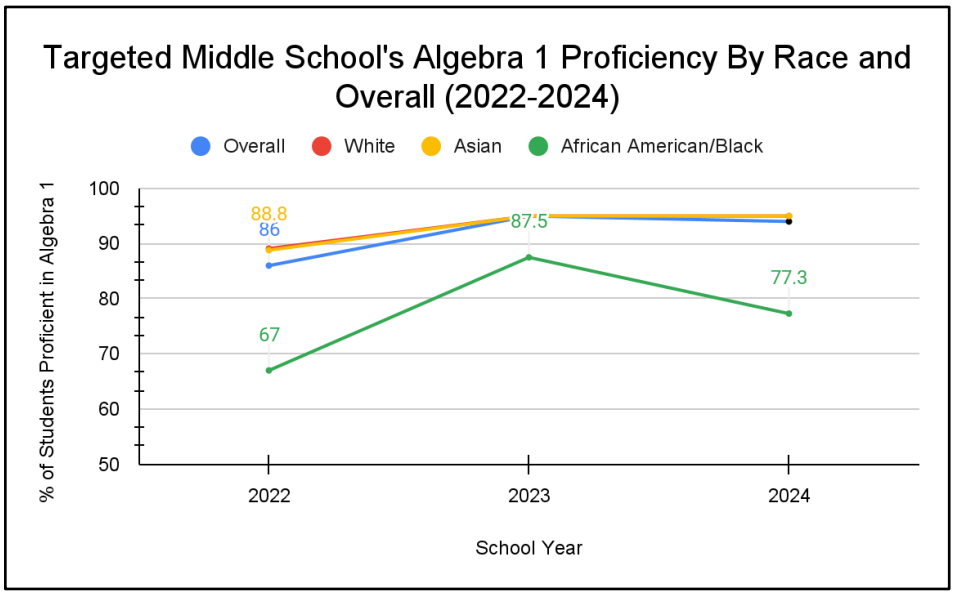


Note: Data is derived from an internal district data set (2023-24).

There are also clear and striking achievement gaps in math between African American, White, and Asian students (MSDE, 2023). In Spring 2023, approximately 83% of Asian and 64% of White students reached proficiency in math classes, while only 39% of African American students were proficient in math (MSDE, 2023). Additionally, there is an achievement gap in Algebra 1 proficiency, as White and Asian students achieve at approximately the same level. In contrast, the performance of African American students in Algebra I is eighteen percentage points lower than that of their Asian and White peers (Figure 12, MSDE 2024).

Figure 12

Targeted Middle School's Algebra 1 Proficiency by Race and Overall (2022-2024)



Note: Data derived from MSDE Report Card 2024.

Positionality

As mentioned in the preface, both personal experiences and professional practice have shaped my journey toward this research. As a graduate student, reading Jonathan Kozol's Savage Inequalities exposed me to the systemic inequities that exist within the public education system. Later, as an administrator, I recognized similar disparities in the schools that I served—particularly the absence of African American students in gifted and talented courses, even in high socioeconomic settings. These realizations help to fuel my commitment to equity and guide my work as a school leader.

In my current role as a principal in a high-SES community, I continue to observe persistent barriers faced by African American students, including underrepresentation in advanced math courses and overrepresentation in lower-level tracks. These patterns highlight that inequities are not confined to underfunded schools but are also present in affluent ones.

I also acknowledge that my positionality as a White principal in a well-resourced school influences how I perceive and interpret this work. This position gives me a unique perspective

on the school's culture and climate, teachers' strengths and weaknesses, parent and guardian concerns, and students' experiences that were shared directly with me. However, it's essential to recognize that this perspective is also likely to lead to unconscious bias in my analysis and interpretation of the data. I also acknowledge that, while offering valuable insight, my viewpoint is limited to that of the school leader and my own observations and experiences. Therefore, this study is exploratory in nature.

Conclusions drawn from this data will be based on the implementation of the GM PD series at the targeted middle school and the data that were collected during and after this process. It should be noted that the environment I describe captures a specific moment in time and does not necessarily represent the current state and experiences of all stakeholders, past or present. This exploratory study reflects both my professional responsibility and personal dedication to addressing inequities to enhance African American students' sense of belonging in middle school math classrooms.

Casual Systems Analysis

Causal Systems Overview & Problem of Practice

In the Casual Systems Analysis (CSA), I identified the problem of practice (PoP) as: *"The substantial opportunity and achievement gaps in Math between African American students and the White and Asian student groups,"* as this is a prevalent problem that can be seen nationally, statewide, and locally.

Context.

Systemic gaps are evident at the middle school that is the focus of this study, and in the experiences of African American students enrolled there. Parents, staff, and students have reported concerns about bias, including instances where African American students were seemingly disciplined more harshly than their peers or where teachers overlooked their

questions in class. While families shared these concerns with administrators, many parents requested confidentiality out of fear of possible retaliation if they approached teachers directly.

Demographic shifts in the school community have added to these dynamics. As the student population has become increasingly diverse, some veteran teachers accustomed to Eurocentric norms and lecture-based instruction have expressed difficulty adapting their practices. At times, implicit biases have surfaced, such as African American boys being described as "scary" or "intimidating," or teachers hesitating to engage with families based on assumptions about responsiveness. In addition, some staff have struggled to acknowledge race as a factor in students' experiences, dismissing student trauma or questioning the need for differentiated supports. Professional development opportunities that explicitly engage with race have sometimes been met with discomfort or hesitation.

Over the past five years, the school has offered a range of professional learning opportunities intended to explore the role of race in shaping students' educational pathways. Some of these efforts led to valuable dialogue, while others faced challenges related to time, comfort level, or perceptions of the material. For instance, in the 2020–2021 school year, two book studies were facilitated—one focusing on the history of racism in America for younger audiences, and another exploring how privilege can shape experiences in schools and society. Some staff members reported difficulty completing the reading, while others found the content uncomfortable or politically charged, which limited its overall impact.

During the 2021–2022 and 2022–2023 school years, the district's Diversity, Equity, and Inclusion office provided professional learning sessions on creating inclusive, student-centered classrooms. While the sessions offered helpful strategies, a few staff members expressed reservations when the discussions explicitly addressed race. Likewise, a trauma-informed practices series in 2022–2023 was shortened after it became clear that perspectives differed on whether the focus should be primarily on students' prior experiences or on the impact of student behavior on teachers.

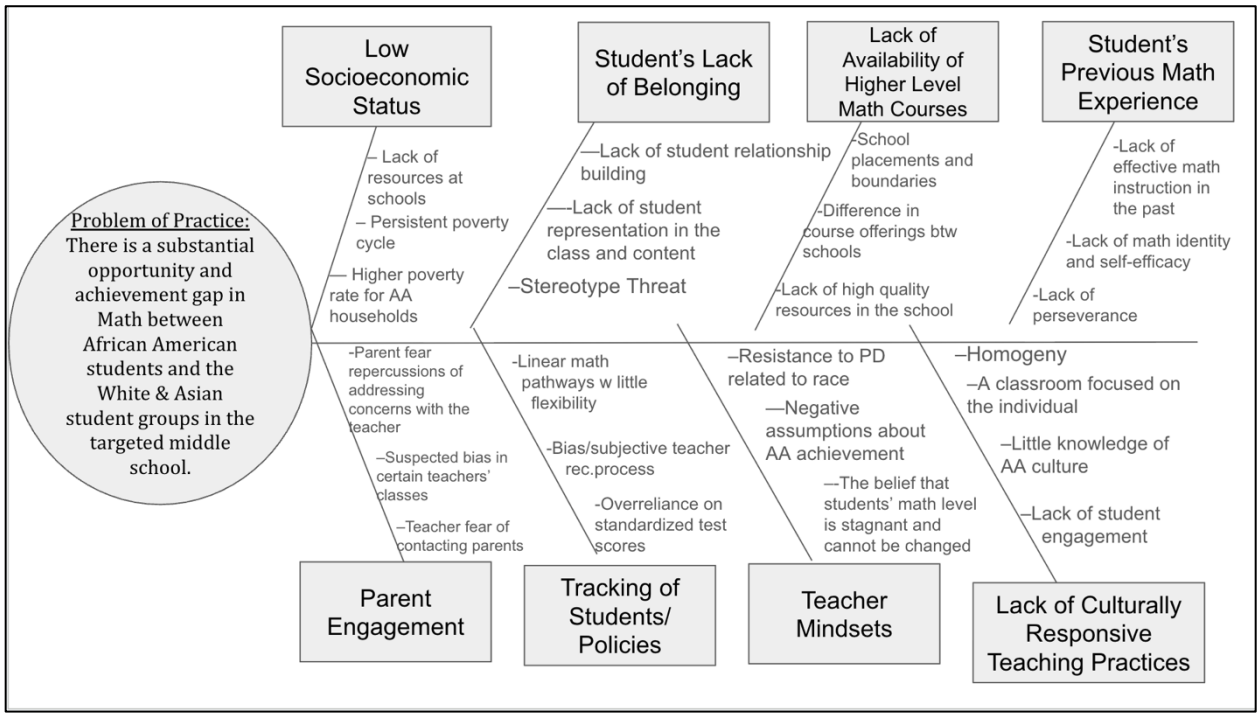
During this time, and even before 2020, the teachers' association also voiced concerns about staff culture, at one point recommending that district leadership consider staffing adjustments to help strengthen the school environment. Taken together, these experiences reflect both the challenges and the opportunities of fostering professional learning that affirms students' lived experiences while also supporting staff as they reflect on their own beliefs and practices.

Casual Systems Analysis

Before I decided to focus on growth mindset and belonging, I worked through the root causes of the problem, carefully considering the factors that were systemically contributing to the issue, as well as those that could be contributing to it locally within the specific context of the targeted middle school. Below are my thought processes and considerations for various bones in the CAS (Figure 13).

Figure 13

Casual Systems Analysis and the Problem of Practice



Note: A CSA (fishbone) is based on the writer's professional knowledge and research.

Low Socioeconomic Status.

Socioeconomic factors significantly intersect with racial disparities in mathematics achievement for African American students. In the state examined, the African American poverty rate is four percentage points higher than the overall state average (KFF, 2024), contributing to persistent resource disparities in schools serving low-income communities. Students from low-income households, regardless of race, often attend under-resourced schools with fewer experienced teachers and limited access to advanced coursework (Allen et al., 2018; OCR, 2021). These inequities have long-term consequences, as early academic tracking decisions—often shaped by available resources—can either open or close pathways to advanced mathematics throughout a student's K-12 career (Dougherty, 2015). However, as previously stated, the middle school I focused on was in a particularly high socioeconomic area, therefore the disparities within this school were most likely not due to poverty concerns, underscoring that socioeconomic status, while critical, does not fully explain the opportunity and achievement gaps in advanced math enrollment and outcomes at the targeted location (Battey et al., 2018; Barbieri & Miller-Cotto, 2021; Johnson et al., 2021; Murphy & Zirkel, 2015).

Tracking of Students & District Policies

Tracking or assigning students to a specific path of mathematics classes is a common practice in schools (Edosomwan et al., 2022; Reyes & Domina, 2017). According to current data, African American students are often tracked into lower-level math classes as early as kindergarten, and these tracks become solidified in middle school (Entwistle et al., 1997; Jabbari & Johnson, 2020; Kelly, 2009; Patrick et al., 2020; Spencer, 2009). Navigating away from these math sequences becomes increasingly complex once students are placed on a track or "opportunity sequence" (Ngo & Velasquez, 2020). As reviewed earlier, math is taught linearly, creating a path that directs students towards GT-level mathematics, above-level mathematics, and on-grade-level mathematics. As students' progress on this path, they become "locked in" (Domina, 2014), with opportunities to accelerate limited, if not untenable (Edosomwan et al.,

2022).

Within this district, when students enter middle school, they have already been placed on a math pathway. As math levels are influenced by the classes students have taken before them, it becomes increasingly complex to change pathways as students advance from sixth to eighth grade. By eighth grade, a student's future math pathway is primarily determined in this middle school. Moving forward, if a student wishes to change their pathway, they must take additional math courses outside of the school day or during the summer to meet the correct prerequisites.

Statistically, African American students are fourteen percent more likely to be trapped in inflexible math pathways than White students, and nine to twelve percent more likely to be trapped than Asian students (Ngo & Velasquez, 2020). Even when African American students begin their math progression on a higher-level math track, as they progress from middle to high school, they have an increased chance of getting off track in their math progression and gradually falling behind White and Asian student groups (Johnson, A. et al., 2021). When this data is combined with the proportion of African American students considered "off-track" in math, "77 percent of Black [African American] students are always off-track in math, relative to … 44 percent of White students, and 28 percent of Asian students" (Johnson, A. et al., 2021). These persistent disparities can be devastating for African American students.

The Impact of Standardized Testing Results.

African American children are also impacted by standardized test results more so than other student groups, with teachers relying more on standardized test results for African American students than for other students, rather than looking at the child through a holistic lens (Kaufman et al., 2024). It is argued that the materials used to assess students are prone to racial biases and do not always account for diversity and students' cultural differences, resulting in inaccurate scores that unfairly impact African American students (Patrick et al., 2020). An overreliance on standardized tests to decide an African American student's academic math

placement in school also contributes to a higher probability that African American students will become stuck in lower-level math pathways (Davis & Martin, 2008; Kaufman et al., 2024; Mollenkamp, 2024). In contrast, White and Asian students are more likely to be placed into classes based on holistic information that is considered along with standardized test scores. The consideration of both factors —test scores and the child —increases a student's likelihood of being placed in an advanced math pathway. Unfortunately, African American students are more likely to be considered for placement based solely on test scores, which reduces their chances of placement in an advanced math course (Kaufman et al., 2024).

Availability of Higher-Level Math Courses.

In a study by Singh & Granville (2016), a student's past enrollment in math courses was the number one determinant of success in Algebra 1 in eighth grade. Yet, nationwide, many African American students attend middle or high schools where advanced-level math courses are not offered (Edosomwan et al., 2022; Mathews, 2022). 35% of the schools serving the *highest* percentages of Black and Latino students do *not* provide Calculus, while 54% schools serving the *lowest* percentages of Black and Latino students do offer Calculus (U.S. Department of Education Office for Civil Rights, 2021; Dougherty, 2015; Edosomwan et al., 2022; Mathews, 2022). Some researchers attribute this to the fact that many majority-African American schools lack resources and quality teachers (Bankston & Caldas, 1996; Morton & Riegle-Crumb, 2019), which limits African American students' opportunities to participate in higher-level math courses.

African American Students' Previous Math Experience.

A student's view of themselves as a mathematician can also impact their success in the math classroom. Depending on their prior experiences in mathematics, African American students may enter the mathematics classroom with little confidence, as "dependent learners," or learners who do not persevere, and lack a strong math identity, self-efficacy, and perseverance (Hammond, 2015). A student's math identity impacts their math proficiency as

they progress through the curriculum, with studies showing a relationship between an African American student's math identity and their level of success in the math classroom (Nasir, 2000; Pyne et al., 2024). Students' math identity is also influenced by whether they feel connected to the class and its content (Murphy & Zirkel, 2015; Pyne et al., 2024).

Parent Engagement.

Parental engagement has been identified as a critical factor influencing the experiences and outcomes of African American students in mathematics (Jeynes, 2007; Hill & Tyson, 2009). Within the targeted school context, some African American parents express fear of potential repercussions if they raise concerns about their children's treatment or academic progress with teachers. Additionally, suspected bias in specific classrooms contributed to parental hesitation and eroded trust between families and educators. On the other side, some teachers reported reluctance or fear in initiating contact with parents, citing time constraints or apprehension about negative responses. These dynamics collectively hindered open communication and collaboration between home and school, further complicating efforts to support African American students in advanced mathematics pathways.

Lack of Culturally Responsive Teaching Practices.

Culturally responsive teaching practices are those that take into consideration the diverse perspectives of students, helping students connect the content, in this case, mathematics, to their differing backgrounds and experiences (Hammond, 2015; Ruppert et al., 2022). The incorporation of culturally responsive teaching practices encourages students to reflect on the impact math has had in their lives and to see themselves in mathematics. These practices are equity- and asset-based, aiming to "motivate and inspire marginalized students" (p. 3, Ruppert et al., 2022).

Many teachers do not implement culturally responsive teaching practices and often lack knowledge of African American culture or effective strategies to connect with African American and other marginalized students (Howard & Terry, 2011; Hammond, 2015; Ruppert et al.,

2022). Studies have also shown that African American students are more likely to succeed when culturally responsive teaching practices are implemented (Hammond, 2015; Ruppert et al., 2022).

When culturally responsive teaching practices are lacking, student disengagement with the content can increase (Altschul et al., 2006; Ruppert et al., 2022). A typical classroom often reflects Eurocentric norms and culture (Battey et al., 2018; Howard & Terry, 2011). White teachers make up 79% or approximately eight in ten of the US teacher workforce, essentially guaranteeing that Black students will have a White teacher during their K-12 education (Schaeffer, 2021). White teachers can be prone to teaching and viewing African American students through a deficit lens or colorblindness, which can impede African American students from achieving well academically (Battey et al., 2021; Blazer, 2021; Chin et al., 2018; Maloney & Matthew, 2020). This mindset defaults to the dominant culture, or hegemony, which creates a barrier to culturally responsive teaching practices and negatively impacts African American students in the math classroom (Howard & Terry, 2011).

Teacher Mindset and Belonging.

As was noted within the literature review, a teacher's mindset and instructional practices can have a profound impact on African American students' sense of belonging in the math classroom (Battey et al., 2018; Barbieri & Miller-Cotto, 2021; Blazar & Kraft, 2016; Murphy & Zirkel, 2015; Yeager et al., 2019).

Teacher Mindset.

A teacher's mindset can significantly influence student outcomes, either positively or negatively. When teachers believe that students are capable of growth and learning, they are more likely to dedicate time, effort, and instructional support to help those students succeed in the mathematics classroom (Dweck, 2016; Blazar & Kraft, 2016). Conversely, when teachers hold negative assumptions or fixed beliefs about students' abilities, students often perceive a lack of support, which can adversely impact their mathematical achievement, self-concept, and

engagement with content (Battey et al., 2018; Bostwick et al., 2020).

Teacher mindset also directly shapes the instructional practices teachers employ in their classrooms. Research indicates that instructional strategies promoting a growth mindset can enhance the academic success of African American students, particularly in mathematics, by fostering higher engagement, perseverance, and confidence in problem-solving (Canning et al., 2019; Yeager et al., 2019).

Furthermore, teachers' mindsets were a critical consideration in evaluating the culture of the targeted middle school for this study. It was essential that teachers approached their students through a growth-oriented lens and demonstrated growth mindsets themselves. By shifting the focus away from individual student characteristics and instead emphasizing shared learning goals, it was anticipated that teachers would be more receptive to incorporating growth mindset principles and instructional practices in their classrooms (Battey et al., 2021; Murphy & Zirkel, 2015).

Students' Sense of Belonging.

A sense of belonging among African American students in the math classroom can stem from several interconnected factors. One significant contributor is building relationships with students; if this is lacking, it diminishes students' sense of connection to teachers and peers. Research has shown that strong, authentic relationships between students and teachers are foundational to creating a classroom environment where students feel valued and included (Goodenow & Grady, 1993; Blazar & Kraft, 2016). When these relationships are absent, African American students may feel isolated or unwelcome, leading to disengagement from rigorous coursework and a decrease in academic motivation (Battey et al., 2018; Murphy & Zirkel, 2015).

Another critical factor is the lack of student representation in class content, meaning students do not see their cultural identities reflected in the curriculum, examples, or instructional practices. This absence can signal to African American students that they do not belong in these math spaces, eroding their engagement and confidence in the class (Howard &

Terry, 2011; Ruppert et al., 2022). Compounding these issues is stereotype threat, in which African American students internalize negative stereotypes about their mathematical abilities, causing anxiety and undermining performance even when they are fully capable (Steele, 1997; Murphy & Zirkel, 2015; Stohlmann, 2022). Collectively, these factors interact to weaken African American students' sense of belonging in the math classroom, hindering both participation in advanced coursework and overall academic achievement (Barbieri & Miller-Cotto, 2021; Walton & Cohen, 2007).

At the targeted middle school, these factors contributing to African American students' sense of belonging have been evident through both anecdotal reports and school data. Parents and students described experiences where meaningful relationships with teachers were lacking, and classroom materials did not reflect diverse cultural identities, leading to feelings of invisibility and disengagement. Additionally, instances of stereotype threat have surfaced, with African American students perceiving lower academic expectations or feeling singled out in disciplinary practices. Further undermining their confidence and participation in advanced-level math classes. Addressing these issues is crucial for creating a supportive learning environment where African American students feel a sense of belonging and can thrive academically.

What is also unique about fostering a growth mindset in teachers and creating a sense of belonging for African American students is that these initiatives provide an opportunity to teach culturally responsive practices, as some growth mindset practices overlap with these approaches. Additionally, a sense of belonging is mentioned when exploring culturally responsive practices that are effective for diverse student groups in the classroom (Hammond, 2015). Finally, teacher bias towards students is also discussed during the growth mindset professional development series. Therefore, many of the root causes outlined in the fishbone diagram are touched on within the GM PD (Hammond, 2015).

Causal Systems Conclusion.

Although each of the causal factors outlined in this section contributes to African American students' success in mathematics, this study focuses specifically on two areas most relevant to the setting: (1) middle school math teachers' growth mindsets and instructional practices, and (2) African American students' sense of belonging in the mathematics classroom.

Research demonstrates that teachers with growth mindsets have a positive influence on students' sense of belonging (Canning et al., 2019; Murphy & Zirkel, 2015; Yeager & Dweck, 2020). A combination of growth mindset and belonging has been shown to enhance student engagement, strengthen math efficacy, and improve mathematics achievement for African American students (Bostwick et al., 2020; Maloney & Matthew, 2020; Murphy & Zirkel, 2015; Nye et al., 2004; Pyne et al., 2024). Moreover, many growth mindset practices align with culturally responsive teaching strategies that promote authentic engagement for diverse learners (Hammond, 2015). Taken together, this evidence suggested that implementing a structured growth mindset professional development series would have a positive impact on African American students in the classroom.

Theory of Change, Short-Term Aims, and Driver Diagram

Theory of Change

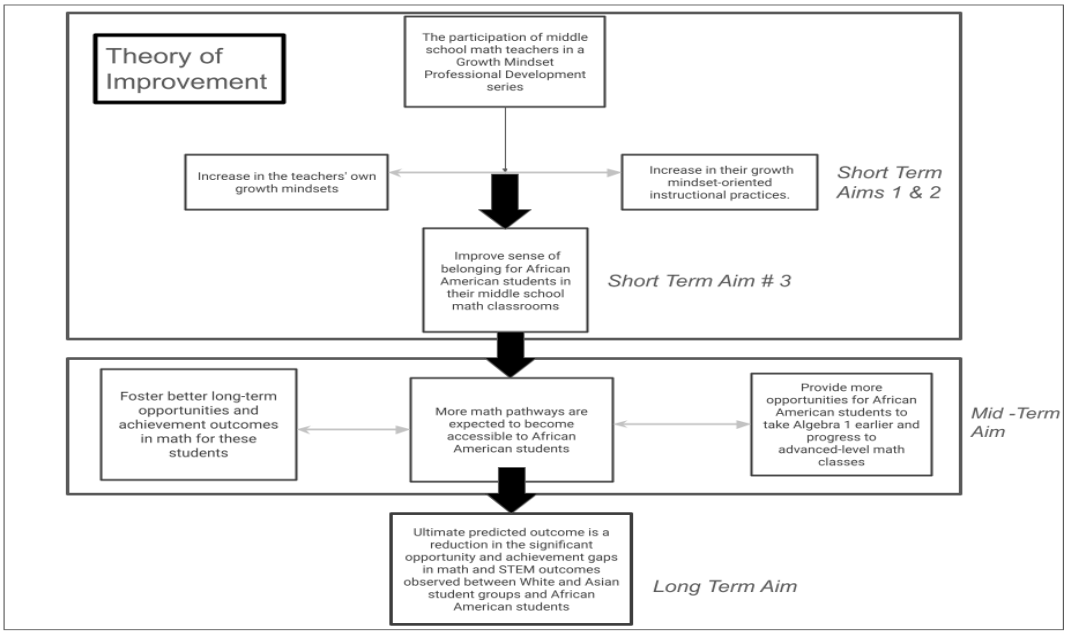
My Theory of Change (TOC) predicts that if middle school math teachers participate in a Growth Mindset Professional Development (GM PD) series, then the middle school math teachers' growth mindsets and instructional practices will increase (Dweck, 2006; Claro et al., 2016; Yeager et al., 2019), which will, in turn, improve African American students' sense of belonging in the middle school mathematics classroom (Walton & Cohen, 2011; Good et al.,

2012; Canning et al., 2019). An increase in African American students' sense of belonging in math class is predicted to improve their long-term opportunities and achievement outcomes in math classes over time (Rattan et al., 2012; Farrington et al., 2012), therefore addressing my problem of practice: *the substantial opportunity and achievement gaps in Math between African American students and White and Asian student groups*. By fostering a growth mindset for teachers and encouraging teachers to integrate GM instructional practices, the anticipated positive effect on African American students' sense of belonging in math class would increase these students' confidence, perseverance, achievement, and opportunities in the math classroom (Canning et al., 2019; Murphy & Zirkel, 2015; Yeager & Dweck, 2020). The future result of these predicted positive gains would be that additional math pathways will become more accessible to African American students, providing these students with more opportunities to take Algebra 1 earlier and continue into advanced-level math classes, thereby reducing the opportunity and achievement gaps in math and STEM outcomes observed between White and Asian student groups and African American students (Figure 14, Ladson-Billings, 2006; Theokas & Saaris, 2013; National Science Board, 2022).

Building on this theory, the goal for the future is to reduce the disproportionate tracking of African American students into lower-level math pathways and to expand their access to higher-level courses. Increased access to advanced math opens doors to additional STEM opportunities, making it more likely that African American students will pursue college-level STEM pathways. With greater representation in these fields, graduates would have access to higher-wage careers and broader opportunities upon graduation. In turn, these outcomes could contribute to narrowing the education and wealth gaps that persist between African American students and their White and Asian peers. Figure 14 presents a Theory of Change flow chart that connects short-term aims with the mid- and long-term goals outlined above.

Figure 14

Theory of Change



Note: Figure 15 is based on the researcher's Theory of Change.

The methods I used to research incorporated primary and secondary data captured from a middle school located in a medium-sized public school district in a Mid-Atlantic state in the United States. In my role as the principal, I created and facilitated, along with my assistant principal and teacher leader, a growth mindset professional development (GM PD) series in the 2023-2024 school year that included presentations, student belonging surveys, teacher pre- and post-growth mindset assessments, a teacher feedback form, and a peer walkthrough observation tool. Results from these tools were collected throughout the 2023 – 2024 school year. Additionally, during the 2024 - 2025 school year, African American students participated in student focus groups to share their impressions of their math teachers' mindsets and their current and past sense of belonging in the math classroom.

Short-term Aims.

The Theory of Change (TOC), as illustrated in Figure 15, predicts that if middle school math teachers participate in a Growth Mindset Professional Development (GM PD) series than

the middle school math teachers' growth mindsets and instructional practices will increase which will, in turn, improve African American students' sense of belonging in the middle school mathematics classroom.

The TOC leads to the following short-term aims:

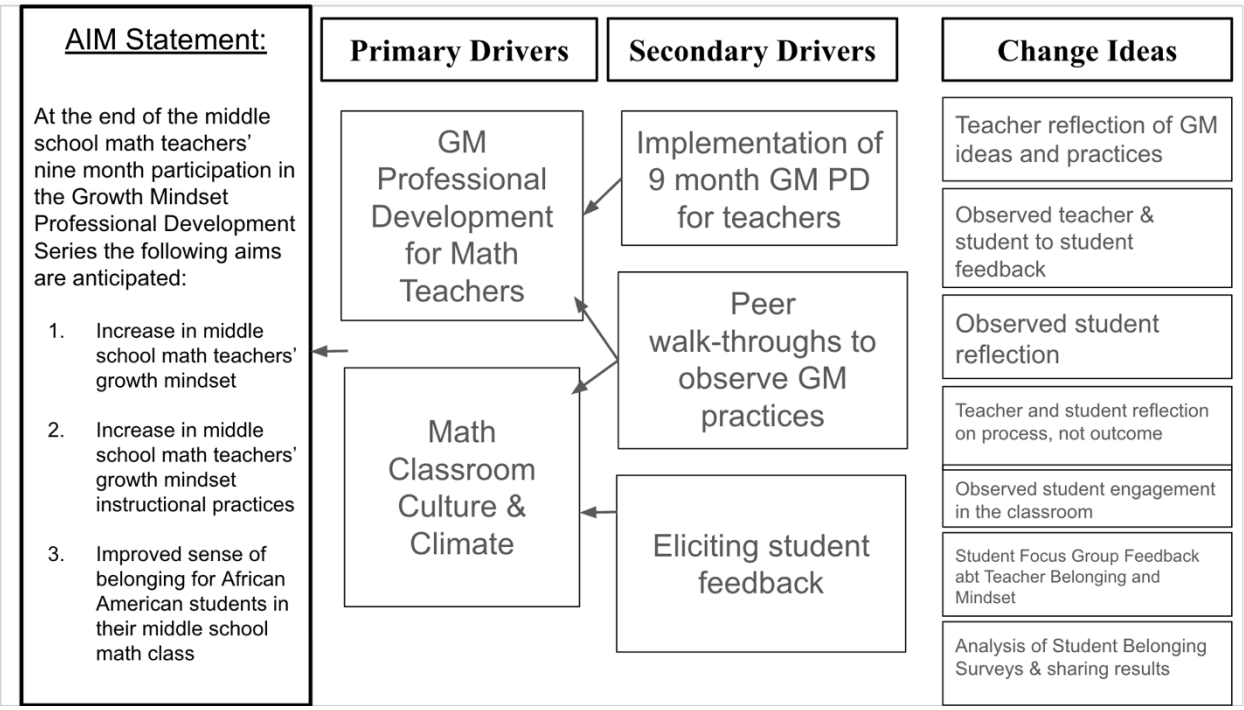
1. Increase in middle school math teachers' self-reported growth mindset
2. Increase in middle school math teachers' growth mindset instructional practices
3. Improved sense of belonging for African American students in their middle school math classes

Driver Diagram.

Using this TOC, my driver diagram (Figure 15) focuses on the following change idea: a nine-month growth mindset professional development (GM PD) series delivered to middle school math teachers, based on the book Mindset by Carol Dweck (2006, 2016), to address the three short-term aims listed above. I predict that the growth mindset professional development results will positively influence middle school math teachers' growth mindsets and instructional practices, in turn enhancing African American students' sense of belonging in the math classroom. If these short-term aims are successful, I predict that more math pathways will become accessible to African American students, which will hopefully lead to the long-term goal of closing the opportunity and achievement gap in mathematics between African American students and their White and Asian peers.

Figure 15

Driver Diagram



Note: Driver diagram with three short-term aims, drivers, and change ideas.

In alignment with the TOC, driver diagram, and short-term aims, the growth mindset professional development series' impact will be measured by a series of tools that include:

- Middle school math teacher growth mindset pre- and post-self-assessments
- African American middle school students' pre- and post-belonging surveys
- Middle school math teacher feedback form results
- Growth mindset instructional peer walkthrough data, and
- African American middle school students' focus group results

Research Questions

These tools will be used to answer the following research questions:

1. How, if at all, do middle school math teachers' growth mindset scores change after participating in a growth mindset professional development series?

2. To what extent did middle school math teachers believe that the growth mindset professional development series influenced their teaching practices, if at all?
3. How did changes, if any, in middle school math teachers' growth mindset scores correlate with changes, if any, in African American middle school students' reported sense of belonging in the middle school math classroom?
4. How did African American middle school students perceive their middle school math teachers' mindset?
5. What is the relationship between how middle school African American students perceived their middle school math teachers' growth mindset and middle school African American students' sense of belonging in the middle school math classroom?

Section 2

Methods

Study Design & Overview

A mixed-methods approach was employed in this study to explore possible patterns and themes between middle school math teachers' growth mindset development and African American students' sense of belonging in math class. The study, conducted from Fall 2023 to Spring 2025, focused on the impact of a growth mindset professional development series on the growth mindsets of math teachers and their instructional practices, as well as the sense of belonging among African American students in the math classroom. Multiple forms of data were collected through teacher mindset self-assessments, a teacher feedback form, peer walkthrough observations, student belonging surveys, and student focus groups (Figure 16).

Figure 16

Timeline of Study & Methods

Data Collected	Participants	Instrument/Tool	Timeline
Pre-Growth Mindset Survey	Teachers	Self-Assessment	Fall 2023
Growth Mindset PD Sessions	Teachers	13 sessions + reflections	Aug 2023 – Apr 2024
Peer Walkthroughs	Teachers	Observation tool	Mar – Apr 2024
Post-Growth Mindset Survey	Teachers	Self-Assessment	Apr 2024
Teacher Feedback Form	Teachers	Self-Assessment & Reflection	Apr 2024
Student Belonging Survey (Pre)	Students	Survey adapted from scales	Fall 2023
Student Belonging Survey (Post)	Students	Survey adapted from scales	Apr 2024
Focus Groups	African American Students	Semi-structured interviews	Jan & Mar 2025

Note: Methods of study are presented chronologically from fall 2023 to spring 2025.

Participants.

Teachers.

All 44 middle school teachers teaching Grades 6–8 participated in the GM PD series during the 2023–2024 school year. They also participated in the pre- and post-mindset self-assessments, peer walkthroughs, and completed the teacher feedback form. Secondary data from the seven math teachers at this school was pulled for analysis.

Students.

During the 2023–2024 school year, approximately 668 students attended the middle school, ranging in age from 11 to 14 across Grades 6–8. The student population consisted of roughly 14% African American, 34% White, and 43% Asian students. Students identifying as two or more races made up 5.4% of the population. In contrast, Hawaiian/Pacific Islander, Hispanic/Latino, and American Indian/Alaskan students comprised less than 5% of the student population combined (School Profile, 2023).

All African American students within the middle school were invited to participate in a student focus group in January and March of 2025; fifteen students volunteered. These students represented grades 6–8 and were enrolled in on-grade-level, above-grade-level, or gifted and talented (GT) math classes. This group represented 19% of the 78 African American students enrolled at the school in the 2024–2025 school year.

Positionality within Data Analysis.

As the principal of the middle school where the growth mindset professional development series was created and implemented, and as the researcher analyzing the data that this PD provided, I want to acknowledge again the dynamic this presented and the impact it could have had on the research results. Teachers responded to the feedback form, knowing that I would review the results, and students completed the survey, aware that school staff, including myself, would be reviewing it.

To avoid insincere responses, both the feedback form and student belonging survey responses were submitted anonymously. To mitigate inaccurate results, there were also a variety of questions that measured similar things, such as: "I feel comfortable asking the teacher a question" or "I feel comfortable voicing my ideas and opinions" (see Appendix Table C), both addressing a student's sense of belonging in the classroom. Additionally, the data provides quantitative measures. There are precise percentages of students who strongly agreed, agreed, disagreed, or strongly disagreed with question responses such as, "I have a strong sense of belonging in my math class."

Teachers were also asked for input in a way that provided space for a more critical stance; for example, teachers were asked which GM PD series sessions they found the most valuable and which sessions they felt held the least value (see Appendix Table B). The teacher mindset surveys provided teachers with a numerical score based on their responses (see Appendix Figure A), which delineated whether they had a strong or fixed mindset. These quantitative elements provide specific data points that I could measure and analyze for themes and patterns. Peer walk-throughs were conducted by fellow teachers from various content areas, rather than the administration. All data were anonymized to protect the identities of teachers and students, and pseudonyms were used for all individuals, including teachers, students, and the school, in this analysis.

Growth Mindset Professional Development Series

Designing the Professional Development Series for the 23-24 School Year

The Growth Mindset Professional Development series (GM PD) is centered on the book Mindset by Carol Dweck (2006, 2016). This book explains and delves into the concept of a growth mindset as it applies to brain neuroplasticity, relationships with oneself and others, and the practical application of growth mindset practices in various settings. This seminal work offers concrete examples and non-examples, as well as specific strategies and phrasing that

encourage readers to adopt a growth mindset. Carol Dweck, a professor at Stanford University, has been involved in this work for several decades. Additionally, since the publication of her book, Mindset, she has conducted further research and analysis on growth mindset, its impact, and its practical implementation (Dweck, 2006, 2016; Dweck, 2014; Dweck & Yeager, 2020; Yeager et al., 2019). Additionally, there is a wealth of research articles, teacher and student resources, activities, and theories that build on or are influenced by Dweck's growth mindset work.

Meeting the Teachers Where They Are: Goal of the GM PD Series.

The GM PD series was designed to positively impact African American students and other traditionally underserved groups, such as students receiving FARMs, another target group within this middle school, without explicitly focusing on race or other diversity, equity, and inclusion (DEI) topics that had historically caused some teachers to disengage. By shifting the focus to teacher mindset and instructional practices taking place in the classroom, rather than race, the series aimed to reduce resistance to and foster participation in the GM PD.

Structure and Implementation of the Growth Mindset Professional Development Series.

Teachers were provided with a copy of the book Mindset by Carol Dweck (2016), along with a reading schedule that coordinated with the professional development session schedule (see Appendix Table A). During each session, staff engaged in reflection, and applicable teaching practices in the classroom were highlighted. Teachers participated in regular monthly sessions, once during the school day, for forty-five minutes. Most sessions took place during the teacher's designated planning time, while two sessions occurred during full staff meetings. In total, thirteen sessions were conducted over a period of nine months.

Growth Mindset Professional Development Sessions.

The Growth Mindset Professional Development series was launched with a full staff session in August, marking the start of the professional development series at the beginning of the school year. During this session, teachers reflected on their personal middle school experiences and how they impacted their mindsets at that time. These past mindsets from middle school were then linked to the mindsets that the teachers now held.

In October, after two GM PD sessions had been held, teachers were given an inventory that measured where they fell within a range of "strong fixed mindset" to "strong growth mindset." The timing of the inventory was intended to ensure that teachers had a basic understanding of the growth mindset premise, while also ensuring that they had not participated in-depth with the content. It was communicated to teachers that these initial results served as their baseline and that they would take another self-assessment after the series to measure whether the GM PD had impacted their answers.

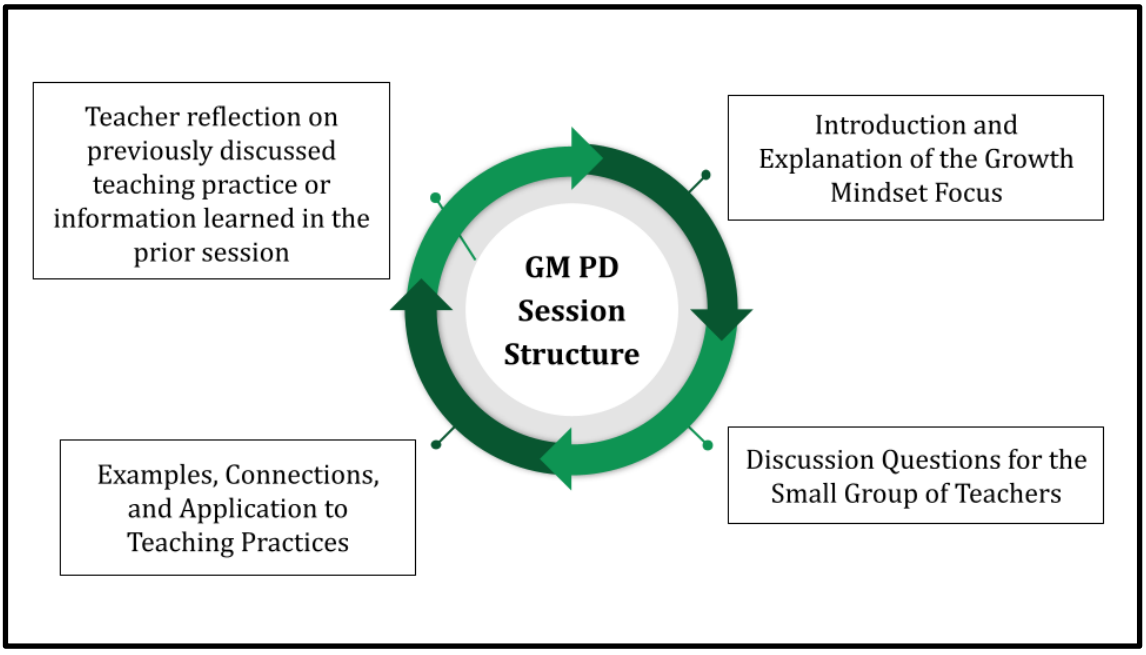
This ten-question self-assessment provided statements adapted from Mindset (2006, 2016) and asked teachers to indicate their level of agreement or disagreement with each phrase, using the options of strongly agree, agree, disagree, or strongly disagree. Statements included: "Your intelligence is something fundamental about you that you can't change very much," and "You are a certain kind of person, and there is not much that can be done to change that" (see Appendix Figure A). Each question and response had a preassigned point value that was shared with teachers after the self-assessment was taken. Point values varied based on the teacher's rating of each statement. Teachers added their points and compared their totals to a scale that measured the teacher's mindset, ranging from 0 (Strong Fixed Mindset) to 30 (Strong Growth Mindset). Teachers' totals ranged from 12, indicating a fixed mindset with some growth ideas, to 29, indicating a strong growth mindset.

As the school year progressed, each growth mindset professional development session built upon a chapter of Dweck's book, Mindset (2006, 2016). Sessions were created to capitalize

on the different themes of each chapter and focused on such topics as "mindset and privilege," "mindset and educational journey," "mindset and stereotypes," etc. (see Appendix Table 1). The expectation was that teachers would read the text before attending each PD session, but to account for those who were not able to read the chapters, a brief overview of the chapters was included within each presentation. Each session included the introduction and explanation of a new theme related to the book, incorporating growth mindset discussion questions for the teacher participants. Connections were made between classroom instructional practices, and teachers reflected on various teaching approaches that fostered a growth mindset in students. To complete each GM PD series cycle, at the beginning of each session, teachers reflected on the previously discussed practice or information gained in the prior PD. This formula was used throughout the first ten sessions of the growth mindset PD series (Figure 17). The eleventh and twelfth GM PD series sessions consisted of peer walk-throughs and debriefs with the group.

Figure 17

Growth Mindset Professional Development Cycle



Note: This outlines the general structure of the ten-growth-mindset professional development sessions implemented at the targeted middle school.

The conclusion of the nine-month growth mindset professional development series consisted of a post-assessment that was identical to the pre-assessment that teachers took at the beginning of the series (see Appendix Figure A). After completing the post-assessment, teachers were asked to complete a feedback form that required them to reflect on their results from both the pre- and post-assessments. Teachers also reflected on the growth mindset instructional practices they had implemented, the perceived impact of the growth mindset professional development series on their connection with students in their classrooms, and their mindsets, as well as which growth mindset sessions they felt were most or least valuable. They were also asked to share their overall opinion on the effectiveness of the professional development series.

Data Collection.

IRB Process

The IRB process through the university was followed to complete this study (see Appendix Figure F), along with the necessary local procedures for the district. Much of the data was collected through my professional role, as the information was part of my daily practice; therefore, much of this study was classified as action research. Student focus groups were also approved through standard procedures, and parents had to sign consent forms for their children to participate. The student focus groups were conducted outside of school hours. To provide extra protection for the students, a county staff member facilitated these groups, thereby reducing the potential conflict of interest between students and the principal and alleviating any discomfort students might have felt when answering questions.

Teacher Growth Mindset Self-Assessments Consisted Of.

- Pre- and post-assessments
- Scale: 0 - 30 range, from having a strong fixed mindset to having a strong growth mindset
- Teachers were categorized as having 1) a strong growth mindset, 2) a growth mindset with some fixed mindset traits, 3) a fixed mindset with some growth mindset traits, or 4) a strong fixed mindset.
- The pre-self-assessment was administered in October 2023, and the post-self-assessment was administered in April 2024, at the conclusion of the GM PD series.
- See Appendix Figure A

The Teacher Feedback Form Consisted Of.

- Scale of strongly agree to strongly disagree, with four being strongly agree and one being strongly disagree.
- Administered in April 2024 at the conclusion of the GM PD series
- See Appendix Figure B

Peer Walkthroughs.

Teachers performed two peer walkthrough sessions with two different teachers, observing colleagues outside of their content areas. Each teacher visited another teacher's classroom for fifteen to twenty minutes while the class was in session. Eighty-three walkthroughs took place within this two-round period in March and ten of these walkthroughs were in math classrooms. The math classrooms consisted of twenty-five to thirty-three students. Six out of the seven math teachers were observed at least once; one teacher was on leave at the time and was therefore not observed. On-grade, above, and gifted and talented math classes were observed.

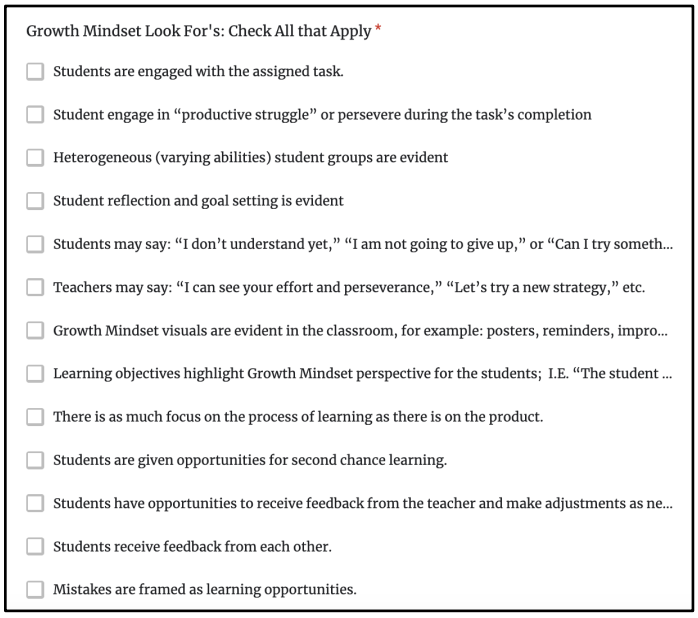
In March 2024, two structured peer walkthrough rounds took place. Teacher partners observed how one another was implementing growth mindset teaching practices in the

classroom and provided feedback via a walkthrough form. This form contained a look-for list that was inspired by Ricci (Figure 18; 2013, 2018), who has written several books based on Carol Dweck's growth mindset theory. The look-for list also reflected teacher input collected in GM PD session ten and focused explicitly on the implementation of instructional growth mindset practices in the classroom. Examples of these look-fors included encouraging productive struggle, framing mistakes as learning opportunities, providing actionable feedback, and emphasizing effort and growth over fixed ability. The look-fors that teachers observed in their partner's classroom were then shared with their partner. They were also asked to provide each other with "Glows and Grows" and any additional comments they felt were relevant.

By choosing from this predefined list (Figure 18), teachers could customize their observations to focus on specific practices most relevant to the instructional goals or content areas being observed, while still ensuring that all observations stayed connected to the GM PD content. These form responses also fed into a database accessible to administrators for analysis and reporting purposes. These walkthroughs provided teachers with a non-evaluative way to receive peer feedback on the growth mindset practices highlighted in the GM PD series and an opportunity to learn strategies by observing their colleagues.

Figure 18

Growth Mindset Walkthrough Look-Fors Implemented within the GM PD Series



Note: Walk-through Look-Fors adapted from Ricci, M. C. (2016, 2018)

Student Belonging Surveys.

In the fall of 2023 and the spring of 2024, all students enrolled in the targeted middle school took a belonging survey (see Appendix Figure D) during a designated time in the school day. Students were asked questions that measured a student's sense of belonging in the school and specific classrooms. Questions included: "I feel comfortable contributing to class discussions," "I feel comfortable asking a teacher for help if I do not understand course-related material," "I have developed personal relationships with other students in class," etc. Belonging questions on the survey were adapted from the Revised Sense of Belonging Scale (Hoffman et al., 2002-2003) and Student Questionnaire: A Sense of Belonging (Building a Culture of Hope, Solution Tree Press, 2013). In this survey, students were asked to identify their race, gender, grade, and class level. They were given a list of environments and classes at the middle school, such as ELA, Science, Math, lunch, and recess, and asked to strongly agree, agree, disagree, or strongly disagree if they had a "strong sense of belonging" in each designated area. These

demographic and context-specific questions allowed the school team to compare the sense of belonging results between student groups and specific environments within the school.

In alignment with the teachers' conclusion of the growth mindset professional development series, students were also given a post-belonging survey in April 2024 that mirrored the fall belonging survey. This data was analyzed and measured to determine if there were any differences between the fall and spring student surveys, following the teachers' participation in the whole growth mindset professional development series. Possible relationships between teachers' levels of growth mindset, teachers' feedback, and student survey results were examined.

Student Focus Groups.

To examine the long-term impact of this GM PD series on African American students and math teachers, semi-structured student focus groups were conducted in Winter 2025, approximately a year after the professional development series concluded. Two focus groups were held outside of school hours, with a total of fifteen African American students. To foster an open and honest dialogue, reduce the power dynamics inherent in the principal-student relationship, and lessen the pressure students might feel to respond in a particular way to questions asked by their white principal, the focus group discussions were facilitated by an African American colleague from outside the middle school who has extensive experience leading student voice conversations.

The facilitator was provided the focus group protocol and questions to ask these students (see Appendix Figure C) about their perception of their math teacher's mindsets, what teacher actions were happening to make them feel successful in math, and if they felt a sense of belonging in the math classroom (see Appendix Figure D).

For the first focus group session, students were invited through an introductory email to parents explaining that I was looking for African American students to participate in a focus group to talk to them about their experiences in math class, how they viewed their math

teacher's mindset, and their sense of belonging in the math classroom. A follow-up invitation email was also sent to parents. Twelve parents who were interested in having their student participate responded and signed the consent form. Initially, two focus group Zoom sessions were scheduled for the end of January 2025 on a teacher professional development day when students were not in school. However, based on the families' RSVPs and concerns about low attendance if two focus group sessions were held, only one focus group session was held that day. Fortunately, when the cancellation of the second focus group was announced to families, five out of six students invited to the canceled focus group session participated in the one focus group session that was held via Zoom. Therefore, the total number of students was eleven, and the facilitator met with them for an hour and forty-five minutes. The session was recorded via the Zoom platform.

A second focus group was held in March 2025. This focus group session was held after school, in person, and in the school building. Nine families initially expressed interest, but only four students submitted completed consent forms and participated in the second focus group, as conflicting activities on the day of the focus group prevented others from attending. This focus group session took place in a classroom after the school day had ended, and students were served pizza and snacks. The students and facilitator met for an hour, and even though the session was in person, it was also recorded via the Zoom platform.

The student focus groups provided vital, real-time information from students, which helped extend the findings from the student and teacher surveys.

Data Analysis

Quantitative Data Analysis.

The quantitative data were analyzed using descriptive and comparative methods to examine changes over time and relationships among variables. Teacher growth mindset scores from pre- and post-professional development surveys were compared to determine shifts in self-reported beliefs. Peer walkthrough observation data were aggregated to track the frequency of growth

mindset instructional practices across classrooms. Student belonging survey results were analyzed using descriptive statistics, including percentage changes in agreement with key items from fall to spring. Correlation analyses were conducted to explore the relationship between changes in teacher mindset scores and changes in African American students' sense of belonging. These analyses provided a numerical complement to the qualitative findings, allowing patterns to be identified and examined across multiple data sources.

- Student pre- and post-belonging survey data (see Appendix Figure B)
    - Includes precise percentages of students who strongly agreed, agreed, disagreed, or strongly disagreed with question responses such as, "I have a strong sense of belonging in my math class."
- Math teachers' pre- and post-mindset self-assessment data
    - Teacher mindset surveys provided teachers with a numerical score based on their responses (see Appendix Figure A), which delineated whether they had a strong or fixed mindset.
- Teacher Feedback Form
    - Includes teacher rankings on a 1 - 5-point scale, for example, did you feel that the GM PD was effective?

The timing of both the belonging survey and the pre- and post-mindset self-assessments, October 2023 and April 2024, aligned with the teachers' progress in the growth mindset professional development series. In addition, the teacher feedback form was administered in April 2024.

Qualitative Data Analysis.

Qualitative data provided me with the richest information, especially as it related to the students' voices. It allowed me to explore the actual student experiences in the math classrooms and learn more about their perspectives. The teacher narratives in the feedback forms and peer walkthroughs gave me a deeper understanding of how teachers received the GM PD, as well as

insights into classroom dynamics. These written comments offered much more detailed information than what could be gathered through a scaled or Likert scale of agree-to-disagree ratings, creating a far more meaningful data set that offered insights into what was genuinely happening in the classroom.

Peer Walkthroughs.

Peer walk-throughs provided additional information to assess whether growth mindset teaching practices were being implemented in classrooms, and these results were compared to math teachers' self-reports on growth mindset instructional practices (see Appendix Table B). Observers wrote narrative comments in the "evidence and observation" and "glows and grows" sections of the walkthrough form, highlighting the practices teachers were using, student comments, and any suggestions they had for the observed teacher. These comments were reviewed, and patterns related to examples of a growth mindset in the classroom were identified.

To examine this information, I pulled the narrative comments from the "Observed Evidence/Comments" and "Glows and Grows" and read through them multiple times. I highlighted commonalities within the observed practices of teachers, student comments and interactions among students and the teacher, and the classroom structure. Based on these narrative comments, four main themes emerged: (1) Levels of Student Engagement, (2) Peer Collaboration and Support, (3) Growth Mindset Practices and Language in Action, and (4) Teacher Facilitation and Classroom Climate.

Using these themes, I sorted responses related to each research question and extracted relevant quotes that illustrated the theme and addressed the research questions. These responses were especially pertinent in answering research question two: "To what extent did middle school math teachers believe that the growth mindset professional development series influenced their teaching practices, if at all?" The four themes could be compared to the quantitative data gathered from the peer walkthroughs, such as the count of each growth

mindset practice observed during the walkthroughs, as well as teachers' rankings of the GM PD's effectiveness and impact in the feedback form.

Teacher Feedback Form Responses.

Teachers were also given space to provide more critical input; for example, they were asked which GM PD series sessions they found most valuable and which ones they considered least beneficial, or what growth mindset practices they specifically implemented in their classrooms (see Appendix Table 2). These quantitative elements offered specific data points that I could measure and analyze for patterns. Along with the quantitative data, I conducted a qualitative coding process with teacher responses. Each open-ended comment was initially coded descriptively to capture the main idea (e.g., "valued peer collaboration" or "limited application"). Then, I performed pattern coding to group related descriptive codes into broader categories such as "instructional shifts," "professional collaboration," or "areas for improvement."

This coding process helped me identify not only which sessions teachers found most or least impactful but also the specific practices they reported transferring into their classrooms. By systematically coding responses, I was able to go beyond surface counts and develop themes about how teachers were experiencing and implementing growth mindset practices. This yielded a more detailed understanding of the PD's effects, especially when aligned with shifts in teacher mindset scores and student belonging data.

Focus Groups.

Comments from focus groups were thematically coded for references to teacher behaviors and mentions of belonging in the math classroom. Using an inductive coding approach, I first read through transcripts line by line, highlighting segments of student talk that reflected perceptions of teacher mindset practices or feelings of inclusion/exclusion. Codes such as teacher encouragement after mistakes, feedback supporting learning, and peer collaboration

emerged directly from the data. These codes were then grouped into broader themes related to growth mindset practices and students' sense of belonging.

The coding process allowed me to explore not only what students reported but also how their experiences clustered around important aspects of classroom culture. For instance, student comments about teachers helping them after mistakes were coded as teacher encouragement after errors and linked to themes of comfort in learning and a positive classroom environment. This connection showed how growth-mindset–aligned practices directly affected students' feelings about themselves as math learners.

By triangulating teacher-reported practices, peer observations, and student perceptions, I strengthened the validity of the findings. The coding allowed me to connect specific growth mindset instructional strategies—such as praising effort, normalizing struggle, and encouraging peer support—to African American students' reported sense of belonging in math class. This step was especially important because belonging is not always explicitly expressed by students; rather, it was revealed through coded references to feeling supported, being seen, and having opportunities to participate meaningfully.

Figure 19 below represents how the data was triangulated, aligned with the aims, research questions, and summary of findings.

Figure 19

Chart Representation of Alignment of RQ, AIM, Tool, Quantitative v. Qualitative Data, Specificity to Study v. PD Evaluation, & Summary of Findings

Research Question	Aligned Aim	Instrument/ Tool	Quantitative V. Qualitative Data	Specific to the Study V. Evaluation of PD	Summary of Findings
RQ1: Teacher mindsets change after GM PD?	Aim 1: Increase teacher mindset	Pre/post teacher mindset self-assessments	Quantitative	Evaluation of PD	6 of 7 teachers showed growth in mindset scores
RQ2: Influence on instructional practice?	Aim 2: Increase GM instructional practices	Teacher feedback forms, peer walkthroughs	Quantitative & Qualitative	Evaluation of PD	Teachers reported using GM strategies; walkthroughs indicated use but showed inconsistency
RQ3: Correlation between teacher mindset and student belonging?	Aim 1 + Aim 3	Teacher + student surveys	Quantitative & Qualitative	Evaluation of PD	Student belonging increased by 12 percentage points in classes with teacher mindset growth
RQ4: Student perceptions of teacher mindset?	Aim 2 + Aim 3	Student focus groups	Qualitative	Specific to the Study	Students linked growth-mindset behaviors with feeling supported
RQ5: Relationship between perceived teacher mindset and student belonging?	Aim 3	Focus groups + belonging surveys	Qualitative	Specific to the Study	Students who perceived teachers as growth-minded felt greater belonging

Note: Alignment based on implementation of GM PD and research study.

Coding of Data.

As outlined in the previous section, responses from these students have been coded to identify themes and patterns. The coding of this qualitative data involved both inductive and deductive approaches. Deductive coding focused specifically on themes such as middle school math teachers' self-reported growth mindset, African American students' sense of belonging in the middle school math classroom, and student-reported instructional practices in that

environment. Inductive coding explored additional themes or sub-themes within the collected qualitative data.

The analysis used a combination of these approaches. Deductive codes were initially created based on the research questions and the theoretical framework of growth mindset and belonging. In contrast, inductive codes emerged directly from patterns identified in teacher surveys, peer walkthrough notes, and student focus groups. The coding process was iterative, with multiple rounds of refinement, where early codes were adjusted and combined into broader themes as more data was reviewed. To improve reliability, data were examined across different sources, allowing themes to be suggested or questioned through triangulation. Codes and themes were revisited throughout the analysis to ensure they stayed grounded in the evidence rather than researcher assumptions. This careful process helped identify both expected and unexpected findings regarding teacher mindset, instructional practices, and student feelings of belonging.

Triangulation of Data.

The qualitative and quantitative data were analyzed and examined for possible relationships and connections. The data analysis focused on patterns of association between the two sets of data, identifying areas where results suggested potential positive or negative trends. No inferential statistical analyses (e.g., Pearson's correlation, t-tests) were conducted due to the small sample size of teachers and the nature of aggregated student data. Instead, descriptive comparisons and thematic qualitative analysis were used to examine potential relationships

between teacher mindset practices and African American students' sense of belonging in math class.

Patterns and trends explored included the following:

- The beginning and the end of the growth mindset professional development series, and the African American students' pre- and post-belonging survey results
- The beginning and the end of the growth mindset professional development series, and the math teachers' pre- and post-growth mindset self-assessment results
- African American students' sense of belonging in math class, pre- and post-survey results, and the math teachers' pre- and post-growth mindset self-assessment scores
- African American students' sense of belonging in math class and growth mindset practices observed during peer walk-throughs
- African American students' sense of belonging in math class and teacher self-reported feedback form data
- Growth mindset practices observed during peer walkthroughs and teacher self-reported feedback form data

In addition, the focus group data were also compared with the above-listed possible connections, the teacher and student forms and surveys, teacher self-assessments, and walk-through data that were collected in Spring 2024. Throughout these analyses, patterns and trends were examined, and positive or negative relationships between qualitative and/or quantitative data were explored. However, further research and analysis will be necessary to establish correlation and/or causation. Nonetheless, these initial findings can guide future researchers in identifying which data relationships may warrant additional study.

Research Questions to Be Answered

1. How do middle school math teachers' growth mindset scores change after participating in a growth mindset professional development series, if at all?

2. To what extent, if any, do math teachers believe that the growth mindset professional development series has influenced their teaching practices?
3. How do changes, if any, in middle school math teachers' growth mindset scores correlate with changes, if any, in African American middle school students' reported sense of belonging in the middle school math classroom?
4. How do African American middle school students perceive their middle school math teacher's mindset?
5. What is the relationship between how middle school African American students perceive their middle school math teachers' growth mindset and middle school African American students' sense of belonging in the middle school math classroom?

Section 3

Findings

In this section, I present findings from my analysis of five types of data: 1) Middle school math teacher growth mindset pre- and post- self-assessments, 2) African American middle school students' pre and post belonging surveys, 3) Middle school math teacher feedback form results, 4) growth mindset instructional peer walkthrough data, and 5) African American middle school student focus groups' results.

While this study explored teacher growth mindset self-assessments, peer walkthrough observations, and student reports of belonging and classroom experiences, it is important to acknowledge that these data sources could not be linked one-to-one at the individual teacher level. Although the peer walkthrough data were connected to specific teachers, the teacher feedback form, student belonging surveys, and focus group comments were collected anonymously and did not identify individual teachers, students, or particular classes. As a result, I could not match individual student comments or belonging survey results to specific math teachers. As a result, any analysis of alignment or differences between teacher-reported practices and student experiences reflects broad patterns rather than exact matches. While student comments captured both growth-mindset-aligned experiences and instances of fixed-mindset practices, these findings are best read as indicators of overall patterns within math classrooms rather than judgments about individual teachers. This limitation should be kept in mind when considering the potential connections between teacher mindset development and African American students' perceptions of belonging in the math classroom.

Research questions organize the findings within this section. African American student input and math teacher feedback data were compared to identify patterns and trends, and may suggest areas for further research. Math teachers' pre- and post-self-assessments of their growth mindsets are compared to the level of belonging that African American students indicated they felt in the math classroom in the fall and spring. The peer walkthroughs conducted by colleagues

of math teachers highlight the growth mindset teaching practices being used in the math classroom. These peer walkthrough results are then compared to the teaching practices that the math teachers self-reported using in their classroom in the feedback form. The teacher feedback form also provided insight into the math teachers' perspectives on the Growth Mindset Professional Development (GM PD) series, which can be compared to teachers' self-assessments and student belonging survey findings. Additionally, the student focus groups provided insight into how African American students perceived their math teacher's mindset, the teaching practices they experienced in the math classroom, and their sense of belonging in the math class. Throughout each research question, the specific instruments used to measure these potential relationships will be clarified.

Research Question One

> **How, if at all, do middle school math teachers' growth mindset scores change after participating in a growth mindset professional development series?**

Teachers' Growth Mindset Self-Assessment: Pre- and Post-Results.

Based on the teachers' self-reported data, the teacher growth mindset self-assessment results showed that six out of seven math teachers' growth mindsets improved, and one teacher's mindset remained unchanged. Five teachers' mindsets increased within the "22-30 = Strong Growth Mindset" category; one teacher's mindset went from "17-21 = Growth with some Fixed Ideas" to "22-30 = Strong Growth Mindset," while the other's mindset went from "11-16 = Fixed with some Growth Ideas" to "22-30 = Strong Growth Mindset." The math teacher with no change in their growth mindset remained in the category of "Growth with Some Fixed Ideas" (Figure 20).

Figure 20

Math Teacher Pre and Post Mindset Self-Assessment Results

Teacher	My *original* growth mindset range: choose your score range.	My *current* growth mindset range: choose your score range.	As a result of this professional development series, my growth mindset:
1	17-21 = Growth with some Fixed ideas	17-21 = Growth with some Fixed ideas	Stayed the Same
2	11-16 = Fixed with some growth ideas	22-30 = Strong Growth Mindset	Increased
3	17-21 = Growth with some Fixed ideas	22-30 = Strong Growth Mindset	Increased
4	22-30 = Strong Growth Mindset	22-30 = Strong Growth Mindset	Increased
5	22-30 = Strong Growth Mindset	22-30 = Strong Growth Mindset	Increased
6	22-30 = Strong Growth Mindset	22-30 = Strong Growth Mindset	Increased
7	22-30 = Strong Growth Mindset	22-30 = Strong Growth Mindset	Increased

Note: Chart of Math Teachers' Growth Mindset Pre and Post Self-Assessment Results; October 2023 - April 2024

It is essential to note that the teacher survey asked respondents to indicate only whether their growth mindset score had increased, decreased, or remained the same following participation in the professional development series. The survey did not capture the actual numerical values of pre- and post-scores. This limited the precision of the quantitative analysis, as it prevented direct measurement of the magnitude of change and restricted conclusions to directional shifts rather than statistically comparable data points.

However, this limitation reinforced the value of the mixed-methods design. While the survey provided a broad directional sense of change, the qualitative data from teacher reflections, peer walkthroughs, and focus groups offered a deeper understanding of how and why teachers perceived growth. Together, these complementary data sources painted a more

nuanced picture of shifts in teacher mindset and classroom practices than quantitative data alone could provide.

Eighty-five percent of math teachers within the middle school had scores that increased from Fall to Spring. This may be related to the reflection, application, and discussion activities within the growth mindset professional development that helped the math teachers internalize the message of the GM PD series. One teacher, whose mindset had shifted from "growth with some fixed ideas" to a "strong growth mindset," indicated that the GM PD series had a positive influence on their teaching practices. They spoke to how they were already utilizing some GM instructional practices in their classroom through the incorporation of student reflection and goal setting, "I have had students reflect on their learning at the end of the second quarter…I intend to do the reflections again at the end of the third quarter for comparison." Another teacher who went from the "fixed with some growth ideas" range to the "strong growth mindset" range, talked about how they personally related to the GM PD, "I honestly found these lessons [GM PD series] more valuable from a personal standpoint;" but they were also able to cite how they had applied these learnings within their math seminar, a math intervention class, "I did, however, think to use class time in Seminar for one-to-one check-ins with students and trying to help them reframe their thinking to see how they can improve." In this example, the teacher used check-ins to encourage students to persevere, promoting the process of improvement and focusing on their growth.

Four of the math teachers began the GM PD series with a strong growth mindset, and, after the GM PD series, all these teachers still reported an increase in their GM scores. Two out of three teachers who began the GM PD series with some fixed-mindset ideas ended the series with a "strong growth mindset." These teachers shared feedback that illustrated how they were incorporating growth mindset practices or how they planned to incorporate GM practices in their classroom, such as adopting learning objectives to be worded in growth mindset language: "I would like to think of ways I can adapt the curriculum goals to include more growth mindset

language without changing the content." Teachers also shared that they planned to "keep in mind my students' backgrounds and how it affects their mindset," showing an acknowledgment that there is more than one influence that affects a student's achievement. A teacher commented that the GM PD "helped bring more of my attention towards what we say and [how we] react to different situations [in the classroom]." These six teachers were able to learn and think through different ways to implement GM practices into their classrooms moving forward, which positively affected their level of growth mindset.

The one math teacher whose score remained the same at "Fixed with Some Growth Ideas," had commented within the feedback form that the information they received from the GM PD was already familiar to them; "I believe that I already had a good understanding about this topic," and that they did not believe that GM was as important as "being prepared and understanding your students." Although this teacher self-reported that they began this GM PD series with an understanding of a growth mindset, their score fell within the range that indicated they had fixed ideas. These views may have contributed to the unchanged score. Perhaps the teacher assumed that they had already learned what they needed to know and did not require any additional information, which limited the impact the GM PD series had on their mindset, resulting in an unchanged score within that range.

Overall, findings from the growth mindset self-assessments indicate that the professional development series positively influenced most math teachers at the middle school. Six out of seven teachers increased their growth mindset scores from fall to spring, with several moving into the "strong growth mindset" category. Teachers who reported growth described implementing practices such as student reflection and goal setting, reframing student thinking during check-ins, and considering students' backgrounds in their instructional approach (Canning et al., 2019; Dweck, 2016; Fashaw, 2024). Even teachers who began the series with a strong growth mindset reported further gains and

shared plans to integrate growth mindset language into learning objectives and classroom interactions.

The math teacher whose mindset score remained unchanged in the "growth with some fixed ideas" range, citing familiarity with the content and prioritizing other aspects of teaching, such as preparedness and understanding students. However, research suggests that growth mindset practices directly support these priorities by promoting student engagement and resilience, and achievement, particularly among historically underserved populations (Bostwick et al., 2020; Dweck, 2016; Blazar, 2021). While the series was effective for most teachers, these findings suggest that individual beliefs about the relevance of growth mindset may influence the effectiveness of mindset change. Overall, the data reflect progress in developing teachers' growth mindsets and point to opportunities for continued support in embedding these practices in math classrooms (Canning et al., 2019; Yeager et al., 2019).

Research Question Two

To what extent do middle school math teachers believe that the growth mindset professional development series has influenced their teaching practices, if at all?

Many math teachers reported applying growth mindset practices in their classrooms, while also reflecting on their use of these practices and their teacher-student interactions, as noted in peer walkthroughs and teacher self-reporting.

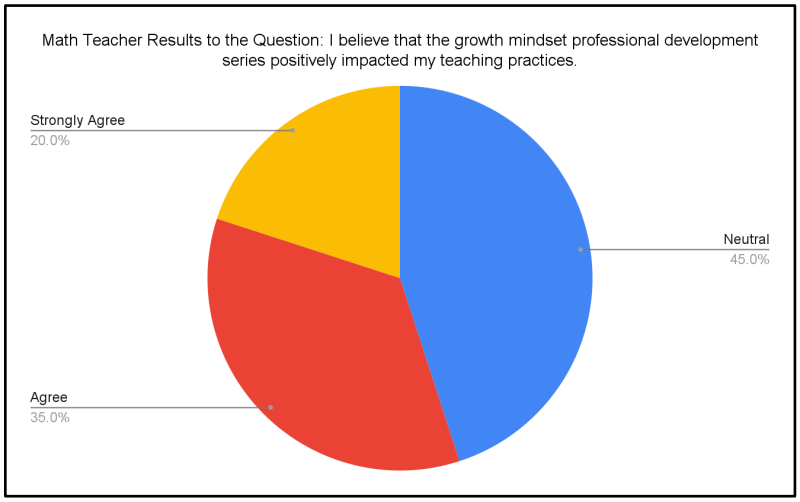
Teacher Feedback Form Data.

The teacher feedback form administered after the GM PD series asked math teachers, on a scale of 1 - 5, 1 being "strongly disagree," "3 - neutral," and "5 - strongly agree," to self-report if they agreed or disagreed that the GM PD series had an impact on their teaching practices. Four math teachers reported that the effect of the GM PD series was neutral, while two agreed that

the growth mindset PD series had a positive impact, and one strongly agreed that the GM PD had a positive impact on their teaching practices (Figure 21).

Figure 21

Math Teachers' Self-Reported Agreement with the Statement "The Growth Mindset Professional Development Series Had A Positive Impact on My Teaching Practices"



Note: Data derived from the teacher feedback form administered at the end of the GM PD.

Growth Mindset Instructional Practices in the Math Classroom.

Growth mindset instructional practices were observed during peer walkthroughs, and implementation was also self-reported by math teachers. There were some similarities and differences between these two data points (Figure 22).

Figure 22

Number of Growth Mindset Teaching Practices Observed During Peer Walkthroughs in Math Classrooms V. Number of Math Teacher Self-Reported Implementation of Growth Mindset Teaching Practices

Growth Mindset Teaching Practice	Number of GM Instructional Practices Observed by Peers (n = 10)	Number of Math Teachers Reporting Implementation of GM Instructional Practices (n=7)
Framing mistakes as learning opportunities	7	7
Providing actionable teacher feedback	6	7
Engaging students in "productive struggle" during a task's completion	6	6
A focus on the process that is needed to get to the product	5	6
Opportunities for second chance learning	4	6
Engaging students in peer-to-peer feedback	2	5
Growth mindset visuals in the classroom	2	4
Heterogeneous (varied ability) student grouping	3	4
Student reflection and goal setting	3	5

Note: The number of growth mindset teaching practices observed during peer walkthroughs in the math classroom versus the number of math teachers' self-reported implementation of those practices.

Peer Walk-Through Observational Data.

Growth mindset teaching practices were observed during the peer walk-throughs (Figure 22). We anticipated that these walkthroughs would show evidence of growth mindset practices being implemented, as the formal GM PD sessions had been completed and growth mindset instructional strategies had been continuously reviewed. During the walkthroughs, about 70% of observers noted mistakes being framed as learning opportunities in the math classroom.

Observers also noted that students were open-minded to the process of solving the problems and continued learning as they received feedback from each other and the math teacher. An observer shared that "a student asked, "Wait - how did you get that? Why that number?" and after, "another student immediately jumped in and explained it to him," the observer noted that "there was a lot of focus on the process and not the product" within the math classroom.

During the walk-throughs, the observers also frequently noted student engagement and "productive struggle," or letting the student wrestle with the problem to find the answer, was evident. These observations aligned with the growth mindset's focus on the process of learning and encouragement of effort and perseverance. Observers noted that "Students led most of the class!" and that they saw the students working through problems, discussing different approaches, and assessing the accuracy of their solutions.

Teacher and student feedback practices that were less frequently observed during the peer walk-throughs but still evident in three out of ten math walkthroughs were strategies such as heterogeneous grouping, student reflection, and goal setting. Examples of students engaging in peer-to-peer feedback and displaying growth mindset visuals in the classroom were evident in two out of the ten math classrooms, suggesting these as areas for relative growth in the math classroom.

Teacher Self-Reported Data.

Math teachers reported that they used growth mindset instructional practices quite frequently. All math teachers noted that they gave their students opportunities to frame their mistakes as learning opportunities and that they consistently provided actionable feedback. Math teachers also highlighted that productive struggle, a focus on the process over the product, and second-chance learning were used by six out of the seven teachers. Five out of seven math teachers cited that peer-to-peer feedback, student reflection, and goal setting were utilized in their classrooms. And, finally, math teachers reported that growth mindset visuals and heterogeneous grouping were implemented in four out of seven classrooms.

Overall, math teachers reported that they incorporated growth mindset practices into their instructional approaches. It should be noted that the frequency of each practice in the classroom was not specified; therefore, the number of math teachers implementing a practice could indicate that they used it once or multiple times within the classroom. More teacher-led strategies were reported to have been used more frequently. In contrast, student-directed activities, such as peer-to-peer feedback, heterogeneous grouping, and student reflection and goal setting, were used less frequently in the math classrooms. As noted in the CSA, teachers entering this school year were accustomed to a more teacher-centered classroom, and this is reflected in the data that the math teachers self-reported.

Growth Mindset Practices in the Math Classrooms - Peer Walk-Through Observational Data V. Teacher Self-Reported Data.

Peer observers and self-reported teacher data showed differences in assessing math teachers' implementation of growth mindset practices, particularly in framing mistakes as learning opportunities and providing actionable feedback. While 100% of math teachers reported engaging in these practices, peer observers noted that they occurred in 70% and 60% of the observed math classrooms, respectively. This suggests that growth mindset practices are indeed being integrated into classroom instruction, with teachers capitalizing on mistakes as learning opportunities and offering feedback in real-time.

Math teachers also reported offering opportunities for second-chance learning 86% of the time; however, peers observed this practice in about 40% of classrooms. This discrepancy may reflect the individualized and sometimes subtle nature of second-chance learning, which can be challenging to capture during classroom observations. Teachers further self-reported implementing student reflection, goal setting, and peer-to-peer feedback in 70% of classes, yet observers noted these practices in only 20–30% of classrooms.

Despite these differences, observers described encouraging instances of student engagement and collaborative problem-solving, citing examples such as, "students were working

together comfortably to correct each other and help solve the problem as a whole group," and "kids were engaged, and despite sometimes being frustrated, their peers tried to encourage them," and "students led most of the class!" These observations suggest that student engagement and peer interaction are happening in some classrooms. However, in most classrooms, students were not consistently observed engaging deeply in peer feedback, reflection, or goal setting. Heterogeneous grouping was also observed in only three out of ten math classrooms.

These gaps between teacher self-reporting and peer observations suggest that teachers may perceive themselves as implementing growth mindset strategies more consistently than what was actually observed. This perception could stem from the subtle and embedded nature of some practices, which may feel routine to teachers but are less visible to observers during a single class period. It may also reflect a natural inclination to align self-reporting with professional expectations following the PD series. Recognizing this difference is important because it highlights the value of using multiple data sources. Relying only on teacher self-reports could lead school leaders to overestimate the extent of classroom change, while incorporating peer observations provides a more balanced and realistic view of practice. This has implications for both professional development design and for accurately measuring program impact.

The implications for students, particularly African American students, are significant. Research shows that consistent implementation of growth mindset practices can contribute to a stronger sense of belonging and greater persistence in mathematics (Canning et al., 2019; Yeager & Dweck, 2020; Murphy & Zirkel, 2015; Barbieri & Miller-Cotto, 2021; Hammond, 2015). If such practices are applied less consistently than teachers believe, then students' day-to-day experiences may not fully reflect the intended classroom shifts. Inconsistencies across classrooms could also mean that some students benefit more than others, which may unintentionally reinforce inequities. Thus, addressing these discrepancies is not about

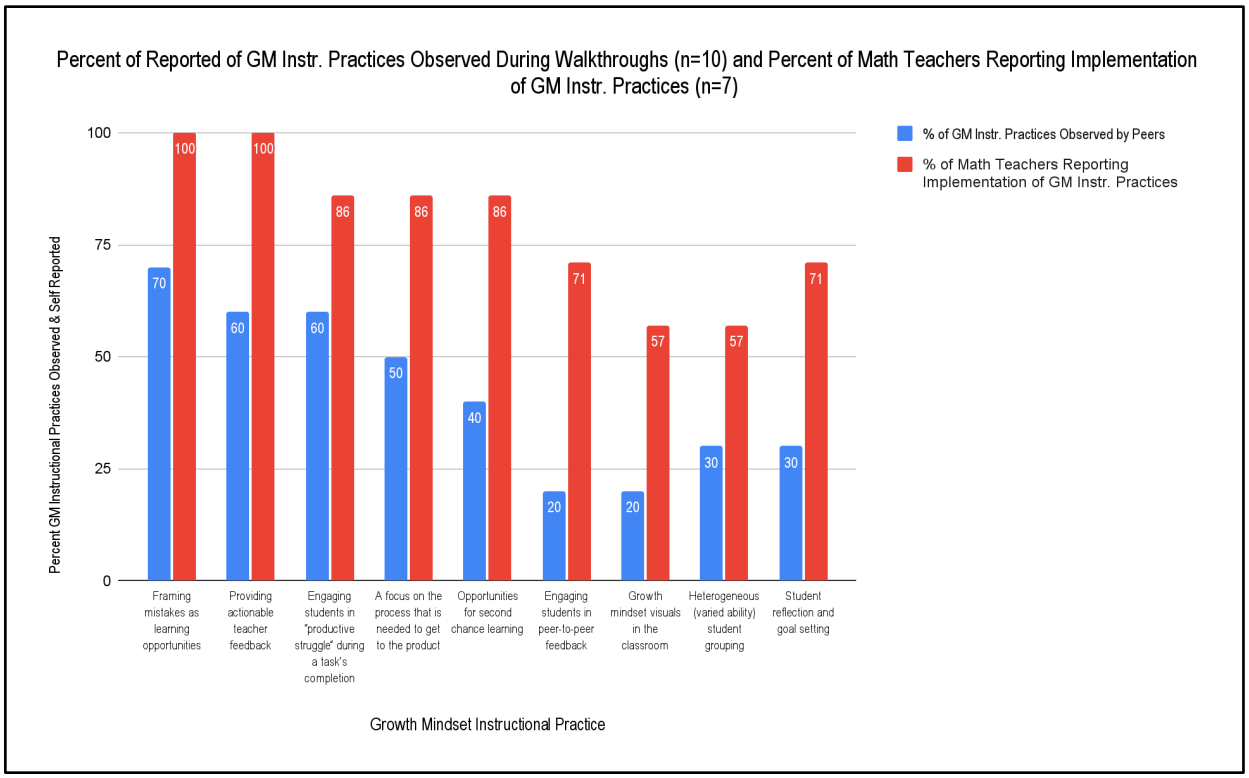
questioning teacher intentions, but about ensuring that students consistently experience growth-oriented messages and opportunities to learn from mistakes. This consistency is especially critical for African American students, who often face systemic barriers in math classrooms and for whom authentic signals of belonging and capability can play a crucial role in shaping their identity and academic outcomes (Dweck, 2016; Blazar & Kraft, 2016; Ricci, 2013).

Additionally, the less frequent implementation of these more student-driven practices suggests that classroom engagement often centers on teacher-student interactions. While such interactions are vital, expanding opportunities for students to collaborate and support each other may further enhance student growth, foster stronger peer relationships, and contribute to a greater sense of belonging in the math classroom (Figure 24; Dweck, 2016; Blazar & Kraft, 2016; Ricci, 2013).

Figure 23 further illustrates these differences by directly comparing the percentages of math teachers who reported implementing specific growth mindset practices with the frequency of those same practices observed during peer walkthroughs. These discrepancies suggest that while math teachers internalized the concepts shared in the GM PD series and expressed intentions to integrate them into their instruction, the consistency and frequency with which these practices were observed in classroom practice varied. Collectively, the data indicate that the GM PD series contributed to increased awareness and reported use of growth mindset strategies among middle school math teachers, while also highlighting areas where ongoing support and follow-up may be necessary to ensure consistent and visible implementation in math classrooms.

Figure 23

Percentage of Teachers Utilizing Growth Mindset Teaching Practices in the Classroom: Walkthrough Data v. Self-Reported Data



Note: Comparison between the math teacher's reported implementation of growth mindset practices in the math classroom and peer-walkthrough observations of the math teachers implementing growth mindset practices (see also Appendix Table D).

In conclusion, middle school math teachers' belief in the influence of the growth mindset professional development series on their teaching practice is shown through several key indicators. These include the math teachers' data ranking the effectiveness of the GM PD, the neutral to strong agreement with the statement "the growth mindset PD had a positive effect on my teaching practices," the application of growth mindset teaching strategies observed in the math classrooms, the self-reported instructional practices by the math teachers, as well as the math teachers' self-assessments and reflections at the end of the GM PD series.

Overall, findings indicate that middle school math teachers appeared to show both belief in and application of growth mindset practices following the growth mindset professional development series. Most math teachers reported implementing growth mindset instructional strategies in their classrooms. Peer walkthroughs conducted after the GM PD sessions concluded observed several key practices aligned with growth mindset principles. Specifically, "framing mistakes as learning opportunities" was observed in 70% of math classroom walkthroughs, "engaging students in productive struggle" in 60%, and "providing actionable teacher feedback" in 60% of walkthroughs (Figure 23). Observers also noted high levels of student engagement, collaborative problem-solving, and discussions focused on learning processes rather than solely on correct answers.

Research Question Three

How do changes, if any, in middle school math teachers' growth mindset scores correlate with changes, if any, in African American middle school students' reported sense of belonging in the middle school math classroom?

Students were surveyed about their sense of belonging in math class, and teachers were asked to assess their level of growth mindset in the fall of 2023 and in the spring of 2024. The student belonging survey and the math teachers' self-assessments were examined and compared in alignment with the beginning and end of the GM PD series.

Fall Baseline.

In the fall of 2023, math teachers began the growth mindset PD series with varied mindsets. According to the mindset self-assessment (see Appendix Figure A) that teachers took at the beginning of the GM PD, four teachers began with strong growth mindsets, two teachers began with mindsets that were "fixed with growth ideas," and one teacher had a mindset that was "growth with some fixed ideas." Therefore, 43% of math teachers started with mindsets that

incorporated fixed-mindset ideas, and 57% of math teachers began with strong growth mindsets.

In the fall of 2023, the middle school students were also asked to react to the following statement, "I have a strong sense of belonging in math class," on a scale of one to four, or strongly disagree (1) to strongly agree (4). Sixty-three African American students took the student belonging survey. They ranked their sense of belonging in the two to three-point range, with fourteen students disagreeing and twenty-six students agreeing with the given statement. Additionally, five students strongly disagreed, and eighteen students strongly agreed with this statement. Overall, in the fall of 2023, nineteen or 43% of African American students disagreed (students who chose 'disagree' or 'strongly disagree'), and forty-four or 57% of African American students agreed (students who chose 'agree' or 'strongly agree') that they had a strong sense of belonging in math class.

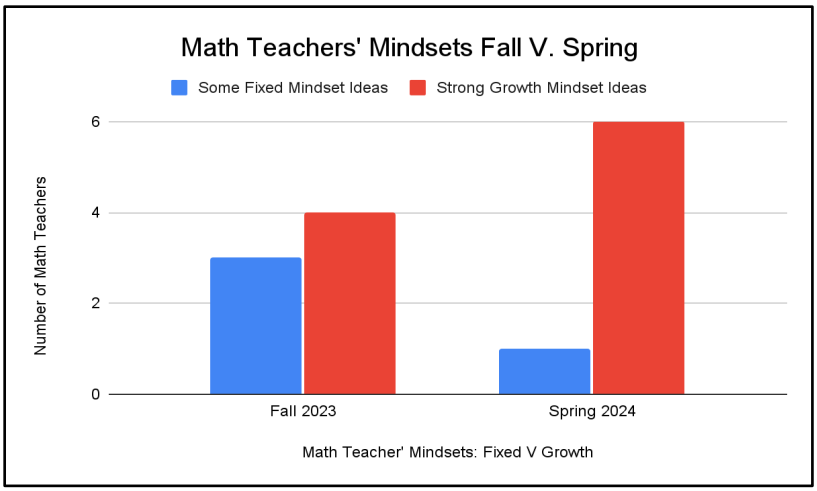
Notably, the student percentages of those who agreed or disagreed that they have a strong sense of belonging in their math class were comparable to the math teachers' growth and fixed-mindset results. This pattern suggests that there may be a connection between the math teacher's mindsets and African American students' sense of belonging in the math classroom. However, further research would be needed to test for any direct relationships between these two variables.

Spring Results.

In the spring of 2024, teachers again took the mindset self-assessment; six out of seven, or approximately 85%, of math teachers' growth mindset scores increased, while one teacher's mindset remained the same (Figure 24). One teacher went from "fixed with some growth ideas" to "strong growth mindset," and another went from "growth with some fixed ideas" to "strong growth mindset." Four teachers reported that they had increased their growth mindset but stayed within the "strong growth mindset" group. One math teacher remained the same, "fixed with some growth mindset ideas."

Figure 24

Comparison of Math Teachers' Growth Mindsets in the Fall v. Math Teachers' Growth Mindsets in the Spring



Note: Math teachers' growth mindsets were measured via the pre- and post-self-assessments.

In the spring of 2024, sixty-three African American students completed the same belonging survey administered in the fall. The results showed modest but positive shifts in students' sense of belonging in math classrooms. Specifically, four students moved from "disagree" to "agree," and another four shifted from "agree" to "strongly agree" with the statement, *"I have a strong sense of belonging in the math classroom."* These changes increased the proportion of students who agreed or strongly agreed by nineteen percentage points. While the number of students who strongly disagreed remained unchanged, the directional movement of some students toward stronger agreement is encouraging.

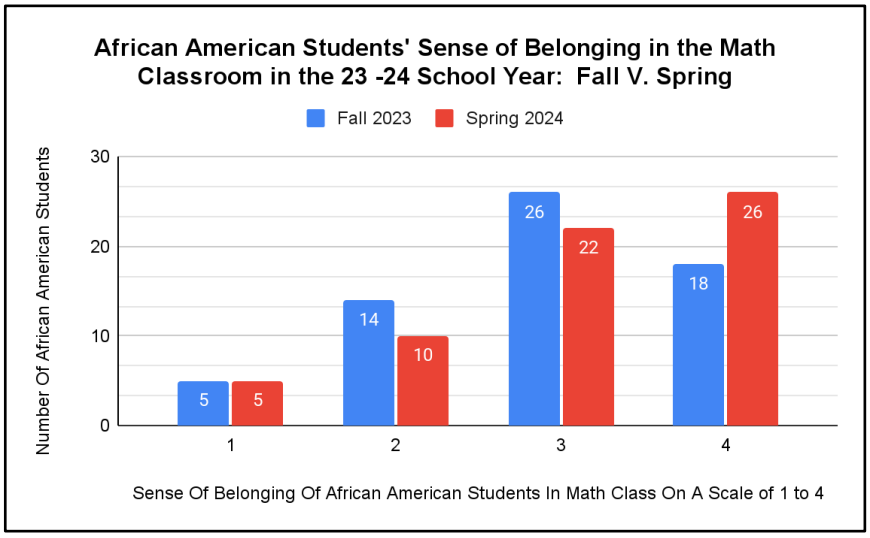
Even small gains in belonging are significant, particularly for African American students, because research has consistently demonstrated that a sense of belonging is tied to persistence, engagement, and academic achievement (Goodenow, 1993; Steele, 2010; Walton & Cohen, 2011). In mathematics, where African American students often face barriers such as underrepresentation in advanced courses and the impact of deficit-oriented mindsets (Dweck, 2006; McEachin, 2025), even incremental progress represents a significant step forward. These

results suggest that growth mindset professional development may have begun to shape teacher practices in ways that supported more students in feeling connected to their math classrooms.

At the same time, the results must be interpreted with caution. The survey responses reflect categorical shifts rather than nuanced scale data, limiting the ability to measure the depth of change. Moreover, the persistence of students in the "strongly disagree" category underscores the ongoing need for targeted strategies to reach those who remain disconnected. Nonetheless, these modest shifts provide an early indication that intentional professional learning focused on teacher mindset and practice can begin to improve African American students' experiences of belonging in mathematics.

Figure 25

Comparison of African American Students' Sense of Belonging in the Math Classroom in the Fall v. the Spring



Note: African American students' sense of belonging in the math classroom based on the pre- and post-belonging surveys

As math teachers' mindsets became more growth-oriented, African American students' reported sense of belonging in math class shifted from disagree to agree, and from agree to agree strongly. These parallel trends suggest a possible link between the math teachers' reported

increases in growth mindset and African American students' increased sense of belonging in the math classroom, which warrants further study (Figures 24 and 25).

Research Question Four

How do African American middle school students perceive their middle school math teacher's mindset?

Research question four was answered through conversations with African American students in student focus groups. Fifteen African American students, across sixth, seventh, and eighth grade, participated in the two focus groups, including girls and boys, in grade-level, above-grade-level, or gifted and talented math classes. These students spoke about the teachers they perceived as having a growth mindset and those they perceived as having a fixed mindset.

Focus groups were held in January and March 2025. This was almost a year after the 2023-2024 Growth Mindset Professional Development series concluded. The timing of the focus groups allowed me to see the longer-term effects that the growth mindset PD series had on math teachers' practices and students' experiences within their past and current math classrooms. Based on the focus groups' feedback, it appeared that many negative experiences occurred either before or during the 2023-2024 school year, when the GM PD series was taking place, with a few still ongoing. During the 2024-2025 school year, many students who participated in the focus groups shared positive experiences in math class. Students were also able to give examples of how their past or current math teacher exhibited a growth or fixed mindset

Defining Growth Mindset.

Students were familiar with the growth mindset concept, as it had been reviewed and reinforced throughout their classes. Students provided examples of what a teacher with a growth mindset did or how the teacher made them feel, for example, one student shared, "She says you didn't do that good, but I can help you get better, and we can practice," and another student said, "my teacher believes that I can." Students' sense that their teacher believed in them was

crucial for them to perceive their math teacher as having a growth mindset. A third student was adamant that their teacher exhibited this mindset; "yes, yes, yes, my teacher has a growth mindset, because she always gives us opportunities to get our work better and make up stuff."

Growth Mindset: Individualized Feedback and Opportunities for Improvement.

Students often cited that individualized attention and opportunities to improve were significant factors in making them feel supported in the classroom. Students appreciated the individual attention they received. Students also spoke to how the teachers ensured that all their classmates understood the concept, specifically citing examples of teachers checking in with each student to assess understanding and taking the time to give individualized feedback: "Every time when she looks around almost at every student, and then every time when a student does something wrong, instead of just saying you did this wrong. She comes to us and shows us how we did it wrong, and she tries to make us get the right answer." Other students spoke about how these actions were encouraging and motivated them to improve in the class. Instead of just receiving a correct or incorrect response, comments were made to promote the student's thinking and indicated to the student how they could fix their mistakes; "she thinks I can improve every time… When she gave me a grade in [the student grading system], she gave me a comment on every question [explaining] why I got it wrong, and how I could fix it."

When teachers took the time to provide their students with feedback that they could learn from and apply, students improved in their math knowledge and processes. The teacher also modeled a growth mindset, fostering this mindset in their students. Students expressed feelings of safety, knowing that there would be opportunities for them to try again in the future and that their math teacher would be willing to help them succeed.

Students also shared that when the teacher came to them or gave a comment explaining their mistake, it helped them understand the math concepts. This individualized attention stood out to students, and they highlighted the fact that the teachers worked to make sure they did get

the correct answer through showing them or explaining where they went wrong; one student shared, "the teacher would not let you fail. They would not let you give up, and on top of that, the support was there." The math teacher's actions encouraged students to engage in the learning process by demonstrating their belief in the students' ability to learn and improve.

A cornerstone of a growth mindset is embracing failure and focusing on processes, such as the process of solving problems (Dweck, 2006, 2016). When students had math teachers who focused on learning from mistakes and who provided opportunities to improve, math teachers' fixed mindsets impacted the students' math self-concept and achievement in their math class.

Fixed Mindset: Feeling Ignored or Shamed.

A teacher's fixed mindset can be harmful to all students. Still, African American students can be more susceptible because they already are faced with teacher deficit thinking, racial bias, and stereotype threat (Graham et al., 2022; Murphy, M., & Zirkel, 2015). When students perceive that their math teacher has a fixed mindset about their abilities, harm can emerge in the classroom, which can lead to grade drops in math, undermined self-confidence, and low achievement among African American students (Murphy, M., & Zirkel, 2015).

Emotions such as shame or frustration were expressed by students based on experiences with math teachers in classes where they did not feel supported or believed in; "[last year] she took a post it, wrote a 62 point something percent, and slid it over to me and said, This is what you get for not doing well in this class, … and it really just made me feel so bad about myself like I wasn't trying enough…" By the teacher highlighting a student's poor grade and creating a narrative that put the onus on the student; rather than providing the student with constructive feedback or using the opportunity to help the student improve, the math teacher created a dynamic in which the student felt bad about themselves, increased the student's frustration, and impacted their confidence in math and their self-worth. This type of negative interaction between the teacher and the student exemplifies the math teacher's fixed mindset, thereby

increasing the likelihood that the student will internalize a negative fixed mindset about their math abilities.

Additional students shared their past experiences with previous math teachers who did not take the time to work with them or support them and their peers in the math class. Many of these experiences occurred during the 2023-2024 school year, while the PD series was being implemented. For example, another student shared that "Last year, the teacher really didn't go around and like help students out. And so it left a lot of the people failing the class." The students felt overlooked or ignored by the teacher. The lack of feedback and connection can lead to students beginning to conclude that their success was not prioritized in the classroom. The students described this teacher as appearing detached and not being attuned to their needs.

Growth Mindset: Math Teachers' Belief in Students.

Students also spoke about how they interacted with their math teacher and if they felt their math teacher believed in and helped them. Multiple students cited teacher feedback, accountability, and practice opportunities as examples of their teachers having a growth mindset and believing in them. One student said, "She tells us to … see how we got the equation wrong and how we can fix it." There was repeated emphasis by students on the teachers who did not let their students give up, who pushed their students, and made sure they understood the content; another student shared that "when somebody gets stuck, usually when somebody keeps on getting questions wrong, she doesn't quit. She keeps on teaching them and keeps on giving them examples until they finally learn it."

Students were perceptive and spoke directly to the effect of the math teachers and their willingness to support their students, "no matter how far gone a student is, no matter how bad their grade is, they [the math teacher] never give up on any of their students…They never shame anyone for having a bad grade or having trouble paying attention, [they are] just always there to help and never giving up, basically." The students' descriptions of their math teachers illustrated that these teachers had growth mindsets. Students observed and experienced their math teacher

believing in each of their students, pushing them to achieve, and never giving up. One student summarized the impact of their teacher's growth mindset in the 24 - 25 school year as compared to their experience in the 23 - 24 school year in the following way:

> I think my teacher knows I can improve because it's already happened so back when earlier this year, I was doing terrible, they built me out, built me out from where I was broken down by other people [in the 23 - 24 school year].

Research Question Five

> **What is the relationship between how middle school African American students perceive their middle school math teachers' growth mindset and middle school African American students' sense of belonging in the middle school math classroom?**

Research question five encapsulates the crux of this research. When I began this work, I wanted to investigate whether a possible connection existed between math teachers who had growth mindsets and the sense of belonging that African American students felt in the math classroom. Although research question number three identified a seemingly positive association between the increase in math teachers' growth mindsets and African American students' sense of belonging in the math classroom, the student focus groups allowed me to delve deeper into this relationship. To do this, African American students in the focus groups were asked to reflect on their math teacher's current mindset and the mindsets of their past math teachers, determine whether they had a growth mindset or not, and describe how they felt their math teacher's mindset influenced their sense of belonging in math class.

Defining Belonging.

To really understand what belonging meant to African American students, the focus group students were asked when they had or did not feel a sense of belonging in any setting.

Feeling a Sense of Belonging.

To describe belonging, students gave examples such as being a part of a sports team, "feel[ing] like you're on the same level as everybody in that group…like you guys are equals, "and being "welcomed and comfortable." Other students described the feeling of belonging as "freeing like I can say whatever I want because everyone…accepts that I'm there and wants me to be there. While others shared that belonging meant feeling "safe, "a part of the classroom…able to answer questions," feeling like friends are in place," and "not feeling like I have to filter myself." Some students also shared that having friends contributed to stronger feelings of belonging. Students described belonging as knowing they were part of something where they could take risks, ask questions, and simply be themselves. Students also equated belonging to feelings of safety, a fundamental need in any setting, and one that can influence a student's focus, vulnerability, and receptiveness to learning (Pyne et al., 2024).

The Feeling of *NO* Sense of Belonging.

Students described *not* feeling a sense of belonging as *not* feeling a part of, and/or *not* feeling safe. Students shared examples such as 1) moving from another state to Maryland and not knowing anyone when they arrived, 2) experiences in elementary school in which they were bullied, and 3) living in an area where the population was majority white and they did not experience belonging until they moved into an area with more African American families. Students vocalized how feelings of not belonging made them feel: "I felt kind of like out of place, and like sad and embarrassed." Many students reflected on how feeling like they did not belong made them question their self-worth; "I started thinking, there's something wrong with me, and I feel like I had a lot of insecurities," and others spoke to the created self-doubt, "when I was at a basketball camp and like everybody, was so much better than me… they [were] on a whole, other level than me." Students were very vulnerable in sharing how not having a sense of belonging had impacted them. For example, another student shared, "I did not like that feeling at all [the feeling of not belonging]. I remember every single day without fail."

Through the discussion of what it felt like to belong and not to belong, it became evident that the students had a clear understanding of both scenarios and could reliably articulate these feelings in math class.

Teacher's Growth Mindset and Student's Sense of Belonging.

Positive Perceptions of Teacher Growth Mindset and Students' Sense of Belonging in Math Class.

Students were able to directly discuss their interactions with their math teacher and how their teacher appeared to show a growth mindset, which in turn impacted their sense of belonging in the math classroom. A student recounted an interaction they had with a teacher that shifted their sense of belonging in the math class.

> Yes, I think our teacher has a pretty like growth mindset, because when I felt like I belonged was once when I wasn't understanding my teacher, let me come for a little bit during morning announcements, and let me ask him some questions. And he was very helpful, and I felt bad. I was like, sorry. I feel like I'm bothering you. He was like, No, I want you to be successful because you're putting in all this effort. And that meant a lot to me. Because I was like, okay, someone's recognizing the effort I'm putting in to try to be successful in this class.

This one-on-one interaction between the math teacher and the student increased the students' confidence, solidified the relationship between the teacher and the student, and made them feel noticed. Additionally, this student entered the interaction with a low sense of belonging, feeling like they were "bothering" the teacher by asking questions, and concluded the conversation feeling a greater sense of belonging. The teacher exhibited a growth mindset by praising the student for their effort rather than their abilities, focusing on the process of solving the math problem and helping the student understand the concept so that they could move forward in their math class. Praising effort and improving processes illustrates the teacher's growth

mindset, and the student shared that this, in turn, increased their sense of belonging in the math class.

Multiple students within the focus groups shared that they felt that their teachers would not give up on them and wanted them to learn the material, regardless of how they started the year. The teachers did not let the students just "get by," and helped them, even if the student had not initially shown enthusiasm towards the class or content. One student gave the example of "[this year] I wasn't turning in homework. I was doing terrible on tests. He…said…, Oh, do you need help with this? And like, no matter if I said no or yes, he would just start helping me, and he'd sit by my desk for however long it took, even if he had to postpone the class for it, and it really made me feel seen like I wasn't just another number." In this instance, the teacher demonstrated a growth mindset by not labeling the student as poor-performing or exhibiting low expectations for them, despite their initial self-report of below-average performance and self-limiting behavior. The teacher showed confidence in the students' abilities and communicated to them a belief that they could achieve within the math class. This led to the student feeling like they were more than a number in the classroom; they felt "seen," and felt that their individual needs were being met.

Other students were also able to cite other teacher practices that positively contributed to their sense of belonging in the math classroom. One thing that was highlighted was how the math teachers reached out to the student's parents and shared their accomplishments, which strengthened the student's sense of belonging in the math class; "After a big increase happened in my grade [this year], my math teacher…communicated to my mom and said, like, Oh, my God, she's doing so much better like I'm so happy for her, etc. Etc. Etc., I felt really like I was seen, like they were really paying attention to me and my progress." By the teacher taking extra time to ensure the student understood the math concept or calling the student's parents, it positively increased the student's sense of belonging in the classroom. These actions by the math teacher kept the students engaged in their learning progress. They created social pathways to

families, therefore strengthening the students' sense of connection and belonging in the math classroom and with the math teacher.

Another student shared how their increased sense of belonging and their math teacher's growth mindset this year helped them to improve in their overall math achievement.

> I feel I really belong in my math class because I was really struggling before at the start of this year with math…But my teacher this year he would … ask me questions and help me all the time, and all my friends…We had a little group like a table, and we were always talking, always throwing ideas around, and I felt really supported in that math class, and it helped me grow because at the beginning of the year, I think quarter one, I had a C or a D. Now I have an A. …Yeah, belonging does matter.

The math teacher in this situation is described as asking questions and helping when needed, while also giving the students space to discuss and discover (productive struggle) the math with their peers. By allowing students to interact in small groups, this also increased the students' sense of belonging in the classroom, as they were able to build connections and expand on their learning with their peers. This student shared that when they felt that their teacher believed in them, helped them when they were struggling, and gave them opportunities to work with their friends, they felt like they belonged in the math classroom, which helped to improve their math confidence and achievement.

The theme of being able to ask questions without judgment and being allowed to work with others was consistently reiterated throughout the focus groups as a factor influencing the students' sense of belonging. One student shared, "I think that I have a sense of belonging in my math class, because I'm with a lot of my friends, and my teachers also really help whenever I'm struggling with something." Those teachers identified by students as having a growth mindset encouraged their students to ask questions, and students became comfortable and curious within their math classes, increasing their sense of belonging as well as their understanding of the math concepts. A student specifically shared that they felt like they could approach their

teacher when they were feeling unsure, "When I am feeling doubtful, I tell her, and she tells me specifically that she thinks I'm still doing well, even if I can't get it perfectly. So that helps." Another student highlighted how their math teacher's interactions with them made them feel comfortable asking questions and gave them a feeling of acceptance in the classroom:

> It's not specifically about how they teach the class. It's more of how they respond to questions, a lot of times. [In the past] I felt ashamed to ask questions because…I thought it made me sound like I'm stupid, and I don't like feeling that way. But this specific teacher, no matter what they make you feel open to questions, they make me not feel ashamed whenever I'm asking questions and make me feel comfortable. You know…. Accepted.

Throughout the focus group conversations, it was evident that African American students were very attuned to how the teacher reacted to them and other students. Foundational to African American students feeling a sense of belonging in the math classroom was the teacher first creating an environment where students felt comfortable asking questions, receiving feedback, and feeling as if the teacher believed in them and their abilities, i.e., exhibiting a growth mindset. Once a strong sense of belonging had been established, students were willing to take risks in the math classroom, ask for help, and try new challenges. In turn, students shared that they had improved in their math skills, experienced an increase in their math self-concept, and became stronger math students.

Negative Perceptions of Teachers' Growth Mindset and Students' Sense of Belonging in Math Class.

Conversely, when students perceived that their math teacher lacked a growth mindset, they were more likely to feel discouraged or frustrated in the classroom. Students were impacted by the type of instruction that took place in the classroom, one sharing that they wished their teacher would teach in different ways; "I think that there should be several different ways to learn. Instead of just going with that one way." Another cited that the teaching style was not a

good fit; "wasn't a good match for me, because I've had this teacher for two years in a row. And I don't really like the way that they teach…The way that she has the lessons set up is really weird." A different student shared how not understanding the content made them feel out of place: "One time when I felt like I didn't belong in math class was when my teacher was teaching a new concept and he was explaining it really fast, and I wasn't able to pick up on what he was teaching." Students also noticed when their classmates did not understand, and the teacher's lack of awareness of this circumstance; "There's a lot of people that are confused. There are a lot of different needs for my class, and I don't know if my teacher covers all the needs." The lack of adjustments to instruction or a change in teaching strategies illustrates teachers exhibiting fixed-mindset traits.

Students also shared instances when they felt their teachers did not believe in them, for example, "get(ing) mad when you don't really know stuff" and wished that the teacher "treated everyone the same, even though they can't do certain things." Students expressed the desire to know the content and wanted to have the comfort of being able to approach their teacher for help. Some students were hesitant to ask questions, citing that they felt like it was a disruption to class: "I usually don't ask questions. I don't want to ruin the full class, and sometimes when I do ask questions, I feel like I don't get my question answered properly, or I don't get the answer that I need." When a student feels like asking for help will "ruin" a class or that asking a question is not worth it because they will not get the help that they need; the teacher is, either consciously or unconsciously, communicating to the student that they do not value that student's learning, or that they believe that the student is not worth the effort of working with.

Additional experiences from the previous year and teachers that may not have fostered a positive environment in the classroom where students felt empowered, safe, and welcome, were often given as examples for when students did not feel a sense of belonging; "One time that I felt like I didn't belong was one time a student in my class like got mad about something, and then caused like a big disruption, and we lost like a lot of learning time," and "another time, where I

felt like I didn't belong was last year… one of the teachers left the room to do something, and I was like, treated really, really badly." The teachers in these examples were portrayed as disconnected and lacking classroom management skills. The teacher's body language was also mentioned as a barrier to students engaging in math instruction: "I don't think she really likes our class, because we like to talk a lot, you can tell in her footsteps, because she like kind of stomps around the room." These types of actions discouraged students from connecting with the teacher, therefore limiting their opportunities for improvement and growth in math skills. Student disengagement was a common theme among students who felt a lack of belonging in the math classrooms. The teacher's limited visible care and investment in students did not reflect a growth mindset approach, nor did it foster a sense of belonging for students in the math classroom.

Finally, connections with teachers as well as peers affected the students' sense of belonging in the math classroom; "I don't personally feel like I belong in my math class, because I don't have that many friends in my math class. I mean, I have some, but I don't like to sit near them anymore. So, I feel like I don't really belong in that math class anymore." When connection with the teacher and other students was hindered, students could speak to the effect that this lack of belonging had on their learning and attention in the math classroom; "I start to zone out, and… I take more bathroom breaks to like not be in the class." When students do not feel valued or a part of the classroom, their belonging decreases, and disengagement increases.

Summary of Findings

In this final section, I synthesize the findings from the five research tools to identify any suggested patterns or themes between the middle school math teachers' level of growth mindset and African American sense of belonging in the math classroom.

Aim Statement One: Increase in Middle School Math Teachers' Growth Mindset.

As the math teachers progressed through the GM PD series during the 2023-2024 school year, six out of seven math teachers self-reported that their growth mindset had increased from Fall 2023 to Spring 2024. Four out of seven of these math teachers began the GM PD with an already self-assessed strong growth mindset, yet all four of these teachers still reported that their growth mindsets had increased from the fall to the spring. Three teachers began the fall with some fixed-mindset ideas, and two of these three math teachers developed a strong growth mindset by the Spring of 2024.

Throughout the professional development, teachers reflected on their mindsets, engaged in discussions with colleagues, and implemented growth mindset teaching practices into their classrooms. The effect of these sessions was highlighted in the teacher feedback form administered after the GM PD. Four math teachers rated the effectiveness of the PD as neutral, two agreed that it was effective, and one strongly agreed that it was effective. Five teachers disagreed or strongly disagreed that the GM PD series had a negative impact, and two teachers rated the PD as neutral.

According to their self-reports, the GM PD had a positive impact on the mindsets of math teachers. Some teachers expressed that some of the content was a review but also shared that the PD provided "new ideas to incorporate" into the math classroom. Even with the teachers' self-reported familiarity with the topic, the GM PD series was associated with most math teachers experiencing growth in their self-assessed growth mindsets, with some teachers demonstrating more growth than others (Figure 25).

AIM Statement Two: Increase in Middle School Math Teachers' Growth Mindset Instructional Practices.

Middle school math teachers generally perceived the Growth Mindset Professional Development (GM PD) series as influential on their teaching practices, although their reported

impacts varied. Feedback data showed mixed responses, with four teachers indicating a neutral effect. In comparison, three teachers agreed or strongly agreed that the GM PD had a positive impact on their instructional approaches. Teachers self-reported frequent use of growth mindset practices, such as framing mistakes as learning opportunities, providing actionable feedback, promoting productive struggle, focusing on process over product, and offering chances for second-chance learning. However, more student-driven strategies, such as peer-to-peer feedback, heterogeneous grouping, and student reflection, were reported less frequently, reflecting teachers' continued tendency toward teacher-centered practices.

Observational data from peer walkthroughs suggested the presence of growth mindset practices in classrooms but revealed discrepancies compared to teachers' self-reports. For instance, while all teachers claimed to frame mistakes as learning opportunities, this was observed in only 70% of classrooms. Practices such as second-chance learning, student reflection, and heterogeneous grouping were observed even less frequently. Despite these gaps, observers highlighted strong student engagement and collaborative problem-solving, with students actively discussing different approaches and supporting one another's learning. Overall, the GM PD series contributed to increased awareness and use of growth mindset strategies. However, further support may be needed to embed these practices consistently and visibly across all classrooms.

Through the analysis and examination of the quantitative and qualitative data collected, promising patterns emerge between the implementation of the growth mindset professional development series and an increase in the use of growth mindset instructional practices by middle school math teachers.

AIM Statement Three: Improved Sense of Belonging for African American Students in Their Middle School Math Class.

Students also participated in a student belonging survey in the fall and spring of the 2023-2024 school year. As the year progressed, from fall 2023 to spring 2024, African American

students' sense of belonging in the math classroom increased, with a modest increase in the "strongly agree" category when students were asked if they felt a strong sense of belonging in their math classroom. Those students who strongly agreed with the statement, "I feel a strong sense of belonging in the math classroom," increased from 29% to 41%, representing an increase of eight African American students. This increase correlates with the implementation timeline of the GM PD. Math teacher self-assessments and teacher feedback from fall 2023 to spring 2024 also suggest a possible relationship between the math teachers' increase in growth mindset and students' sense of belonging in the math classroom. A decrease in African American students who disagreed with the statement, "I feel a strong sense of belonging in my math class," was also noted, with a 6% decrease of four students.

Student focus groups also provided a window into this aim. Through these focus groups, the longer-term effects of the growth mindset professional development series were heard. Through the focus group dialogue, students shared experiences that had occurred within or before the 2023-2024 school year and compared them to their current experiences in the 2024-2025 school year. Students spoke about negative experiences that had happened before, which made them question their belonging in the math class. For example, one student shared, "I had a math teacher who…shamed me" because they did not understand a concept. While other students spoke about how their current math teacher had "lifted them up" from their prior experiences, helped them regain their confidence, and made them feel a stronger sense of belonging in the math classroom.

Students also shared examples in the focus group of the impact that the math teacher's mindset and/or instructional practices had on them, and how these factors affected their success in math class, self-concept as a math student, level of engagement, and sense of belonging in the math classroom. A student's sense of belonging in the math classroom affected students' willingness to take risks, ask questions, and the amount of pride they felt in their work.

A Note

Although achievement of African American students in math was not directly studied, the purpose of creating an increased growth mindset in math teachers was to ultimately decrease the academic and opportunity gaps that African American students face within our current educational system. Therefore, it is worth noting that state testing scores increased by 5% in all math classes in 2024 compared to the previous year, from 47% proficiency to 52% proficiency for African American students in the targeted middle school. The 2023 school year data were collected before the GM PD series was introduced, and the 2024 data were collected after the conclusion of the GM PD series. The 2025 data showed a 3% increase, with the proficiency of African American students rising to 55%. Causal findings cannot be drawn from this data. Still, it is a promising anecdotal finding that suggests that further research into mindset and achievement may be beneficial in the future.

Alignment of Research Questions and Aims

To fully illustrate the relationship between the research questions and the three short-term aims, as well as the findings presented above, refer to the table below (Figure 26).

Figure 26

Alignment of Research Questions, Short-Term Aims, and Findings

Research Question	Aligned Short-Term Aim(s)	Summary of Findings
RQ1: How, if at all, do middle school math teachers' growth mindset scores change after participating in a GM PD series?	Aim 1: Increase in teachers' growth mindset	Teachers showed measurable growth in mindset scores from pre- to post-PD surveys, indicating a positive shift in their beliefs.
RQ2: To what extent did teachers believe the GM PD series influenced their teaching practices?	Aim 2: Increase in use of growth mindset instructional practices	Teachers reported changes in language, feedback, and strategies; peer walk-throughs suggested implementation of growth mindset practices.
RQ3: How did changes in teacher mindset scores correlate with changes in students' sense of belonging?	Aim 1 + Aim 3	Classrooms where teachers improved mindset scores also saw increased belonging scores among African American students, suggesting a positive relationship.
RQ4: How did African American students perceive their teachers' mindset?	Aim 2 + Aim 3	Students could identify growth vs. fixed mindset behaviors; those who perceived growth-oriented teachers reported stronger connection and support.
RQ5: What is the relationship between student perception of teacher mindset and their own sense of belonging?	Aim 3: Improve African American students' sense of belonging	Students who saw their teachers as growth-oriented reported a higher sense of belonging, confidence, and engagement in math.

Note: A short synopsis of research questions, aligned with short-term aims, and study findings.

Conclusion

This study suggests that a possible positive relationship exists between the GM PD series and math teachers' growth mindsets and instructional practices, as well as African American students' sense of belonging in the math classroom as a modest connection seemingly exists between math teachers' level of growth mindset and African American students' sense of belonging in the mathematics classroom. These findings support the Theory of Change

previously stated; if middle school math teachers participate in a growth mindset professional development series, then the middle school math teachers' growth mindsets and instructional practices will increase, which will, in turn, improve African American students' sense of belonging in the middle school mathematics classroom.

Therefore, a growth mindset professional development series for math teachers may help address the academic and opportunity gaps that African American students experience in mathematics. The GM PD series gives schools and districts a low-cost, easily implemented intervention to help math teachers' growth mindsets evolve. Based on the evidence gathered within this study, it is likely that implementing GM PD may increase African American students' sense of belonging in the math classroom. It is predicted that with an increase in belonging, African American students will become more successful in mathematics, as well as other STEM subjects, thereby improving their achievement and narrowing the existing academic and opportunity gaps.

Study Limitations & Recommendations

This study was exploratory, as a variety of data collection tools were used to collect preliminary information that may prompt further studies. Several study limitations should be considered when examining this data. Although patterns and trends are surfacing as they relate to math teachers participating in the GM PD series and African American students' sense of belonging in the math classroom, to determine causation or even correlation, additional variables would need to be in place. For example, accounting for the study setting and the students who participated in the focus groups, setting sample sizes and control groups, collecting additional baseline and quantitative data, norming and increasing the number of peer walkthroughs, and establishing clear parameters for the timing of each GM research component.

Setting & Student Focus Group Participants.

It is worth noting that this study took place in a middle school situated in a high socioeconomic area, where African American students comprise only 14% of the student

population. Results may vary in different socioeconomic settings or with different student demographics. Additionally, fifteen students took part in the voluntary student focus groups; therefore, not all student experiences were captured. Although the focus group included a good representation of students across various grades and levels, this self-selection to participate may have influenced the results to be more positive or negative. To mitigate this, future researchers should strategically select students to participate in the focus group discussion and solicit teachers' suggestions, in addition to allowing students to self-select.

Sample Size & Control Groups.

This study had a math teacher group of seven who took the mindset pre- and post-assessment, and a student group of sixty-three who took the belonging surveys. The teacher group of seven is small and could be expanded to include more teachers from different schools, levels, or content areas. A larger group of teachers would provide more in-depth information about the effect of the growth mindset professional development series and opportunities for more detailed analysis.

Although the African American student group of sixty-three who took the belonging survey is a good number size-wise, students replied anonymously, meaning that specific student scores from the fall and spring could not be compared at the individual student level. In this case, the overall scores provided relevant information, but it would also be beneficial to track the experiences of specific students rather than solely examining the population of African American students in general. Comparisons to other racial groups may also help illustrate the effect that the teachers participating in the growth mindset had on different student populations, such as White and Asian students. This would also be beneficial when collecting information via the student focus groups.

Additionally, the level of math class, though recorded, was not heavily weighted in the analysis of this data. Tracking specific students in alignment with their math levels also helps to

inform who is in these focus groups. If quantitative data could be aligned with the student participants who participated in the focus group, a richer picture may result.

Control groups of both students and teachers would strengthen the study design. This could involve a group of teachers who did not participate in the Growth Mindset professional development series, along with the students in their classes, providing a comparison to the teachers and students who did take part in the GM PD. These control groups would allow researchers to have a clear comparison between what is seen in the classrooms of those teachers engaging in the PD and what is seen in the classrooms of those teachers not participating in the PD. Student experiences could also be compared. These types of controls would allow the researcher to have comparison groups, helping to determine whether the PD is creating a change in teachers' instructional practices or if another factor is at play.

Additional Data: Baseline & Quantitative.

Baseline data were available for the math teachers' initial measure of growth mindset and their post-PD measure of growth mindset, as well as pre- and post-student belonging surveys. However, to draw more precise conclusions, baseline data would also be beneficial when examining the instructional practices implemented in the math classroom in the fall and the results of a fall student focus group session.

A baseline of instructional practices in the math classroom in the fall would help us determine if there is a significant difference between the GM instructional practices implemented in the fall and those in the spring. This information would help us examine whether the GM PD series has made a substantial impact on instructional practices in the classroom and on teachers' implementation.

The fall student focus group would enable the researcher to gain insight into the students' experiences before the GM PD takes place, providing a baseline to measure against at the mid-point and end of the GM PD series. This additional data point would help us to

determine if there was a difference between students' initial experiences in the math classroom before, during, and after the teachers participated in the GM PD series.

Additional quantitative data points would also help measure the impact. For example, the level of growth mindset among teachers was calculated using the ranges of scores; the exact numerical growth of the teacher's growth mindset from fall to spring would help measure the impact of the GM PD more accurately. Additionally, more specific information about math class and the experiences of African American students could be gathered from students, creating multiple data points that can be measured, rather than just focusing on whether the student feels a strong sense of belonging in math class.

Norming and Increasing the Number of Peer Walkthroughs.

Peer walkthroughs were implemented to inform the implementation of growth mindset instructional practices in the classroom. Although the observers all completed the same form with the same criteria, it would have been beneficial to norm what the observers would be looking for and what constituted that specific instructional practice. Norming of look-fors was not provided during the performed walkthroughs; instead, peer observers used their prior professional knowledge to make determinations about what they observed in the classroom. A lack of an agreed-upon understanding of each walkthrough's look-fors weakens the validity of the walkthrough tool results.

Additional walkthroughs should also be completed. These walkthroughs should be scheduled, normed, and regularly implemented. This would increase the validity of this data and measure the impact of the GM PD on teachers' instructional practices over time.

Clear Parameters for the Timing of Each Growth Mindset Research Component.

A benefit of this study is that a clear professional development schedule was adhered to throughout the year. As mentioned earlier, student focus groups and the addition of more peer walkthroughs would have also been beneficial.

For researchers moving forward, I would recommend holding a student focus group before the GM PD series implementation, midway through, and at the PD's conclusion, and possibly later in the school year or the next school year. This will help the researcher qualitatively track the students' experiences in the math class and make real-time adjustments to the GM PD based on the students' feedback. Collecting student feedback throughout the GM PD series and then sharing it with teachers may also help increase buy-in from teachers as they progress in their professional development.

Additionally, peer walkthroughs, although scheduled in the original PD plan, need to take place more often and in addition to the professional development sessions. Ideally, a new or review of a GM PD instructional practice or a mindset shift could be introduced, expectations could be normed, and peer walkthroughs could take place afterward, to give feedback on the teacher's implementation of this practice in their classroom. Following this walkthrough, a feedback and reflection cycle could take place. This strategic planning ahead would help teachers solidify their learning and growth mindset practices in the classroom, creating a more impactful professional development experience for them.

Implications of this Study

Short Term

The growth mindset professional development findings and the observed associations with African American students' sense of belonging in math class can be immediately shared with math classroom teachers within the school and/or district. Teachers can use this data as a starting point for reflection and examine their use of GM practices in their current pedagogy. Teachers can make adjustments in their math classes that support the continued use of growth mindset instructional practices or increase their use of these practices as they move forward. African American students can be solicited for feedback on the current state of their math classes and whether they feel their teachers have a growth mindset. These students can also share their current sense of belonging in the math classroom. Baselines of teacher practice and

mindsets, as well as African American students' sense of belonging in the math classroom, can be gathered and examined.

Additionally, a growth mindset professional development series can be implemented with math or with all teachers to encourage the use of these strategies and potentially support the sense of belonging in the classroom among African American students or other targeted student groups. The PD could also be generalized to include all teachers and all students. Student belonging baselines can be measured immediately, and student feedback can be elicited at the start of the series. This PD can be utilized immediately to make a potentially meaningful impact on teachers and students.

Intermediate

The Growth Mindset Professional Development series can be tailored to specific subject areas and/or grades or presented to a larger population of teachers across content areas and grade levels. Data from other content areas and student groups can be gathered and examined. Specific growth mindset practices, tailored to content, can be researched and implemented. Shorter or longer GM PD series can be created depending on time constraints or the immediacy of need.

This information should also encourage teachers to reflect on the instructional practices they are using in the classroom. Grades and test scores, in comparison to the implementation of growth mindset instructional practices, can be analyzed for patterns and potential themes. Student math recommendations, students' reported sense of belonging, and teachers' level of growth mindset can be followed and examined throughout the school year.

Long Term

Long-term patterns associated with a growth mindset professional development series could be studied, such as how a teacher's level of GM may relate to an African American student's educational outcomes over an extended period. The admission of African American students into college STEM programs and their possible connections with their K-12 teachers'

knowledge and implementation of growth mindset practices could be examined. Real-world outcomes, such as employment opportunities in STEM fields, the examination of the wealth gap, and societal inequalities between African American adults and White and Asian adults, may be explored in relation to African American students' experiences in math classes and the math teachers' mindsets. Student outcomes between those whose teachers participated in a GM PD and those who did not could be compared and analyzed for trends over an extended period.

Final Conclusions & Next Steps

These initial findings offer key insights and actionable next steps that can be implemented immediately within a school or district, while also illuminating opportunities for future research and refining the structure of the GM PD series. Through this process, it became clear to me that my driver diagram, which had three separate aims, would have been stronger with one unified aim. Trying to capture multiple goals blurred the cause-and-effect relationships among aims, drivers, and change ideas. In future iterations, I would refine the aim and focus on asking questions rather than rushing to conclusions. Although imperfect, I hope this work made a difference for students and enhanced my understanding of how clarity in design strengthens efforts to improve. This insight underscores the broader implication of my study: clearly defined aims are crucial for linking teacher learning to student belonging and achievement.

Building from this, schools and districts are encouraged to educate teachers on the possible benefits that growth mindset practices can have for African American students in the classroom, using this study as a starting point. Teachers should also be made aware of how specific GM teaching practices—such as providing feedback both from teachers and peers, offering one-on-one assistance and encouragement, and framing mistakes as learning opportunities—can be incorporated or strengthened within their current practice to support students more effectively. And perhaps most importantly, student input should be sought on a regular basis. The focus group discussions made abundantly clear that students are highly

perceptive of their math teachers' attitudes and beliefs. They know when a teacher believes in them—or when a teacher does not.

Teachers should be reminded that the connections they form with their students are powerful and can have lasting effects, either positive or negative. The importance of teacher-student interactions should be emphasized, and teachers should reflect on the messages they are sending to their students, both in and outside the classroom. Student voice should be an integral part of the educational program to ensure that students are served in the best possible way by the school and the district. Additionally, student feedback from historically marginalized groups, such as African American students, should be strategically sought and acted upon.

While this study focused on the associations between the GM PD series and math teachers' growth mindsets and African American students' sense of belonging in the math classroom via the short-term aims, the study could continue to explore the mid and long-term aims noted in the TOC (Figure 14). Researchers can monitor the long-term patterns related to students' sense of belonging in the math classroom and/or the math teachers' growth mindset. Student data could be tracked to include students' sense of belonging data in math class throughout middle and high school. This longitudinal data could be collected and examined to analyze the students who had one or more growth-focused math teachers during their middle and high school careers, as well as their long-term math trajectories. This analysis would include the number of students who pursue STEM careers in college and graduate with STEM degrees.

Persistent academic and opportunity gaps in mathematics between African American students and their White and Asian peers will not be closed overnight. Addressing these disparities requires sustained, intentional action and coordinated strategies at both the school and district levels. One promising and practical approach is implementing a growth mindset professional development series for teachers. The observed relationships between the Growth Mindset Professional Development series and the mindsets and instructional practices of math teachers, as well as the sense of belonging in math classrooms among African American

students, demonstrate a clear, research-informed pathway for building more inclusive and equitable learning environments. Cultivating a growth mindset among teachers represents not just an instructional shift, but a meaningful step toward dismantling systemic barriers and reducing the persistent opportunity and achievement gaps that disproportionately affect African American students in mathematics education.

Impact Product

Growth Mindset Professional Development Series for District and School Leaders

Significant gaps in math achievement and opportunities exist between African American students and their White and Asian peers. Closing these gaps requires schools and districts to implement strategic, well-designed interventions. A growth mindset professional development series is one way district and school leaders can begin to address the inequalities that affect the African American student experience in mathematics, as well as in other academic areas. The positive relationship between the Growth Mindset Professional Development (GM PD) series and the mindsets and instructional practices of math teachers, as well as the sense of belonging in math classrooms among African American students, provides educators with a starting point that is actionable and relevant. The GM PD is a vehicle that can be used to create a more inclusive and productive learning environment for African American students.

Goal of the GM PD Series

Research shows that African American students' sense of belonging can be positively affected by positive teachers' mindsets and/or growth mindset practices in the classroom (Canning et al., 2019; Blazar, 2021; Bostwick et al., 2020), and there is specific research citing that a growth mindset can positively impact African American students' success in the math classroom (Fashaw, 2024). The goal of the GM PD is to increase teachers' awareness of growth mindset practices and thought processes, while also changing teachers' instructional practices to become more growth-centered.

Applicability of the GM PD Series

A benefit of the GM PD series is that the concepts studied can be applied to various student groups and serve as a neutral framework that can be easily implemented in the current educational climate. In a space where schools and districts are losing funding due to "DEI" initiatives, the principles of a growth mindset provide a neutral platform that applies to all

teachers and students. In the studied middle school, the staff traditionally put up barriers when professional development presentations included topics that they interpreted as diversity, equity, and inclusion initiatives, particularly if these topics related to race. As there is a similar dynamic in our current social and political environment, the GM PD provides a way to positively impact traditionally underserved student groups' (such as African American students) experiences in the classroom, without explicitly focusing on race or "diversity, equity, and inclusion" (DEI) topics that can cause resistance or an undermining of the learning process. Through a focus on teacher growth mindset and instructional practices rather than the impact of race on a student's success, less resistance to the professional development series can be expected and was experienced within this study. Also unique about this professional learning series is that it can be generalized to other content areas and/or implemented within the whole school community.

In creating the impact product, I realized the three-aim structure of my driver diagram sometimes pulled professional learning in different directions. A single, focused aim would have aligned the PD, walkthrough look-fors, and teacher reflections more coherently. In future iterations, I would ground the product in one precise aim to strengthen both its design and its connection to student outcomes. This reflection highlights the role of the impact product as a tool for focusing teacher practice on ways that directly support student belonging and access.

As a next step, I invite other school leaders to consider implementing this GM PD series within their own schools or districts. By participating in this collaborative professional learning experiment, leaders can contribute to a broader body of evidence on how growth mindset practices impact both teachers and students across various contexts. Leaders who engage with this initiative are encouraged to not only deliver the series but also to collect and analyze teacher and student data, including feedback on classroom practices and students' sense of belonging. Sharing these results collaboratively will help refine the model, strengthen its credibility, and build a network of schools committed to equity-centered yet politically neutral professional

learning. In doing so, schools can learn from one another, create consistency in practices, and ultimately enhance outcomes for students who have historically been underserved in mathematics and beyond.

Overview of the GM PD Series

District and school leaders need quick and practical resources that can be immediately utilized to address the evolving needs of a school building, student instruction and well-being, and teacher growth. I have created a Growth Mindset Professional Development series housed on a Google site that outlines seven four-week GM PD cycles, provides recommendations for school leadership teams, and contains presentations based on relevant chapters from the book Mindset by Carol Dweck (2006, 2016) that address such topics like stereotype threat, the importance of failure, the power of praise, brain neuroplasticity, etc.

Tools Within the GM PD Series.

Mindset self-assessments, student belonging surveys, walkthrough resources, and student and teacher reflection tools that leaders can readily use with the staff and students within school buildings are also included. The basis for these tools is modeled after the ones I used within the original GM PD. Some of these tools have been updated, and implementation guidelines have been modified based on the results of my study. The seven cycles, as well as additional resources for implementing the GM PD, can be found on the Google site. The tools have not been specialized for a particular content; instead, they are generalized and can be used with any content and staff.

Walkthroughs and Student Focus Groups.

One of the most substantial revisions I made to the GM PD initially implemented is the timing and quantity of walkthroughs and student focus groups. The increase of both student focus groups and classroom walkthroughs will help to more fully center student voice and growth mindset instructional practices in the classrooms.

Student Focus Groups.

Student focus groups have been scheduled at the beginning, middle, and end of the professional development series, with one session at the prerequisite portion of the plan, before the first cycle, and another session at the end of cycle three. The final session will take place at the end of cycle six. Along with this designated time for students to provide feedback, designated times within cycles one, four, and seven give teachers time to reflect on the feedback gathered through the student focus groups. Increasing the number of student focus groups helps both the leadership team and staff adjust based on real-time student feedback.

Peer Walkthroughs.

Walkthroughs have also been scheduled in six out of the seven GM PD cycles, with assigned weeks for the peer walkthrough, a reflective conversation between the observed and the observer, and, in cycles one, two, and five, a whole-group reflection on patterns and trends observed in classrooms. Furthermore, after the first walkthrough has been completed and during the initial whole-group reflection sessions, teachers will also discuss what each practice should look like in the school, therefore norming practices and ensuring that common understanding and definitions are used during each subsequent walkthrough. The increase in and norming of walkthroughs will also allow teachers more opportunities to reflect with one another and to trial and deliberately implement growth mindset instructional practices in their classrooms.

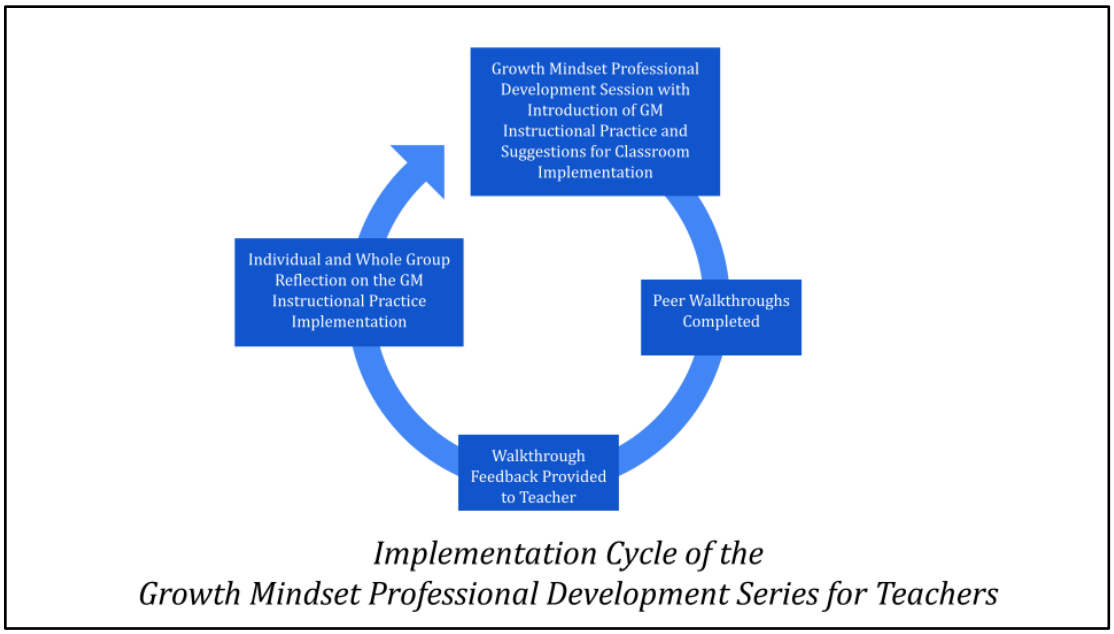
GM PD Cycles.

Five of the GM PD cycles are arranged so that an introduction of the concept or reflection on the prior cycle's learnings happens in week one, week two consists of the peer walkthrough process, week three's time is allotted for teachers to share and receive their walkthrough feedback with and from their partners, and week four gives time for the teachers in each GM PD

group to come back together either with their partner or as a whole group to reflect and consolidate their learning for that particular PD cycle (Figure 27).

Figure 27*:*

Proposed Implementation Cycle of the Growth Mindset Professional Development Series for Teachers



Note: Suggested implementation cycle of the GM PD Series for Teachers

Teachers will also be involved in activities, dialogue, and readings that enable them to recognize the potential in students, create strategic opportunities for a growth mindset in the classroom, reflect on their teaching strategies, and develop awareness of the unconscious messages they may be sending to their students. By increasing teachers' growth mindsets and students' sense of belonging in the classroom, a more productive and positive community can be established between staff and students.

Before cycle one and at the end of the seventh PD cycle, mindset self-assessments for teachers and belonging surveys for students are available for administration. A teacher feedback form is also provided to collect feedback from teachers at the end of the series. Furthermore, peer walkthrough capture and reflection forms are also provided for school teams. School

leadership teams can access this data to identify trends and patterns occurring in classrooms, subjects, or the school. After the conclusion of this GM PD series, school leadership teams have also been provided with a sample data analysis protocol that they can use to analyze teacher and student data gathered during the GM PD and plan next steps for professional development.

Alignment of the GM PD Series

The GM PD plan aligns with the priorities of most other school districts; particularly strategic plan goals centered on "Belonging and Equity." Within the studied district, fostering a sense of belonging and providing an equitable learning experience for students are cornerstones to achieving district goals. Three of the district's top four goals include the phrase "minimize disparities across student groups" in the areas of reading, math, and college career readiness. The fourth district goal is to increase quality professional learning experiences for teachers. Additionally, a key strategy within the strategic plan is to foster a sense of "instructional belonging." Instructional belonging is defined as promoting "student voice and self-advocacy by partnering with students to co-create learning," and supporting "students' social-emotional needs and creating a restorative, safe, and supportive learning environment" (Strategic Plan, 2025). This GM PD series directly supports the goals and strategies outlined in this strategic plan by explicitly emphasizing fostering a sense of belonging among students through growth mindset instructional practices in the classroom and by amplifying student voice.

This GM PD series serves as a crucial step toward ensuring a safe and supportive classroom environment where students can learn and progress, and disparities between student groups can be eliminated. Through the implementation of this professional development, teachers and staff can create a school and classroom environment that is conducive to student success and encourages growth mindset instructional practices. In turn, students will gain more confidence and a stronger sense of belonging, enabling them to focus on the instruction and learning that occur in the classroom. The goal is that, in the long term, students will become more academically successful, disparities between student groups in terms of opportunity and

achievement will be mitigated, and the inequalities experienced by students in the district, state, and nation will be addressed.

Professional Development Growth Mindset Series Google site (linked)

The Growth Mindset Professional Development Series information will be disseminated through an initial presentation to district leadership and then shared with school leadership teams. Sharing this growth mindset professional development series with leaders will provide schools with an easy-to-use, adaptable, and relevant resource that can be quickly and easily implemented within the school to impact teachers' growth mindsets and students' sense of belonging in the classroom. The GM PD site also serves as a resource bank of growth mindset professional development options. District or school leaders can utilize the entire series or select those sessions or activities that are more directly related to their students' and the specific district or school's needs.

Purpose

The purpose of the GM PD is to guide and support teachers in developing and applying growth mindset principles and instructional strategies that foster equitable learning environments for all students. By aligning teacher mindset with targeted growth mindset instructional practices, a student's sense of belonging in the classroom can increase, hopefully leading to long-term academic achievements.

Alignment to District Goals

Through the implementation of the GM PD series, progress will be made towards the following district goals:

1. Increase the percentage of students reading proficiently by the end of Grade 3 and minimize disparities across student groups.
2. Increase the percentage of students proficient in mathematics by the end of middle school and minimize disparities across student groups.

3. Increase the percentage of students who are college and career-ready by the end of Grade 10 and minimize disparities across student groups.

4. Increase the percentage of professional learning experiences that lead to better teaching.

(District Strategic Plan, 2025)

Outcomes for Educators

1. Demonstrate increased understanding and application of growth mindset principles in classroom practices.
2. Implement instructional strategies aligned with growth mindset practices.
3. Create a more inclusive and affirming classroom environment that supports a stronger sense of belonging for students.

Resources Needed

1. The Professional Development Growth Mindset Series Google site
2. A school leadership team to facilitate and steer the GM PD series for their unique setting.
3. Designated time for teacher teams to meet for professional development, whole group, and partner activities.
4. The Text - Growth Mindset: The New Psychology of Success; By Carol Dweck - Bulleted Summaries
5. Teacher Mindset Self-Assessment - Pre & Post
6. Pre & Post Student Belonging Survey *(school leadership team can revise as needed, insert content for class)*
7. Peer Walkthroughs
8. One-on-One Peer Walkthrough Reflection
9. Student Focus Group Sample Questions (these may vary based on targeted content and

student group)

10. Teacher Feedback Form
11. All PPT presentations and reflections are within each PD cycle.

Figure 28

Outline of the Growth Mindset Professional Development Series for District and School Leaders

Suggested Timeline	Chapter Focus Mindset By Carol Dweck	Pg. #	Professional Learning/ Peer Walkthroughs/ Student Voice/Activity	Summary Of Activity
PD Opening Prerequisites	Introduction	NA	Baseline Teacher Self-Assessment / Baseline Student Belonging Survey (revised to include specific content questions)	Teachers take the baseline growth mindset self-assessment; students take the baseline student belonging survey.
			Student Focus Groups - Session 1	How do students feel within the classroom? Do they have a sense of belonging? Do they feel that their teachers have a growth mindset? Do they think their teachers believe in them? Do they feel a part of the class or school?
GM PD CYCLE # 1				
Week 1			Growth Mindset v. Fixed Mindset & Reflection on Student Focus Group Feedback	Teachers review the differences between a growth and fixed mindset, reflecting on the messages about the growth mindset they are sending to their students.
Week 2			Peer Walkthroughs	Peer observers collect a baseline of the practices that are being implemented in the classroom. All teachers will be observed, and all teachers will observe.

Week 3	1: The Mindsets	4-14	One-on-One Peer Walkthrough Debriefs	Peer walkthrough information is shared with and explained to the teacher. These are one-on-one meetings. Please note that two sessions are scheduled to take place. The teacher would be an observer in one meeting and the observed in the other meeting.
Week 4			Individual and Whole Group Reflection, Peer Walkthrough Feedback	Identifying patterns and trends, and norming what each instructional practice looks like based on observer feedback. Recording the baseline of what is happening in classes and the frequencies of implementation.
GM PD CYCLE # 2				
Week 1	2: Inside the Mindsets (Mindsets Change the Meaning of Failure)	15-32	Growth Mindset FAIL	This professional development explores the celebration of failure and the encouragement of resilience in the classroom. Those with growth mindsets seek out challenges and look for opportunities to learn. Teachers reflect on how they provide these types of opportunities for students. Facilitators can emphasize the use of second-chance learning, an emphasis on process over product, and a no-fault approach to classroom failure.
Week 2			Peer Walkthroughs	Peer observations. All teachers will be observed, and all teachers will observe.
Week 3			One-on-One Peer Walkthrough Debriefs	Peer walkthrough information is shared with and explained to the teacher. These are one-on-one meetings. Please note that two sessions are scheduled to take place. The teacher would be an observer in one meeting and the observed in the other meeting.
Week 4			Individual and Whole Group Reflection, the Peer Walkthrough Feedback	Identifying patterns and trends, and norming what each instructional practice looks like based on observer feedback. Recording what is happening in classes and the frequencies of implementation.
GM PD CYCLE # 3				

Week 1	2: Inside the Mindsets (Mindsets Change the Meaning of Failure)	43-52	Inside the Mindsets	The science behind GM is reviewed through the explanation of neuroplasticity, which is the brain's ability to grow and develop new neurons, allowing it to continue learning. The importance of failures and mistakes is again emphasized. The learning that occurs when stepping outside one's comfort zone will be reviewed, and teachers will reflect on the messages they convey to students to encourage them to explore beyond their comfort zones.
Week 2			Peer Walkthroughs	Peer observers collect a baseline of the practices that are being implemented in the classroom. All teachers will be observed, and all teachers will observe.
Week 3			One-on-One Peer Walkthrough Debriefs	Peer walkthrough information is shared with and explained to the teacher. These are one-on-one meetings. Please note that two sessions are scheduled to take place. The teacher would be an observer in one meeting and the observed in the other meeting.
Week 4			Student Focus Groups - Session 2	Do students see a change in their teachers' instructional strategies? Do students feel comfortable in the classroom?
GM PD CYCLE # 4				
Week 1			Student Focus Group Feedback	What can staff improve on? What are students noticing in the classroom?
Week 2			Stereotypes, Labels, and Assumptions	Labels and stereotype threat will be reviewed, with a focus on their impacts on students. The power of looking beyond the surface level of a person and knowing them on a deeper level is emphasized. The connection lies in the fact that there is a cultural iceberg, and a GM iceberg, with the surface level of knowledge and skills being easier to identify and change. At the same time, social roles, self-image, traits, and motives are much harder to change below the surface. Teachers reflect on how stereotypes, assumptions, and labels influence their interactions with students in the classroom.
Week 3			Peer Walkthroughs	Peer observers collect a baseline of the

	3: The Truth About Ability and Accomplishment (The Danger of Praise and Positive Labels)	55-71		practices that are being implemented in the classroom. All teachers will be observed, and all teachers will observe.
Week 4			One-on-One Peer Walkthrough Debriefs	Peer walkthrough information is shared with and explained to the teacher. These are one-on-one meetings. Please note that two sessions are scheduled to take place. The teacher would be an observer in one meeting and the observed in the other meeting.
GM PD CYCLE # 5				
Week 1	4: Sports the Mindset of a Champion	71-81	Make A Mark: Understanding Our Impact as Educators	Teachers review fixed and growth mindsets. They reflected on how they encourage growth in their classroom and foster creativity. Teachers were empowered to foster creativity, promote student growth, and enhance their confidence in their teaching practices.
Week 2			Peer Walkthroughs	Peer observers collect a baseline of the practices that are being implemented in the classroom. All teachers will be observed, and all teachers will observe.
Week 3			One-on-One Peer Walkthrough Debriefs	Peer walkthrough information is shared with and explained to the teacher. These are one-on-one meetings. Please note that two sessions are scheduled to take place. The teacher would be an observer in one meeting and the observed in the other meeting.
Week 4			Individual and Whole Group Reflection, the Peer Walkthrough Feedback	Identifying patterns and trends, and norming what each instructional practice looks like based on observer feedback. Recording what is happening in classes and the frequencies of implementation.
GM PD CYCLE # 6				
Week 1			Growth Mindset Parents, Teachers, and Coaches: Where Do Mindsets Come From - Communicating Effective Student Praise	Praising effort over achievement and/or "process over product" was reviewed, reminding teachers that praising effort through a growth mindset lens was the most impactful. Teachers were given specific examples of praise for effort to try in their classroom and asked to reflect on the current messages they are sending to their students.

Week 2	7: Parents, Teachers, and Coaches: Where Do Mindsets Come From	98-107	Peer Walkthroughs	Peer observers collect a baseline of the practices that are being implemented in the classroom. All teachers will be observed, and all teachers will observe.
Week 3			One-on-One Peer Walkthrough Debriefs	Peer walkthrough information is shared with and explained to the teacher. These are one-on-one meetings. Please note that two sessions are scheduled to take place. The teacher would be an observer in one meeting and the observed in the other meeting.
Week 4			Student Focus Groups- Session 3	Do students see a change in their teachers' instructional strategies? Do students feel comfortable in the classroom?
GM PD CYCLE # 7				
Week 1	8: Changing Mindsets	223 - 264	Student Focus Group Feedback	Share general student group feedback (maintaining confidentiality) with teachers and discuss common themes. Talk through how these themes are relevant to the teachers' classrooms and instructional practice, and what the teachers' takeaways are from the focus group feedback.
Week 2			Changing Mindsets	This is a wrap-up of the Mindset book study. Teachers are asked to reflect on how they promote GM in their classrooms and what practical strategies they use. They are also asked to think about their three walkthroughs that took
Week 3			Post GM PD Teacher Self-Assessment / Teacher Feedback Form	Post Assessment & Teacher Feedback Solicited
Week 4			Post Student Belonging Survey	Post GM PD Series Student Belonging Survey Administered
Conclusion				
GM PD Conclusion			Post GM PD Teacher Self-Assessment / Teacher Feedback Form / Post Student Belonging Survey	Teachers retake the growth mindset self-assessment; teachers fill out the feedback form, and students take the post-student belonging survey. Within the feedback form, teachers reflect on their post-assessment score in comparison to their pre-assessment score.

Data Analysis			Data Protocol for School Leadership Teams	Look at the data. Was the GM PD effective? Did students' sense of belonging increase? Did the teacher's mindset increase?

Appendix

Figure A

Teacher Growth Mindset Inventory

MINDSET QUIZ

1. Circle the number for each question which best describes you
2. Total and record your score when you have completed each of the 10 questions
3. Using the SCORE chart, record your mindset

	Strongly Agree	Agree	Disagree	Strongly Disagree
Your intelligence is something very basic about you that you can't change very much	0	1	2	3
No matter how much intelligence you have, you can always change it quite a bit	3	2	1	0
Only a few people will be truly good at sports, you have to be born with the ability	0	1	2	3
The harder you work at something, the better you will be	3	2	1	0
I often get angry when I get feedback about my performance	0	1	2	3
I appreciate when people, parents, coaches or teachers give me feedback about my performance	3	2	1	0
Truly smart people do not need to try hard	0	1	2	3
You can always change how intelligent you are	3	2	1	0
You are a certain kind of person and there is not much that can be done to really change that	0	1	2	3
An important reason why I do my school work is that I enjoy learning new things	3	2	1	0

SCORE CHART
22-30 = Strong Growth Mindset
17-21 = Growth with some Fixed ideas
11-16 = Fixed with some growth ideas
0-10 = Strong fixed mindset

MY SCORE:

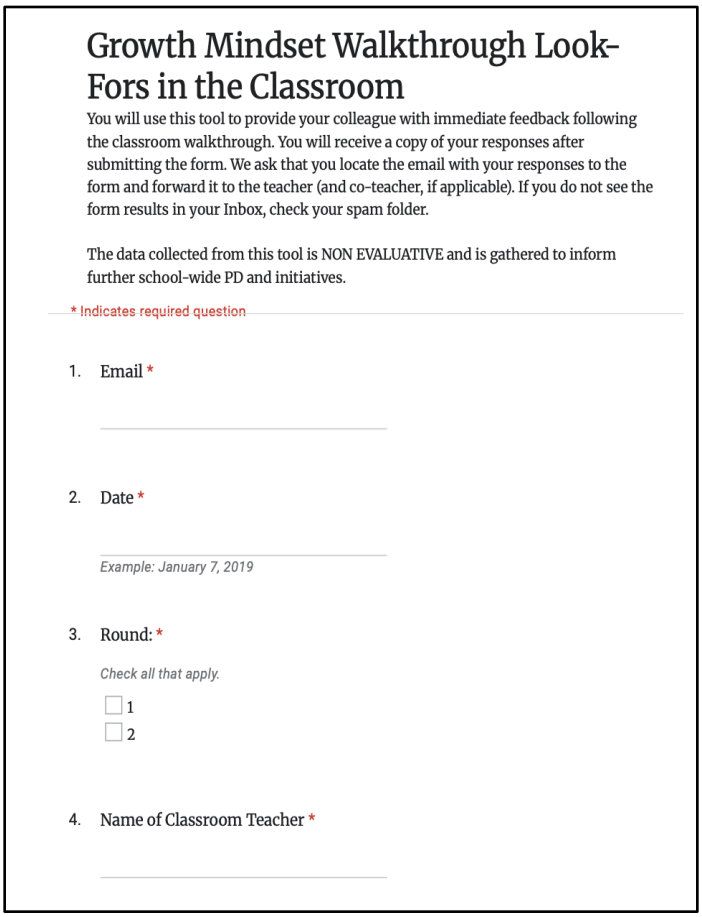
MY MINDSET:

Adapted from:
Dweck, C. S. (2006). *Mindset: The new psychology of success*. New York: Random House Inc.

MINDSET QUIZ | UNC Advising (retrieved 2023)

Figure B

Growth Mindset Walkthrough Look-Fors in the Classroom



Growth Mindset Walkthrough Look-Fors in the Classroom

You will use this tool to provide your colleague with immediate feedback following the classroom walkthrough. You will receive a copy of your responses after submitting the form. We ask that you locate the email with your responses to the form and forward it to the teacher (and co-teacher, if applicable). If you do not see the form results in your Inbox, check your spam folder.

The data collected from this tool is NON EVALUATIVE and is gathered to inform further school-wide PD and initiatives.

* Indicates required question

1. Email *

2. Date *

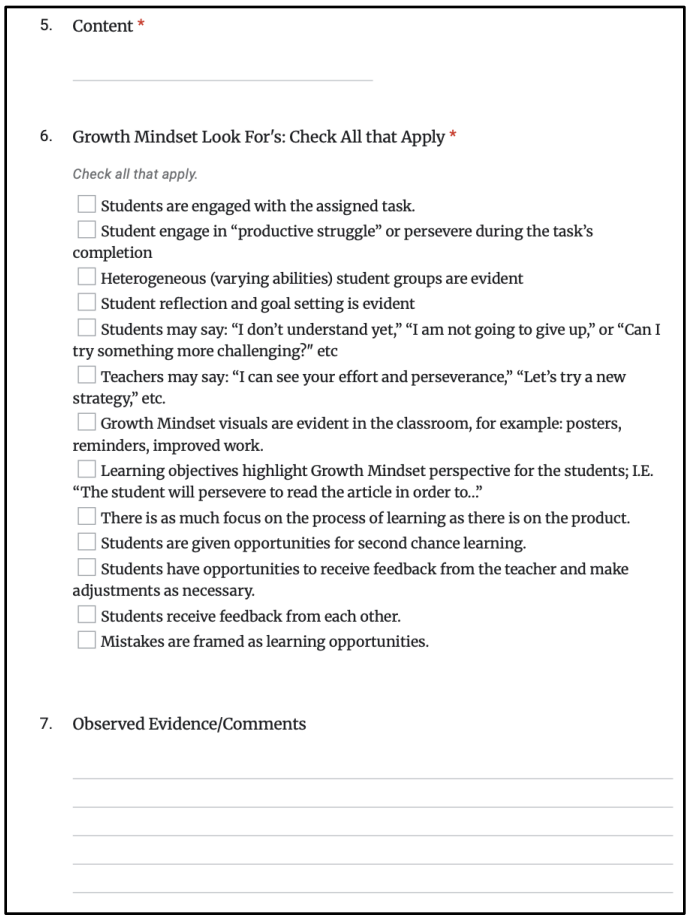
Example: January 7, 2019

3. Round: *

Check all that apply.

- [ ] 1
- [ ] 2

4. Name of Classroom Teacher *



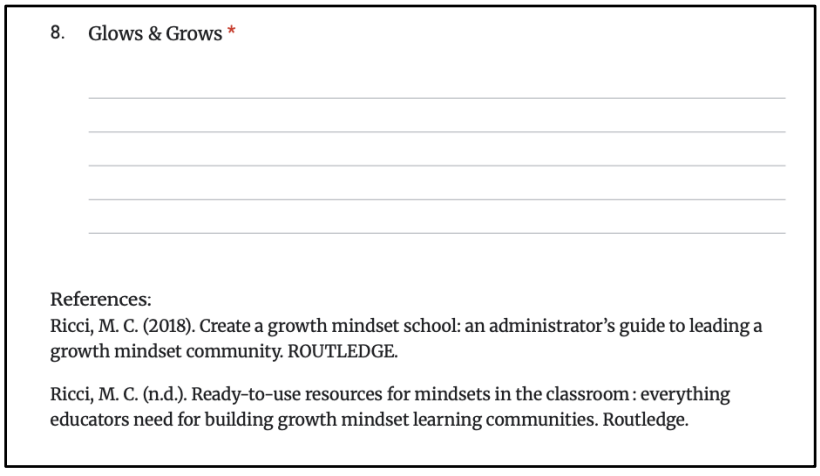
5. Content *

6. Growth Mindset Look For's: Check All that Apply *

Check all that apply.

- [ ] Students are engaged with the assigned task.
- [ ] Student engage in "productive struggle" or persevere during the task's completion
- [ ] Heterogeneous (varying abilities) student groups are evident
- [ ] Student reflection and goal setting is evident
- [ ] Students may say: "I don't understand yet," "I am not going to give up," or "Can I try something more challenging?" etc
- [ ] Teachers may say: "I can see your effort and perseverance," "Let's try a new strategy," etc.
- [ ] Growth Mindset visuals are evident in the classroom, for example: posters, reminders, improved work.
- [ ] Learning objectives highlight Growth Mindset perspective for the students; I.E. "The student will persevere to read the article in order to..."
- [ ] There is as much focus on the process of learning as there is on the product.
- [ ] Students are given opportunities for second chance learning.
- [ ] Students have opportunities to receive feedback from the teacher and make adjustments as necessary.
- [ ] Students receive feedback from each other.
- [ ] Mistakes are framed as learning opportunities.

7. Observed Evidence/Comments



8. Glows & Grows *

References:

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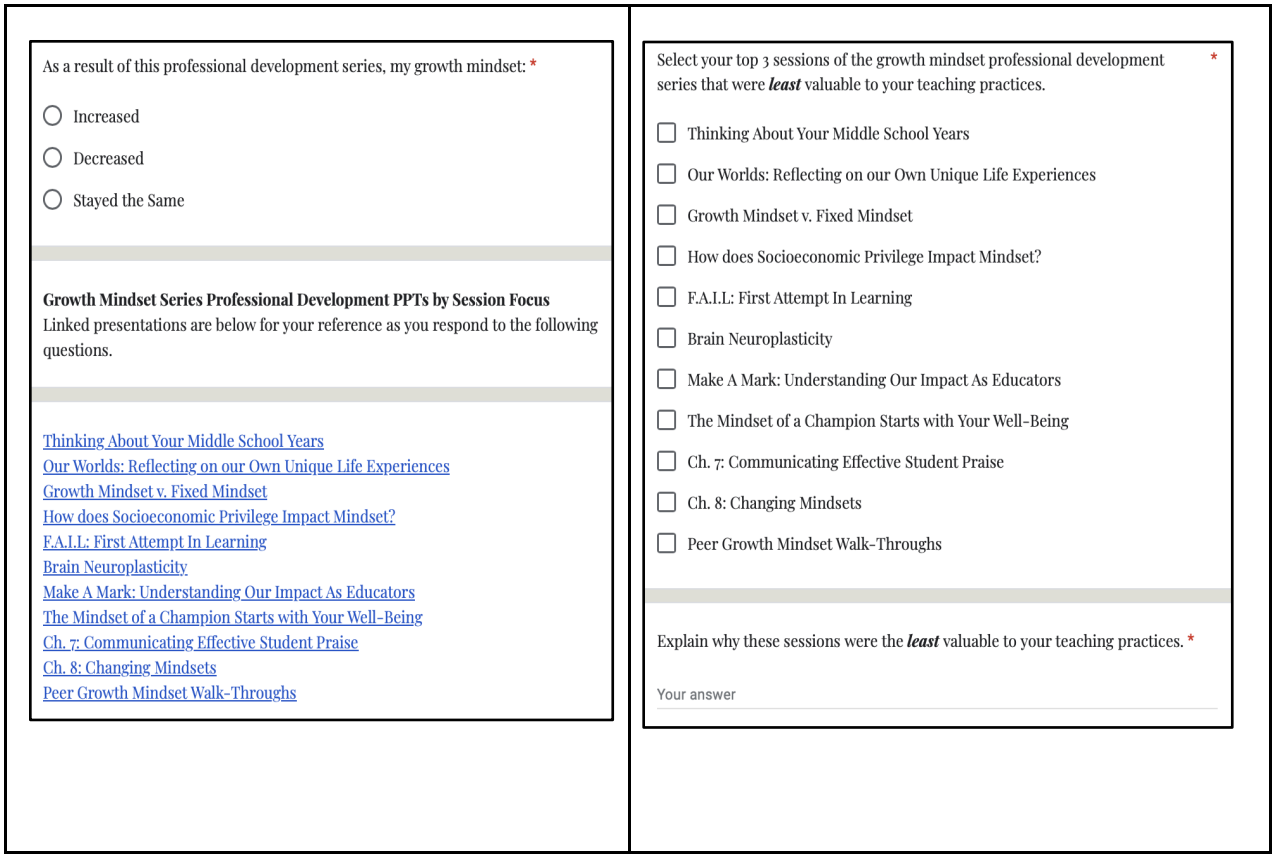
Figure C

Teacher Growth Mindset Professional Development Series Feedback Form



Select your top 3 sessions of the growth mindset professional development series that were ***least*** valuable to your teaching practices. *

- [ ] Thinking About Your Middle School Years
- [ ] Our Worlds: Reflecting on our Own Unique Life Experiences
- [ ] Growth Mindset v. Fixed Mindset
- [ ] How does Socioeconomic Privilege Impact Mindset?
- [ ] F.A.I.L: First Attempt In Learning
- [ ] Brain Neuroplasticity
- [ ] Make A Mark: Understanding Our Impact As Educators
- [ ] The Mindset of a Champion Starts with Your Well-Being
- [ ] Ch. 7: Communicating Effective Student Praise
- [ ] Ch. 8: Changing Mindsets
- [ ] Peer Growth Mindset Walk-Throughs

Explain why these sessions were the ***least*** valuable to your teaching practices. *

Your answer

What growth mindset practices are you implementing in your teaching, if any? *

- [ ] Sustained engagement of students
- [ ] Engaging students in "productive struggle" during a task's completion
- [ ] Heterogeneous (varied ability) student grouping
- [ ] Student reflection and goal setting
- [ ] Engaging students in peer to peer feedback
- [ ] Providing students with actionable teacher feedback
- [ ] Growth mindset visuals in the classroom
- [ ] Learning objectives that incorporate growth mindset
- [ ] A focus on the process that is needed to get to the product
- [ ] Opportunities for second chance learning
- [ ] Framing mistakes as learning opportunities
- [ ] None
- [ ] Other:

I believe that the growth mindset professional development series ***positively*** impacted my teaching practices. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

I believe that the growth mindset professional development series ***negatively*** impacted my teaching practices. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

Explain how this impact was positive, negative, or neutral. *

Your answer

I believe that the growth mindset PD series ***positively*** impacted how I connect with students in my classroom. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

Explain how this impact was positive, negative, or neutral. *

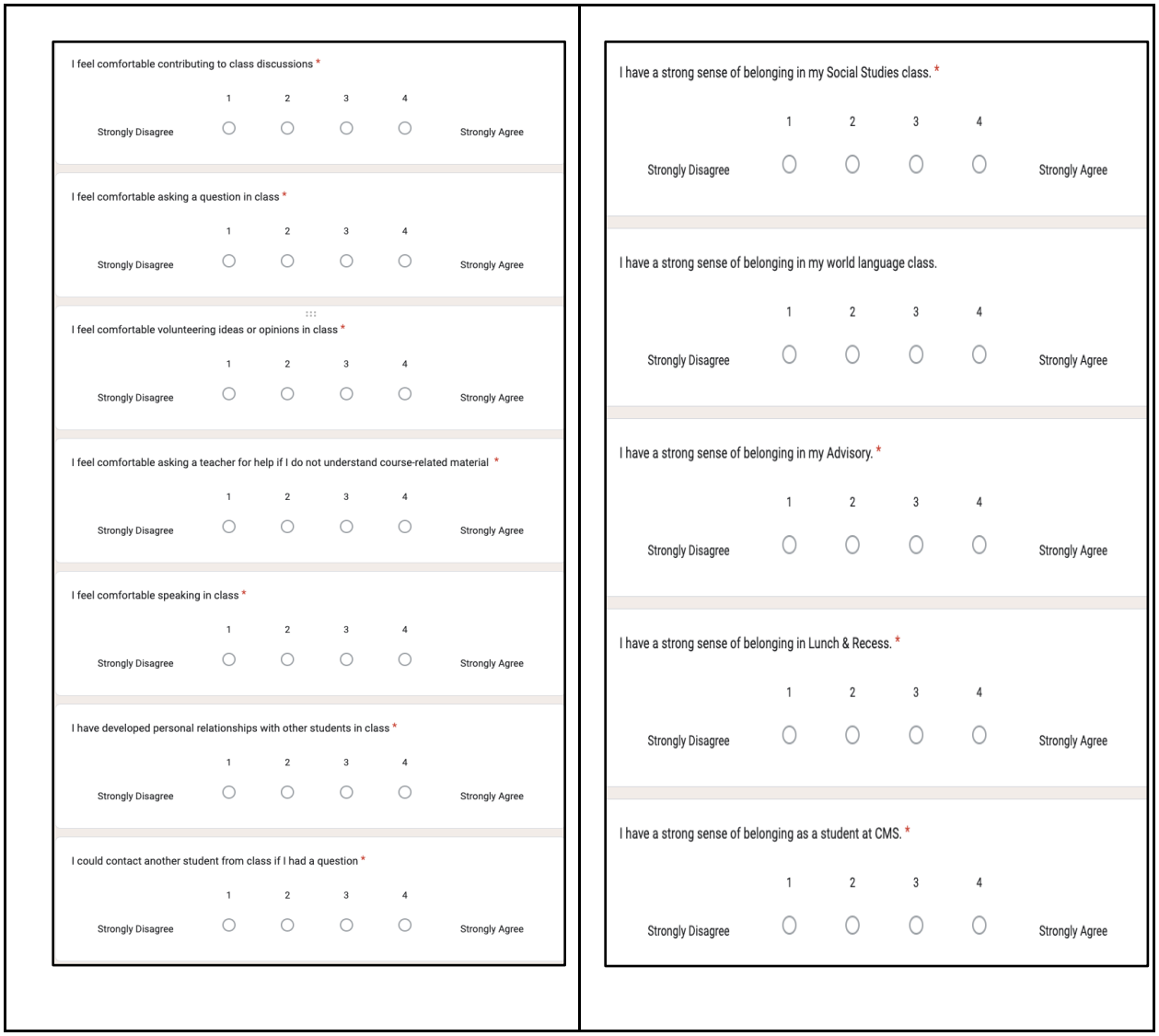
How would you rate the overall effectiveness of the growth mindset professional development series? *

Mark only one oval.

	1	2	3	4	5	
Inef	○	○	○	○	○	Highly Effective

Figure D

Student Belonging Survey



I have a strong sense of belonging in ELA / English class. *

	1	2	3	4	
Strongly Disagree	○	○	○	○	Strongly Agree

I have a strong sense of belonging in my fine art class; i.e., art, theater art, music

	1	2	3	4	
Strongly Disagree	○	○	○	○	Strongly Agree

I have a strong sense of belonging in my math class. *

	1	2	3	4	
Strongly Disagree	○	○	○	○	Strongly Agree

I have a strong sense of belonging in my performing arts classes (orchestra, band, or choir).

	1	2	3	4	
Strongly Disagree	○	○	○	○	Strongly Agree

I have a strong sense of belonging in my related arts classes (Health, PE, Tech Ed, FACS) *

	1	2	3	4	
Strongly Disagree	○	○	○	○	Strongly Agree

I have a strong sense of belonging in my reading classes (reading seminar, digital citizenship, 21st century, read and write) *

	1	2	3	4	
Strongly Disagree	○	○	○	○	Strongly Agree

I have a strong sense of belonging in my Science class. *

	1	2	3	4	
Strongly Disagree	○	○	○	○	Strongly Agree

Figure E

Capstone Student Focus Group Questions

Belonging Questions:

1. Can you tell me what it feels like when you really belong in a group, place, or team?
    a. Can you think of a time when you felt like you really belonged somewhere?
    b. Can you think of a time when you felt like you did not belong? What did this experience feel like?
2. Do you feel like you really belong in math class? What makes you feel that way?
    a. Dependent on the student's answer:
        i. Can you describe what it looks, sounds, or feels like when you belong?
        ii. Can you describe what it looks, sounds, or feels like when you don't belong?
3. What could happen in class, if anything, that would make you feel more of a sense of belonging? What would that look like or feel like for you?
4. Can you give examples of something that happened in math class that has made you feel like you belong or didn't belong in math class?

Teacher Practices and Classroom Environment:

1. How does it make you feel when your teacher talks or teaches? Does it help you feel confident, or do you feel unsure about your math class? Explain why.
2. What do you think your teacher thinks about you as a student? What makes you think that?
3. What do you think your teacher thinks about the math class? What makes you think that?
4. When you're in math class, how easy is it for you to raise your hand and ask or answer questions? Why do you feel that way?

5. What does your math teacher do in the classroom that helps you learn the material? OR Is there something your math teacher could do to help you learn the material? Give specific examples if you can.

Growth Mindset and Feedback Questions:

1. Do you think your teacher believes that you can improve and get better at math with practice? What makes you think that?
2. Does your teacher show you that they think you can succeed in math? How?
    a. Is there something more you wish they would do?
3. When your teacher gives you feedback, tips, and corrections on your math work, how do they do it?
    a. How soon do you typically receive feedback in math class? Immediately? 1 - 2 days? 3 - 4 days?
    b. Is the feedback helpful for you? How?
    c. How do you use that feedback to improve?

Wrap-Up Question:

1. Is there anything else you'd like to share about math class or your math teacher that we haven't talked about today?

Figure F

IRB Approval Letter

UNIVERSITY OF MARYLAND
INSTITUTIONAL REVIEW BOARD

1204 Marie Mount Hall
College Park, MD 20742-5125
TEL 301.405.4212
FAX 301.314.1475
irb@umd.edu
www.umresearch.umd.edu/IRB

DATE: November 19, 2024

TO: Kimberly Scaife
FROM: University of Maryland College Park (UMCP) IRB

PROJECT TITLE: [2090469-1] Ed.D. Capstone: Teacher Mindset and African American Students' Sense of Belonging in Middle School Math

SUBMISSION TYPE: New Project

ACTION: APPROVED
APPROVAL DATE: November 19, 2024

REVIEW TYPE: Expedited Review

REVIEW CATEGORY: Expedited review category #5, 7. 45CFR46.404 applies. Waiver of Parental Consent - 45 CFR 46.408(c)/45 CFR 46.116(f)(3).

Thank you for your submission of New Project materials for this project. The University of Maryland College Park (UMCP) IRB has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a project design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

Prior to final approval of this project scientific review was completed by the IRB Member reviewer.

This submission has received Expedited Review based on the applicable federal regulations.

This project has been determined to be a MINIMAL RISK project.

Please remember that informed consent is a process beginning with a description of the project and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Unless a consent waiver or alteration has been approved, Federal regulations require that each participant receives a copy of the consent document.

Please note that any revision to previously approved materials must be approved by this committee prior to initiation. Please use the appropriate Amendment forms for this procedure.

All UNANTICIPATED PROBLEMS involving risks to subjects or others (UPIRSOs) and SERIOUS and UNEXPECTED adverse events must be reported promptly to this office. Please use the appropriate reporting forms for this procedure. All FDA and sponsor reporting requirements should also be followed. All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to this office.

Please note that all research records must be retained for a minimum of seven years after the completion of the project.

If you have any questions, please contact the IRB Office at 301-405-4212 or irb@umd.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within University of Maryland College Park (UMCP) IRB's records.

Tables

Table 1

Growth Mindset (Dweck, 2006, 2016) - Professional Development Schedule

Date (SY 23-24)	Mindset by Carol Dweck Chapter Focus	Pg. #	Professional Learning	Summary
8/25	Growth Mindset Kick-Off	NA	Thinking About Your Middle School Years	Teachers grouped themselves by the year they were 12 years old. Together, they recounted the current events of the time and reflected on the impact these experiences had on their mindset then and now.
9/14	Intro to Growth Mindset	NA	Our Worlds: Reflecting on our Own Unique Life Experiences	Teachers were tasked to reflect on the demographic makeup of growing up, in college, and currently. They reflected on how the specific demographics they have experienced have impacted their mindset and worldview.
9/28	1: The Mindsets	4-14	Growth Mindset v. Fixed Mindset	Teachers reviewed the differences between growth and fixed mindset; they took a survey that measured their current level of growth mindset and reflected on the messages about GM that they are sending to their students.
10/12	2: Inside the Mindsets	15-32	How does Socioeconomic Privilege Impact Mindset?	Teachers reflected on their socioeconomic privilege using a provided checklist and how these experiences impacted how they grew up and approached adversity. It was emphasized to teachers that GM's impact on students living in poverty can be greater than it is for other students.
10/12	2: Inside the Mindsets (Mindsets Change the Meaning of Failure		F.A.I.L: First Attempt In Learning	This PD reviewed celebrations of failure and encouragement of resilience in the classroom. Those with GM seek out challenges and look for opportunities to learn. Teachers reflected on how they provided these types of opportunities for students through the use of second chance learning, emphasis on process vs. product, and no-fault failure in the classroom.
11/16	3: The Truth About Ability and Accomplishment	43-52	Brain	The science behind GM was reviewed through the explanation of neuroplasticity, or the

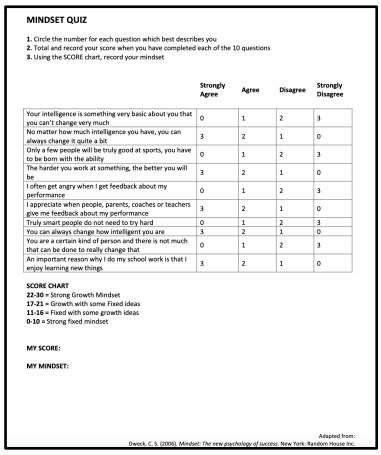
			Neuroplasticity	ability of the brain to grow and develop new neurons and continue to learn. The importance of failures/mistakes was emphasized. The learning that happens by going outside of one's comfort zone was reviewed, and teachers reflected on the messages that they are reframing classroom obstacles and helping students explore outside of their comfort zones.
11/30	3: The Truth About Ability and Accomplishment (The Danger of Praise and Positive Labels)	55-71	Stereotypes, Labels, and Assumptions	Stereotype threat and its impact on students was reviewed. The power of looking past the surface level of a person and knowing the person/student on a deeper level was emphasized. Just as there is a cultural iceberg, there is a GM iceberg with the surface level of knowledge and skills being easier to identify and change, while social role, self-image, traits, and motives are much harder to change below the surface. Teachers were asked to determine how stereotypes, assumptions, and labels play into their interactions with students in the classroom.
12/14	4: Sports the Mindset of a Champion	71-81	Make A Mark: Understanding Our Impact As Educators	Teachers reviewed fixed and growth mindset. They reflected on how they are encouraging growth in their classroom and how they might be inadvertently stifling creativity. Teachers were empowered to foster creativity, student growth, and confidence in their teaching practices.
1/11	4: Sports the Mindset of a Champion (What is Success?	82-98	The Mindset of a Champion Starts with Your Well-Being	Teachers reflected on their current mental health and mindset. A growth mindset was emphasized, encouraging teachers to push through "disillusionment" and continue to grow in their craft for the betterment of the students.
2/8	7: Parents, Teachers, and Coaches: Where Do Mindsets Come From	98-107	Ch. 7: Communicating Effective Student Praise	Praising for effort over achievement and/or "process over product" was reviewed, reminding teachers that praising effort with a GM lens was the most impactful. Teachers were given specific examples of praise for effort to try in their classroom and asked to reflect on the current messages they are sending to their students.

2/22	8: Changing Mindsets	223-264	Ch. 8: Changing Mindsets	This was a wrap-up of the Mindset book study. Teachers were asked to think about how they are encouraging GM in their classroom and what practical strategies they are using. Preparations for peer walkthroughs were also discussed. Teachers were asked for feedback about what they would hope to observe (see and hear) in a classroom that utilizes GM practices and how GM's effect could be measured.
3/7 & 3/21	Peer Walkthroughs	NA	Peer Growth Mindset Walk-Throughs	Over two days, teachers completed peer walkthroughs of two teachers. Teachers selected from a list of GM look-for and checked off those they had observed. Teachers shared glows and grows with each other and reflected on the strategies/teaching practices they could use within their classrooms.
4/4	Reflection on PD and Post-Surveys	NA	MINDSET QUIZ | UNC Advising Growth Mindset PD Feedback Form	Teachers take a post-survey using the same survey they took at the beginning of the PD series on 9/28. They use these survey results to reflect on their learning. Teachers complete the feedback form, which asks them to share which sessions they felt the most and least valuable, what GM classroom practices they have implemented, and whether the GM positively or negatively impacted their teaching practices and connections with students.

TABLE 2

Teacher Feedback Survey Questions

Research Questions	Teacher Feedback Survey Questions	Student Survey Questions
1. How do middle school math teachers' growth mindset scores change after participating in a growth mindset professional development series? 2. To what extent do middle school math teachers believe that the growth mindset professional development series has influenced their teaching practices?	● *My original and my current growth mindset is… 22-30 = Strong growth mindset = 17-21, Growth with some fixed ideas, 11-16 = Fixed with some growth ideas, 0-10 = Strong fixed mindset.* ● *As a result of this professional development series, my growth mindset…increased, decreased, remained the same.* ● *What growth mindset practices are you implementing in your teaching, if any?* ○ *Teachers chose from the following options, as many as needed:* ○ *Sustained engagement of students, Engaging students in "productive struggle" during a task's completion, Heterogeneous (varied ability) student grouping, Student reflection and goal setting, Engaging students in peer to peer feedback, Providing students with actionable teacher feedback, Growth mindset visuals in the classroom, Learning objectives that incorporate growth mindset, A focus on the process that is needed to get to the product, Opportunities for second chance learning, Framing mistakes as learning opportunities, None, Other.* ○ *b) Teachers chose from the following options to answer the below questions:* ○ *strongly disagree, disagree, agree, strongly agree.* ● *I believe that the growth mindset professional development series **positively impacted** my teaching practices.* ● *I believe that the growth mindset professional development series **negatively** impacted my teaching practices.*	*NA*

	• *I believe that the growth mindset PD series **positively** impacted how I connect with students in my classroom.* • *I believe that the growth mindset PD series **negatively** impacted how I connect with students in my classroom.*	
3. How do changes, if any, in middle school math teachers' growth mindset scores correlate with changes, if any, in African American middle school students' reported sense of belonging in the middle school math classroom?	• *I teach… math.* • *My original and my current growth mindset is… 22-30 = Strong growth mindset = 17-21, Growth with some fixed ideas, 11-16 = Fixed with some growth ideas, 0-10 = Strong fixed mindset.* • *As a result of this professional development series, my growth mindset…increased, decreased, remained the same.* 	• *Race/Ethnicity…Black/African American.* • *I have a strong sense of belonging as a student at this middle school…strongly disagree, disagree, agree, strongly agree* • *I have a strong sense of belonging in my Math class… strongly disagree, disagree, agree, strongly agree.* • *I feel comfortable asking a teacher for help if I do not understand course-related material…strongly disagree, disagree, agree, strongly agree.*
Additional Context	*Growth Mindset Walk-Through Data (figure 11)*	*NA*

MINDSET QUIZ

1. Circle the number for each question which best describes you
2. Total and record your score when you have completed each of the 10 questions
3. Using the SCORE chart, record your mindset

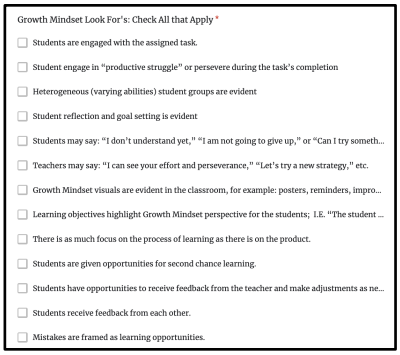
	Strongly Agree	Agree	Disagree	Strongly Disagree
Your intelligence is something very basic about you that you can't change very much	0	1	2	3
No matter how much intelligence you have, you can always change it quite a bit	3	2	1	0
Only a few people will be truly good at sports, you have to be born with the ability	0	1	2	3
The harder you work at something, the better you will be	3	2	1	0
I often get angry when I get feedback about my performance	0	1	2	3
I appreciate when people, parents, coaches or teachers give me feedback about my performance	3	2	1	0
Truly smart people do not need to try hard	0	1	2	3
You can always change how intelligent you are	3	2	1	0
You are a certain kind of person and there is not much that can be done to really change that	0	1	2	3
An important reason why I do my school work is that I enjoy learning new things	3	2	1	0

SCORE CHART
22-30 = Strong Growth Mindset
17-21 = Growth with some Fixed ideas
11-16 = Fixed with some growth ideas
0-10 = Strong fixed mindset

MY SCORE:

MY MINDSET:

Adapted from:
Dweck, C. S. (2006). *Mindset: The new psychology of success*. New York: Random House Inc.


Growth Mindset Look For's: Check All that Apply *

- Students are engaged with the assigned task.
- Student engage in "productive struggle" or persevere during the task's completion
- Heterogeneous (varying abilities) student groups are evident
- Student reflection and goal setting is evident
- Students may say: "I don't understand yet," "I am not going to give up," or "Can I try someth...
- Teachers may say: "I can see your effort and perseverance," "Let's try a new strategy," etc.
- Growth Mindset visuals are evident in the classroom, for example: posters, reminders, impro...
- Learning objectives highlight Growth Mindset perspective for the students; I.E. "The student ...
- There is as much focus on the process of learning as there is on the product.
- Students are given opportunities for second chance learning.
- Students have opportunities to receive feedback from the teacher and make adjustments as ne...
- Students receive feedback from each other.
- Mistakes are framed as learning opportunities.

- *What growth mindset practices are you implementing in your teaching, if any?*
    a. *Teachers chose from the following options, as many as needed:*

  Sustained engagement of students, Engaging students in "productive struggle" during a task's completion, Heterogeneous (varied ability) student grouping, Student reflection and goal setting, Engaging students in peer to peer feedback, Providing students with actionable teacher feedback, Growth mindset visuals in the classroom, Learning objectives that incorporate growth mindset, A focus on the process that is needed to get to the product, Opportunities for second chance learning, Framing mistakes as learning opportunities, None, Other.

  b) Teachers chose from the following options to answer the below questions:

  strongly disagree, disagree, agree, strongly agree.
- *I believe that the growth mindset professional development series **positively impacted** my teaching practices.*
- *I believe that the growth mindset professional development series **negatively** impacted my teaching practices.*

Table 3

Student Focus Group Interview Questions

Research Questions	Student Focus Group Interview Questions
4. How do African American middle school students perceive their middle school math teacher's mindset? 5. What is the relationship between how middle school African American students perceive their middle school math teachers' growth mindset and middle school African American students' sense of belonging in the middle school math classroom?	**Belonging Questions:** 1. Can you tell me what it feels like when you really belong in a group, place, or team? a. Can you think of a time when you felt like you really belonged somewhere? b. Can you think of a time when you felt like you did not belong? What did this experience feel like? 2. Do you feel like you really belong in math class? What makes you feel that way? a. Dependent on the student's answer: i. Can you describe what it looks, sounds, or feels like when you belong? ii. Can you describe what it looks, sounds, or feels like when you don't belong? 3. What could happen in class, if anything, that would make you feel more of a sense of belonging? What would that look like or feel like for you? 4. Can you give examples of something that happened in math class that has made you feel like you belong or didn't belong in math class? **Teacher Practices and Classroom Environment:** 1. How does it make you feel when your teacher talks or teaches? Does it help you feel confident, or do you feel unsure about your math class? Explain why. 2. What do you think your teacher thinks about you as a student? What makes you think that? 3. What do you think your teacher thinks about the math class? What makes you think that? 4. When you're in math class, how easy is it for you to raise your hand and ask or answer questions? Why do you feel that way? 5. What does your math teacher do in the classroom that helps you learn the material? OR Is there something your math teacher could do to help you learn the material? Give specific examples if you can. **Growth Mindset and Feedback Questions:** 1. Do you think your teacher believes that you can improve and get better at math with practice? What makes you think that? 2. Does your teacher show you that they think you can succeed in math? How? a. Is there something more you wish they would do? 3. When your teacher gives you feedback, tips, and corrections on your math work, how do they do it? a. How soon do you typically receive feedback in math class? Immediately? 1 - 2 days? 3 - 4 days? b. Is the feedback helpful for you? How? c. How do you use that feedback to improve? **Wrap-Up Question:** 1. Is there anything else you'd like to share about math class or your math teacher that we haven't talked about today?

Table 4*: % of GM Practices Observed and % of Math Teachers Implementing GM Practices*

% of GM Practices Observed and % of Math Teachers Implementing GM Practices

Growth Mindset Instructional Practice	Percent of GM Instr. Practices Observed by Peers (n = 10)	Percent of Math Teachers Reporting Implementation of GM Instr. Practices (n=7)
Framing mistakes as learning opportunities	70	100
Providing actionable teacher feedback	60	100
Engaging students in "productive struggle" during a task's completion	60	86
A focus on the process that is needed to get to the product	50	86
Opportunities for second chance learning	40	86
Engaging students in peer-to-peer feedback	20	71
Growth mindset visuals in the classroom	20	57
Heterogeneous (varied ability) student grouping	30	57
Student reflection and goal setting	30	71

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