THE GATEKEEPERS
THE ROLE OF SCHOOL LEADERSHIP ON STEM STUDENT ACHIEVEMENT

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ABSTRACT

While scholars and school leaders have investigated the diminishing diversity and quantity of the STEM pipeline, there is little empirical research on the relationship between secondary school leadership and STEM student performance. Using data from the National Center for Educational Statistics' 2009 High School Longitudinal Study-School Administrator survey, this study analyzed variables contributing to student academic outcomes. The study found a statistically significant positive relationship between school leadership and student achievement. The regression finds that variables such as school locale, public school classification, and principal certification influence student achievement as measured by enrollment in post-secondary learning institutions.

Three years ago, I entered the classrooms of Temple University's Executive Educational Leadership doctoral program. As a member of one of the inaugural classes, Cohort 3, I was immersed in a robust group of educational leaders and change agents. Three years later, after engaging in readings, rigorous discussions, and intense research, I emerged as a powerfully informed and motivated visionary ready to impact the educational landscape significantly. Completing this program would not have been possible without the prayers, encouragement, and unquestionable support of my husband, Phillip. I dedicate my dissertation to the love of my life and my best friend. Phillip, I love you beyond measure and look forward to walking into the destiny God has reserved for me with you by my side.

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CHAPTER 1

INTRODUCTION

Introduction

Carter G Woodson's classic, *The Miseducation of the Negro (1933),* rattled the nation with polarizing claims of drastic educational shortcomings for the African American population (Snyder, 2015). Because of the lack of recognition, appreciation, and incorporation of African American culture into the fibers of education, African Americans were said to be victimized by the system designed to enrich them. Woodson believed education in the African American community failed (Snyder, 2015; Orator, 1992). Years later, John Dewey (1938) wrote about identifying and using student interests to create authentic learning experiences. He believed to motivate students to learn, they had to see themselves in it (Dewey, 2012). A century later, there has been little change. Despite millions of dollars invested into reform, standardization, assessment, and support programs, there are disparities between the achievement of African American students and their Caucasian counterparts. The educational system continues to miseducate African Americans (Seiler, 2001; Ford & Moore, 2013). When students begin to progress across the spans of K-12 education, achievement gaps grow wider and educational opportunities narrow for many marginalized minority students. At every social class level, African- American students perform less well than Caucasian students. (Ogbu, 2003). Whether middle-class African American students in suburban districts or poor African American students in inner-city schools, Ogbu (2003) argues the students are not doing well. Many inner-city schools are deficient in elective course choices and void of student choice (Williams et al., 2019). Forced to accept fixed course

progressions framed by prerequisites and co-requisites, African American students have become the “silent recipients of schooling” (Seiler, 2001, p.1003).

The silence has lasting effects. Research suggests early placement in mathematics and science courses positions students for later participation in advanced Science, Technology Engineering, and Math (STEM) courses. Placed in general and remedial courses, Krakehl and Kelly (2021) found that underrepresented students are less likely to enroll in advanced mathematics and science courses. Significantly fewer African American and Hispanic students complete advanced coursework than Caucasian and Asian students. A study by Palmero et al. (2022) found that the greatest challenge was fostering African American initial course enrollment. “Schools serving predominantly high-poverty students and ethnic minorities underrepresented in STEM have limited access to advanced sciences” (Palermo et al., 2022, p.1352). From financial funding to teacher qualifications and student preparation to learner perceptions and support networks, many constricting forces have shaped the African American advanced science experience (Hart, 2020; Rodriguez & McGuire, 2019).

STEM Pipeline Shortages

Society is quickly evolving, and its demands are rapidly increasing (Cannady et al., 2014; Lee & Robbins, 2016). As students prepare for the known and unknown needs of the 21st century, there is a pronounced deficit of qualified workers (Collins, 2018). Critical thinkers, capable of advancing technology via the integration of scientific concepts and mathematical calculations, are in low supply in a time of high demand. There is an urgent need for well-trained, skilled STEM workers (Cannady et al., 2014; Camilli & Hira, 2018; Collins, 2018). Since the 1950s, leaders in education, politics,

science, and business have stressed the importance of “science literacy” to meet future needs (Jackson & Rudin, 2019). Understanding scientific concepts and their applications has become paramount to technological advancement and leadership. Science occupations are predicted to grow faster than the average rate for all other fields. According to Quinn and Crooc (2015), a significant amount of science and math training requiring a bachelor's or higher degree will be required for nine of the ten fastest-growing occupations. Because of the projected gap and STEM pipeline shortage, the President’s Council of Advisors on Science and Technology has forecasted the need for a 33% increase in annual STEM bachelor's degrees. The pipeline to produce proficient STEM workers cannot meet society’s demands (Collins, 2018; Castro & Williams, 2020).

To improve STEM achievement and remain competitive in the global market, it is critical to identify effective practices and strategies to strengthen the quality of STEM education. (Jackson & Rudin, 2019; Camilli & Hira, 2018). While many elementary classrooms strive to spark interest in STEM via engaging experiments, spirited discussions, intriguing inquiries, and active investigations, the K-12 learning progressions have diminishing effects on the STEM pipeline. “Although a student’s decision to pursue a career in the sciences is influenced by many factors- including cultural norms and stereotypes related to the field and the student’s perceived value of scientific occupations, preparation and achievement in science play key roles” (Quinn & Crooc, 2015, p.337). Economists advise that the increasing demand for science literacy will require confronting the persistent gender and racial gaps in science proficiency (Quinn & Cooc, 2015).

Minority Achievement Gaps

With approved state standards, model curricula, support resources, and instructional practices, all students should strive to reach their maximum potential in science. Instead, the opposite is true (Anderson & Ward, 2014). Whether infidelity of practice, unavailability of funding, limitations of resources, or more, science achievement is not universal for all (Archer et al., 2015; Morgan et al., 2023). Science achievement in U.S. urban schools serving high-poverty, high-minority student populations is extremely low and threatens student success (Ruby, 2006; Anderson & Ward, 2014).

Using assessments from 1969 and 1999, the U.S. National Assessment of Educational Progress (NAEP) results show that in over 30 years, there has been little consistent progress in closing racial and ethnic gaps in science achievement (Quinn & Crooc, 2015). African American and Hispanic students have less access to school resources, which promotes science achievement. They are less likely to be taught by qualified science teachers and are less likely to have exposure to the necessary science lab facilities and equipment needed by rigorous STEM curricula (Ruby, 2006; Quinn & Crooc, 2015). “Sociologists emphasize that disparities in scientific understanding and science achievement exacerbate social stratification in today’s high-tech global economy” (Quinn & Crooc, 2015, p.336).

Patterns in the 1996 and 2000 NAEP data support that scientific achievement significantly worsens under inner-city conditions. According to Ruby (2006), while 39% of students scored “Below Basic,” the percentage significantly increased when disaggregated by race. The NAEP results show almost 70% of African American and Hispanic middle school students are considered “Below Basic.” Ruby (2006) argues that

elementary and middle school students are unprepared for high school's demanding content and stringent grading policies. Because they have not mastered what is expected of them in earlier grades, they may be less able to make adequate progress in higher grades and more advanced sciences. (Ruby, 2006; Morgan et al., 2023). The lack of progress factors in minority students lagging behind their majority counterparts in achieving degrees in STEM (Nicholls et al., 2007; Archer et al., 2015).

Given in 2015 and again in 2019, the digital-based science NAEP assessment of over 90,000 students in 3900 schools provided additional evidence of shortcomings for all students (Education Week, 2021). Over the past decade, the percentage of 4th graders performing below basic rose significantly to 27%, while the "proficient or above" fell to 36%. One-third of the 8th graders were "below basic," while twice as many 12th graders performed "below basic," 41%, as compared to the "proficient" group, 22%. "Of course, it's not hard to understand why students fared so poorly--at least in part. If you have never been exposed to the material, you're unlikely to do well" (Education Week, 2021, p.2).

Representation in Mathematics and Science

There is a large disparity between the demographic composition of the U.S. population and that of STEM students (Means et al., 2017). While more than one in nine U.S. adult citizens identify as African American, less than one in twenty STEM professionals are African American (National Science Board, 2016). According to Means et al. (2017), the variance sparks concern not only for national economic competitiveness but also for individuals with limited opportunities. To address the need to increase minority representation in the STEM pipeline, many leaders are creating inclusive high school settings aimed at increasing the diversity of the student STEM population. Leaders

believe secondary schools should provide underrepresented groups with experiences that equip them academically and attitudinally to enter and stay in the STEM pipeline. Means et al. (2017) argue that a course-taking gap develops if African Americans comprise 16% of the high school population and only 8% of these students enroll in calculus. STEM course continuity not only increases the students' collegiate competitiveness but also, the courses prepare them for college-level STEM courses and occupations. A contributing factor to the secondary STEM course enrollment discrepancy is the lack of STEM course offerings in high schools with large concentrations of African Americans (Means et al., 2017, p.684).

According to the U.S. Department of Education's Office for Civil Rights (2014), one in five African American high school students attends a school without advanced placement (AP) courses. Significantly fewer African American and Hispanic students complete AP coursework than Caucasian or Asian students (Palmero et al., 2022). While enrollment in secondary science directly predicts postsecondary persistence in STEM, it also verifies the effectiveness and shortcomings of early science education. Students with lower math and reading skills are disadvantaged in science class. Because racial disparities in math and reading develop early on, students' prior achievement in these subjects may help explain science test score racial gaps (Quinn & Crooc, 2015; Morgen et al., 2023). The varied representation in math and science education is a defining characteristic of the STEM pipeline.

The 2015-2016 Civil Rights Data Collection (CRDC) describes all of the public and private school districts in the United States. Over 50.6 million students in 96,360 schools representing 17 337 districts were part of the study, and data were analyzed based

on enrollment and academic success in secondary STEM courses (CRDC, 2018). Of the sample, 15% were African American. The survey revealed significant disparities in African – American enrollment and success. As algebra is commonly referred to as a "gatekeeper course" because it is a foundational course for upper-level math and science courses, early enrollment in algebra prepares students for upper-level STEM courses. African American students constituted 17% of the student population in schools offering Algebra I in 8th grade, but only 11% of those enrolled in 8th-grade Algebra I and 9% passed the course.

The CRDC data shows that 2015-2016, "16.7 million students enrolled in 26,300 public high schools" (US Department of Education, 2018, p.5). An analysis of STEM courses in all high schools versus high African American and Hispanic enrollment showed lower STEM course offerings in schools with higher minority populations. For math sequences, from Algebra I to Advanced Mathematics and Calculus, the course offering disparities widen with course progressions. The same trend is seen in math-based science courses. Math incorporation increases as students advance from Biology to Chemistry to Physics. In high schools with large populations of African- American and Hispanic students, the availability of upper-level science classes decreases at a higher rate. One-third of the minority-dominant high schools do not offer college preparatory chemistry.

Focusing on course enrollment and race, according to the CRDC data, African American enrollment in STEM courses did not align with representation in the total population. African American students represented 16% of the total population, but 13% in advanced mathematics, 8% in Calculus, 15% in Biology, 14% in Chemistry and 12%

in Physics. Combining course availability and school demographics, the survey reveals lower participation in STEM courses for African Americans, lower enrollment, and lower positive academic outcomes for African American students.

Conclusion

According to Quinn and Crooc (2015), “The urgency of developing scientifically literate citizens stems from the demands of living in a high-tech global economy, and science achievement gaps raise concerns about equity, efficiency, and the nation’s future” (p.2). The pipeline to produce STEM thinkers capable of scientific innovation and technological advancements is not producing a diverse workforce. Throughout the K-12 education span, multiple factors shape experiences and influence STEM decisions. This research aims to inform policy and practice by identifying and analyzing contributing factors that affect student outcomes. More specifically, the relationship between school leadership and access to STEM courses is analyzed to inform building-based practice and policy.

CHAPTER 2

LITERATURE REVIEW

Introduction

Many contributing factors shape the pathway leading to enrollment in STEM courses. Whether indirect or direct relationships, school, school leader, teacher, family, and student characteristics each play a role in determining student outcomes. All components affect the ability of underrepresented and marginalized students to have enrollment opportunities and exposure to secondary STEM courses. Previous research has provided clarity on primary factors affecting African American student outcomes.

Theoretical and Conceptual Frameworks

Educational Leadership

Educational leadership is multifaceted and dynamic. One of the most defining components is vision creation. Setting and communicating direction is paramount to progression. Clear articulation is key to gaining the trust and buy-in of all organizational stakeholders. Administrative leaders must provide individualized support. Establishing a culture of listening and understanding breeds increased creativity, efficacy, and efficiency among students and teachers alike (Leithwood et al., 2019). People are willing to take risks to learn and grow. And lastly, effective educational leaders use data to drive instruction (Bigham & Riney, 2017). Consistently investing time, energy, and resources to measure the progress of teachers and students provides concrete evidence to set meaningful goals and drive instructional changes. Effective educational leaders set educational direction, develop people, and manage the instructional program (Kalkan et al., 2020).

In a study designed to examine the methods of principals to demonstrate core leadership practices while being responsive to their immediate contexts, researchers Klar and Brewer (2013) used multiple linear regression to analyze the relationship between educational leadership and student performance. Considering adverse school factors such as social, academic, and health-based needs and poverty, the study identified three high-needs public middle schools that demonstrated better-than-expected performance despite negative factors. The three schools, each from a different geographic region, were identified as showing a steady increase in academic achievement and school climate after the arrival of their school principals. Using principal, teaching, and nonteaching staff interviews, Klar and Brewer found that "the principals demonstrated a keen understanding of and responsiveness to their challenging demographic, cultural, fiscal, and political contexts while employing a core set of leadership practices" (Klar & Brewer, 2013, pp.800-801). The researchers identified the core leadership practices as setting and communicating direction and vision, developing people by modeling appropriate values and practices, redesigning the organization by aligning goal-supportive resources, and monitoring the instructional program. Klar and Brewer (2013) argued that demonstrating these practices while responding to considerations of demographic, cultural, socioeconomic, and political contexts shapes leadership quality. Simple "knowing" is not enough. Understanding "how" to lead in concert with context determines student success and positive outcomes. "A key implication is that good leaders are adept at listening to stakeholders and understanding the nuances of the contexts in which they work" (Klar & Brewer, 2013, p.801). Educational leadership is

defined by the ability to implement the major components of leadership in a culture of awareness, appreciation, and responsiveness.

Paradigms of Ethical Educational Leadership

In Ethical Leadership and Decision Making in Education: Applying Theoretical Perspectives to Complex Dilemmas, Shapiro, and Stefkovich (2016) extensively wrote on the multiple ethical paradigms as a framework of educational leadership. They organized their discussion of the conceptual framework around the paradigms of justice, critique, care, and profession. These four paradigms focus on the proposed research.

Paradigm of Justice

With a filter shaped by fairness, equity, and justice, leaders should look at issues from the perspective of "the school as a community, a concept that extends beyond the school walls and into the local community, taking into account not only students, teachers, and administrators, but also families'' (Shapiro & Stefkovich, 2022, p. 12). To understand not only the demographics of the community but also the cultural diversity of the community, school leaders should focus on equity for all. The paradigm of justice requires leaders to create learning communities that provide students with equity in treatment, equity in opportunity, and equity in supportive programming to reach their full potential. School leaders must use the justice paradigm to analyze the current district and school policies that may be restrictive to underrepresented minority groups to foster the maximum amount of fairness and equity. Leaders must understand how to use their positionality and political capital to treat all student groups fairly (Cook, 2022).

Paradigm of Critique

With the changing demographics, socio-emotional, and learning needs of educational communities, school leaders must exercise the ethic of critique. School leaders must actively "challenge the status quo by seeking an ethic that will deal with inconsistencies, formulate hard questions, and debate and challenge issues" (Shapiro & Stefkovich, 2022, p. 13). School leaders must be careful about the implicit, explicit, and complicit messages shared in comprehensive school structures and intimate classrooms. Racial segregation, patterns of economic homogeneity, and cultural exclusivities shape the neighborhoods that characterize communities and define schools. Accordingly, schools become manifestations of inequities. School leaders should create responsive policies that make "the voices of those who are silenced, particularly students" (Shapiro & Stefkovich, 2022, p. 14). The paradigm of critique requires school leaders to develop ways to empower the oppressed, underprivileged, and marginalized populations and to amplify their voices. Educators must "go beyond questioning and critical analysis to examine and grapple with those possibilities that could enable all children, whatever their social class, race, or gender, to have opportunities to gain experience, learn, and achieve" (Shapiro & Stefkovich, 2022, p.15). Using an analytical approach, leaders can create opportunities for all students to experience a fair and equal education.

Paradigm of Care

Taking every opportunity to listen, identify concerns and needs, and respond to them is a distinguishing characteristic of effective educational leadership. As leaders are often asked to make moral decisions, the traditional standardized methods of analyzing dilemmas of inequities are not optimal. The multiple voices and experiences of

stakeholders should inform the decisions. “Educational leaders need to move away from a top-down, hierarchical model for making moral and other decisions and instead turn to a leadership style that emphasizes relationships and connections” (Shapiro & Stefkovich, 2022, p. 17). Leaders must avoid exclusionary decision-making processes that silence select audiences' voices. During this age, educational leadership requires that school leaders understand the impact of their decisions and consider the benefits and the consequences of their decisions on all stakeholders. To garner buy-in and build trust, students, parents, staff, and community members must know that leaders value them, are inclusive of their needs, and genuinely want the best for them (Cook, 2022).

Paradigm of Profession

School leaders must be aware of their professional code of ethics. Lived experiences define personal values, shape filters, and outline analytical frameworks. During this time of fluid student populations, changing teacher workforces, educational supports, and politics, school leaders must combine their personal experiences, the ethics of care, justice, and critique to bring realistic meaning to broad, generalized school and district policies. Defining personal and professional codes is a dynamic process for effective school leadership. “Ethical codes set forth by the states and professional associations tend to be limited in their responsiveness in that they are removed from the day -to-day personal and professional dilemmas that educational leaders face” (Shapiro & Stefkovich, 2022, p. 22). Awareness of professional community and neighborhood standards is primary to developing effective policies that are responsive and relevant to the targeted audience. Shapiro and Stefkovich (2022) describe the educational leaders' ethics of profession should be centered upon the best interests of the students. While all

professional decisions and judgments are influenced by multiple frameworks, rules, regulations, personal experiences, and environmental pressures, the betterment of the students must be at the heart of ethical leadership.

Recognizing the application of ethical paradigms of care, justice, critique, and profession as prerequisites of effective leadership is the beginning of becoming a strong leader. Embracing the characteristics of selflessness, servant leadership, and democratic approaches are critical elements to meeting the needs of students. Using the lens of democratic, ethical leadership to analyze learning opportunities and equitable access is essential to recognizing and addressing the needs of diverse populations**.**

Relevant Empirical Research

Introduction

Researchers have focused on student STEM achievement disparities from multiple perspectives. From previous achievement to motivation, from socioeconomic status to racial identity perceptions, stereotypes, and stereotype threats, the differential achievements of student subgroups are multidimensional and dynamic.

Achievement Gaps

Since the 1950s, education, science, and policy leaders have championed the quest to increase science literacy (DeBoer, 2000). As technology advances, STEM occupations are expected to significantly increase more than any other field (Quinn & Cooc, 2015) to meet societal needs. In America, Caucasian males dominate STEM occupations. Researchers have found that females are less likely than males to declare a college STEM major, which leads to a STEM career. Quinn and Crooc (2015) found that there are significant disparities in STEM achievement by race and gender, and

"sociologists emphasize that disparities in science understanding and science achievement exacerbate social stratification "(Quinn & Crooc, 2015, p.366). Seeking to answer research questions concerning the existence of science test score gaps by gender and race/ethnicity in Grades 3, 5, and 8, Quinn and Crooc used data from a study of U.S. children's academic and social development, the NCES's Early Childhood Longitudinal Study (ECLS-99). With parental interviews, student, teacher, and principal surveys, as well as assessment data to study achievement, Quinn and Crooc tracked youth STEM achievement. In Grade 3, the researchers found significant Black-White, Hispanic-White, and Asian-White achievement gaps. While the Asian-White gap disappeared by 8th grade, the Hispanic-White gap narrowed, and the Black-White gap remained the same. From grades 3 to 8, the gender gap was small but did exhibit significant narrowing. Quinn and Crooc's study found that the "leaky" science pipeline might begin as early as the 3rd grade and suggests interventions should begin early.

Similarly, in response to a growing concern that U.S. students are not being successfully prepared for STEM careers at a rate in alignment with the country's needs, Lewis and Farkas (2017) studied science achievement using the Early Childhood Longitudinal Study, Kindergarten 1998-1999 (NCES, 2023). Understanding that 8th-grade science achievement is linked to later STEM careers, the researchers aimed to analyze predictors of science outcomes through opportunities and propensities to learn. Using an opportunity-propensity framework, they found that previous achievement and motivation affect science track placement, which determines motivation. They also found that "track placement is related to access to teachers with background education in science, student behavior in the classroom, and the quality of classroom science

equipment" (Lewis & Farkas, 2017, p.195). Further, the authors found that middle school students' science achievement is strongly determined by their socioeconomic background and, for African American and Asian students, the race of the students. From their research, Lewis and Farkas recommended K-12 STEM education reform to prevent further decline of U.S. innovation and technological competitiveness.

According to Cokley and Chapman (2007), academic achievement among African American students is an urgent issue. Their achievement is associated with various factors, from social and socioeconomic disadvantage to cultural conflict and academic preparation (Cokley & Chapman, 2007). The researchers investigated the influence of ethnic identity, racial identity, and anti-white attitudes on academic achievement. Surveying 274 African American college students, Cokley and Chapman (2007) found academic self-concept and positive attitudes of other ethnic groups were predictors of GPA. The authors also found that African American students who expressed a strong dislike for Caucasians and who did not value doing well in school had lower grades. Cokley and Chapman (2007) also found that students with more positive ethnic identities had higher academic self-concepts and grades (p.360). The researchers found a relationship between cultural identity, academic identity, and school environment.

Stereotypes and Stereotype Threats

Preconceived notions of identity, ability, performance, and potential can cause the development of stereotypes. Stereotypes are defined as a conscious belief that an individual's abilities or attributes are based on their social identity (Wang et al., 2022). The potential limitations of negative stereotypes can cause stereotype threats. A stereotype threat is "a disruptive apprehension about the possibility that one might

inadvertently confirm a negative stereotype about one's group could interfere with how well the student learns the course material" (Taylor & Walton, 2011). Taylor and Walton's (2011) study provides direct evidence that stereotype threats can cause a double jeopardy scenario for African Americans by disturbing both learning and performance environments. The threats can cause stereotyped students to perform below their capabilities and undermine their intellectual performance. Conducting two experiments on African American and Caucasian student groups in both threatening (evaluative) and non-threatening (non-evaluative) conditions, their research revealed a stereotype threat "causing poor performance by interfering with both the acquisition of academic knowledge and its retrieval" (Taylor & Walton, 2011, p.1060).

In experiment one, students studied uncommon words in threatening and non-threatening environments. Several weeks later, when participants were asked to recall word definitions, half in a nonthreatening "warm-up" and half in a threatening "test," African American students performed worse on the test than on the warm-up. While Caucasian students were unaffected, the African American students who initially studied in the threatening setting performed even worse on the warm-up. In experiment two, African American students completed a value affirmation before studying the uncommon words in a threatening environment. "Past research shows that when people reflect on personally important values, they experience less psychological threat and stress. If so, completing a value affirmation in a threatening learning environment might reduce the experience of threat among stereotyped students and help them acquire new information more effectively" (Taylor & Walton, 2011, p.1060). Taylor and Walton's study found that after the value affirmation, the African American students defined more words

correctly on the nonthreatening "warm-up" a week later than did African American students who had studied in the same setting without having completed the value affirmation. According to Taylor and Walton, experiment two eliminated the learning threat and evidenced a psychological process.

Mickelson (1990) studied psychological factors. Many African American students say that education is important and then behave in a manner contrary to their stated beliefs. Mickelson (1990) explains this paradox via a multilayered discussion of abstract and concrete attitudes. The abstract attitude is based upon the ideology that "education paves the road to social mobility and is the remedy for poverty and unemployment" (Mickelson, 1990, p.46). The abstract attitude centers on the belief that educational credentials are related to merit.

On the contrary, concrete attitudes are based upon individual realities. It is class and race-specific and is connected to lived experiences. After surveying 1,193 high school seniors in 8 public high schools, 41% of which were African American, Mickelson found that African Americans "embrace the dominant ideology about the positive links between education and mobility even more strongly than do whites" (Michelson, 1990, p.52). She also found patterns in African American concrete attitudes. "In all comparisons of class and gender cohorts, Black people's concrete attitudes are more pessimistic about education than are those of similar whites. These findings also show that middle-class students in each gender and racial subgroup are more positive about education than are their working-class peers." (Mickelson, 1990, p.53). The study's data showed that abstract values did not affect grades, while concrete attitudes positively

affected high school performance. If students believe education will benefit their future lives and situations, they will perform better in school.

The role of racial stereotypes is potent during adolescence. In a three-year longitudinal study of 2,546 adolescents aged 11-16, Wang et al. (2021) investigated the relationship of sociocultural contexts on engagement and achievement in school. The sample of African American and Caucasian participants were in 6th, 8th, and 10th grades from 17 urban public schools across the Mid- Atlantic region. The students were surveyed to analyze the effects of racial stereotypes on cognitive engagement, ability mindset (fixed or growth), and math performance. Wang et al.'s (2022) research support that both positive and negative racial stereotypes are aligned to lower mental engagement and stronger fixed mindsets. For African American adolescents, in-group academic stereotypes were linked to lower math achievement. For Caucasian students, the study also found that in-group stereotype endorsement affects math cognitive engagement and ability mindsets. "Adolescents with growth mindsets view academic ability as mutable, learning as effort-based and mastery-oriented, and academic setbacks and challenges as an inevitable part of the learning process. Thus, when students internalize in-group math ability stereotypes regardless of the valence, it is unsurprising learning-related beliefs and lower cognitive engagement because they associate their social identities with a set of immutable or fixed cognitive skills" (Wang et al., 2022, p. 994-995).

Revealing a linkage between negative stereotypes and lower math scores, Wang et al. (2022) research data supported that stereotypes could undermine stigmatized individuals' self-perceptions of academic competence and engagement. The study's findings reflect critical components of the identity-based motivation theory, which

describes how social identities frame academic mindsets and behavior. Internalized negative in-group stereotypes may influence adolescents' perceptions of content difficulty. These beliefs can lead to perceptions of limited ability and low probability of academic success. The researchers found that students believe that because of their African American identity, they are unlikely to be successful in math.

Hotchkins' (2016) qualitative case study of six African American males found racial stereotypes lead to microaggressions, which negatively affect the educational learning environment and academic outcomes. Based on prior research identifying African American males as being labeled by Caucasian teachers and administrators as disruptive and defiant, Hotchkins argues " deficient perceptions about African American students as held by White teachers and administrators serve as sources of racial micro aggressions within K–12 contexts" (Hotchkins, 2016, p.2). Caucasian teachers' stereotyping of African- American males leads to hostile learning environments, which impact academic outcomes. Hotchkins focused on student-teacher interactions and how African American males respond to racially motivated micro-aggressive behaviors. Study participants viewed Caucasian teachers as deficit thinkers who reinforced dominant stereotypes about a lack of African American male academic aptitude. Participants responded to the negative stereotypes by working harder to counteract the lowered expectations of achievement, elevated beliefs of defiance or deviance, or becoming invisible to avoid racial associations. Hotchkins' research showed that African American males were navigating an adverse learning environment characterized by stereotypes. African American males must withstand frequent racial insults, assaults, and

invalidations in the quest to learn and grow. Hotchkins concluded that the added challenges affect the process and the products of academics.

Model of Relationships

Enrollment and success in STEM secondary classes are a measure of achievement. It exemplifies an educational progression to content-rich courses requiring high degrees of active learning, higher-order questioning, and critical thinking. Because of prerequisite course completion, successful completion of STEM courses measures student outcomes. In addition to a firm K-8 educational foundation, multiple factors shape student STEM outcomes. From student to family characteristics, comprehensive school characteristics to teacher and principal characteristics, all factors indirectly or directly impact student achievement.

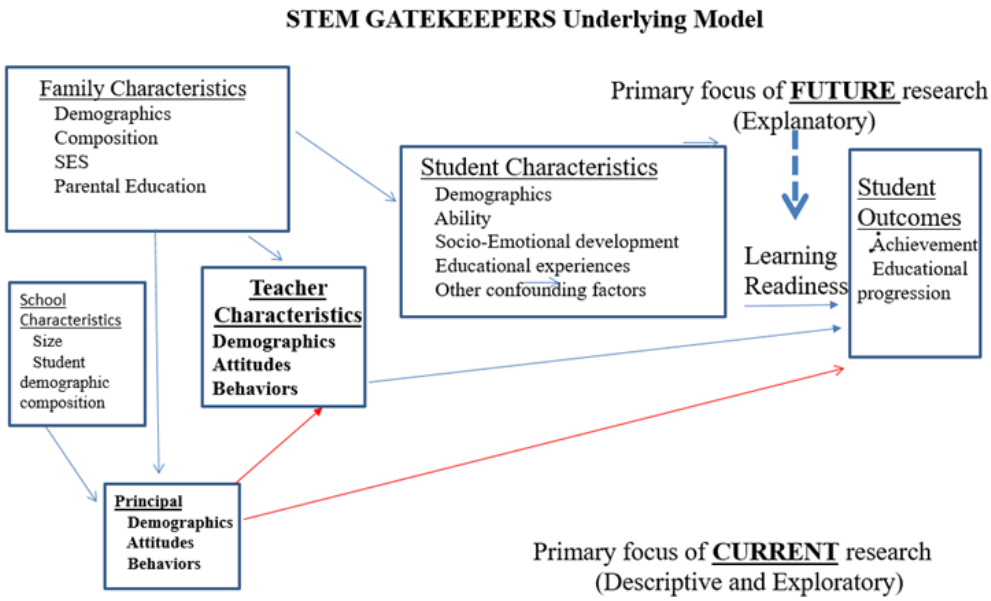

Figure 2.1. STEM Gatekeepers Model of Relationships

Understanding relationships among contributing factors allows a full understanding of the educational structure of student outcomes. Analyzing student

characteristics in combination with family and school characteristics will contextualize the framework in which teachers' and principals' characteristics affect student outcomes.

School Characteristics

The school setting serves as students' primary learning environment. Providing a space to gain exposure, take risks, and develop maturity, students embrace the school setting as the major learning vehicle. The defining features of the school have the power to shape the depth and breadth of learning experiences. According to the research of Fletcher and Moore (2021), for African American students, the combination of school and home factors commonly contributes to significant negative school experiences and adverse student outcomes. Seeking to understand the identities, experiences, and challenges of low-income, African American students, Fletcher and Moore selected a STEAM-themed career academy to conduct a case study. The researchers interviewed 30 African American male students and conducted focus groups with associated school and non-school stakeholders. "Data analysis revealed three salient themes: (a) missing critical school and home supports, (b) searching for significant relationships and role models, and (c) desiring to earn money to provide for their families" (Fletcher & Moore, 2021, p.2). The researchers found that despite having challenges of living in poverty in single-parent households, most without fathers, African American males continuously searched for African American role models in school for guidance in school and extracurricular matters. The case study Science Technology Engineering Arts and Math (STEAM) School, Johnson Academy, lacked African American administrators, teachers, and counselors to mentor the students. Regardless, the participants expressed a strong desire to take on adult roles and fill the void of a father as a provider, supporter, and encourager.

The researchers outlined school-centered recommendations to meet the needs of African American students. Recommendations focused on the critical need for schools with significant African American populations to recruit and retain African American and culturally competent teachers, school counselors, and staff. Fletcher and Moore argue that hiring staff of similar backgrounds provides students with productive and positive learning experiences. The researchers also recommend that school personnel "implement culturally sustaining and appropriate practices to engage African American males and to design curricula based on students' individualized interests is reasonable" (Fletcher & Moore, 2021, p.10)

In addition to African American role model representation, the curricular structure of the school may cause concerns for marginalized student groups. The power structure of schools has become oppressive to African American students (Seiler, 2001). Silencing and marginalizing populations, science curricula, and pedagogy have used an assimilationist perspective to identify and gauge both content mastery and qualifications for science acceleration. Even though multi-million-dollar reforms have attempted to enhance teaching and learning through structured curricula and dynamic assessments, the pedagogical frameworks ignored social, cultural, and historical contexts, leading to ineffective outcomes for African American students. "Ratcheting up conformity to the curriculum will not change the role of schools in social reproduction (Bourdieu & Passeron, 1977).

The school infrastructure creates a framework for learning. Ability grouping leads to gifted and honors pathways, college preparatory programs, vocational studies, special education spaces, and other forms of within-school tracking. This homogeneous grouping

can accentuate educational inequity and lead to racial and socioeconomic student segregation (Xu et al., 2021). Socioeconomically disadvantaged students are more likely to be assigned to lower tracks. The curricular differences lead to increased achievement gaps compared to those on higher tracks. Fletcher and Hayne's (2020) case study of 40 high school seniors and 20 alums from an urban STEAM career academy found traditional vs. college prep tracking leading to differences in educational quality. The school's demographics outlined a 98% African American population, with 100% coming from low- income families. Through a four-day study characterized by interviews and observations, research found college preparatory students have "ample opportunities to participate in out-of-school and co-curricular activities, such as field trips, college visits, dual enrollment (students earning college credits in high school) options, university laboratory experiences (working with faculty and doctoral students on research projects) at local colleges and universities, STEM and robotics clubs and competitions, and Project Lead the Way (PLTW) course curricula" (Fletcher & Haynes, 2020, p.281). The traditional track students were not afforded the same opportunities. The school within a school model led to traditional students being treated as second-class citizens without access to high-quality college preparatory resources and curricula. Researchers believe that students' negative self-perception may lead to lower motivation and college participation (Fletcher & Haynes, 2020; Xu et al., 2021).

Seeking to analyze variations by ethnicity and gender in advanced placement (AP) Physics participation and achievement, researchers Krakehl and Kelly (2021) conducted quantitative research analyzing the 2019 College Board AP Physics examination. The study's results evidence "considerable demographic disparities in

enrollment and performance in AP Physics" (Krakehl & Kelly, 2021, p.9). Because limited women and underrepresented groups take precollege Physics, it is identified as a "significant leak" in the STEM pipeline. Krakehl and Kelly argue that it is important to analyze the context to address needs. Participation results revealed that Algebra-based AP Physics provided the widest access to students. This was due to lower-level mathematical prerequisites and co-requisites. While many enrolled, many were unsuccessful. The failure rates were extremely high, suggesting underlying problems related to academic preparation for the pace and rigor of the AP course. While previous research has suggested increased achievement when classes are more exclusive and access is significantly restricted, Krakehl and Kelly (2021) argue that student self-selection may exacerbate these conditions. Students may eliminate advanced science as a viable choice based on perceived relevance, personal interest, and lack of prerequisite science and mathematics courses. Disparities exist between the quality of AP coursework and support offered at schools serving low-income and minority students and those where students learn in more affluent environments and have greater access to highly qualified teachers, rigorous curriculum, and structural supports (Palermo et al., 2022). From school personnel to school structure and curricular frameworks, school characteristics contribute to student achievement and academic outcomes.

Principal Characteristics

School leadership creates a framework for the learning environment. School leadership sets the tone for school culture and the expectations for students' behavioral and academic performance. Heck and Hallinger (2009) explored the effects of distributed leadership on school improvement and math achievement in a 4-year longitudinal study

of 195 elementary schools, including 13,389 third-grade students. Changes in school processes were recorded via teacher surveys, and student performance was measured using achievement data. The research data "found significant direct effects of distributed leadership on change in the schools' academic capacity and indirect effects on student growth rates in math" (Heck & Hallinger, 2009, p. 659). Third, the study results also suggested that teacher perceptions of distributed leadership and academic capabilities were related to student perceptions of school quality and culture. Lastly, while the research did not directly measure principal longevity, Heck and Hallinger's (2009) data evidenced a statistically significant yet small positive impact of principal stability on teacher perceptions of distributed leadership. The study supports a relationship between school leadership and academic capacity.

In Seiler's (2001) ethnography of eight African American male students, he found that most teachers and administrators spent much time making students acceptable to mainstream expectations. Seiler's findings show that, from regimented standards to mainstream culture, the tension between the goals of the school and those of the students manifests itself in multiple ways, affecting student outcomes. School leaders are positioned to effectively address the tension by unifying the educational environment and developing pathways to success. One avenue of influence is found in staffing. As school leaders play an active role in the hiring process, Fletcher and Moore (2021) recommend that school counselors play a pivotal role in assisting school administrators in recruiting and retaining counselors who reflect the student population within their school. Seiler (2001) wrote, "Mainstream science and science education can benefit and grow from the recognition and inclusion of distinctly African American ways of thinking, being, and

knowing .” (p.1012). Leaders can build educational teams that relate to, support, and encourage African American student growth.

Teacher Characteristics

Teachers are on the frontline of education. Teacher roles are multifaceted and critical to student outcomes when managing the daily planning and implementing dynamic lessons while addressing students' emotional, physical, and academic needs. Teacher preparation, retention, ongoing professional development, and support all play key roles in the overall quality of education. Whether it is funding for supplies, higher teacher salaries and benefits, or educational resources, the characteristics of teachers of African American populations play a role in student outcomes.

Race makes a difference. Although the K-12 student population is diversifying, the teaching and school counseling workforce remains mostly white (79%) and female (77%) (Fletcher & Moore, 2021). The amount of African American counselors is dismal, and the amount of African American male counselors are even more daunting. While African American males comprise 16% of the K-12 U.S. population, only 2% of all teachers are African American males. For African American students, particularly male students, the absence of educators of color is meaningful. African American male teachers bring unique lived experiences, “ dispositions, qualifications, capacities, and pedagogical performances” (Fletcher & Moore, 2021, p.2) to the classroom that engage and address African American males' conditions and needs. Engaging students in the learning process and gauging understanding and concept mastery while encouraging application and progression to higher levels are related to rapport with and respect for the teacher. Teacher characteristics are important to African American populations.

Diemer et al.'s 2016 study examined the relationships between teacher treatment and math instruction on African American students' math value, ability, and achievement self-concept. The Maryland Adolescent Development in Context Study followed 618 socioeconomically diverse African American youth (45.6% female) from 7th to 11th grade from 23 public middle schools in Prince George's County, Maryland. The study found that both math instructional strategies (relativeness and relevancy) as well as teacher differential treatment "corroded students' math beliefs and achievement over time" (Diemer et al., 2016, p. 1208). The results show that teacher discrimination also undermined students' views of their teachers.

In Muhammed and Arar's (2019) study of 630 Arab Israeli school teachers, the relationship between leadership style and teacher performance was studied. The participant sample was 65% female and 43% high school, with an average seniority of 14.48 years and 11.21 years at the present school. Using surveys to gather teacher perspectives and experience, the researchers found that teacher performance is affected by principal leadership. "Teachers' in-role performance increases as they perceive their principals' leadership style as more transformational and less transactional" (Muhammed & Arar, 2019, p.186). If building leaders promote a strong culture of valued profession, teacher satisfaction, and performance will increase. Similarly, principals should know how strongly their roles affect teachers' perceptions about their occupation and performance. While the role of teachers can affect student outcomes, so can the role of a principal.

Family Characteristics

Developmental psychologists and sociologists agree that the first socializing agent a person experiences is within their family. Family is foundational. Seeking to examine perceptions of support from significant others on African American male achievement, Clayton and Teasley (2022) conducted a mixed methods study of 139 African American male high school seniors. Results show teacher support was predictive of higher-grade point average (GPA), and family support was associated with lower GPA. Clayton and Teasley (2022) argue that familial relationships, togetherness, or bonding provide the basis of support and have a meaningful impact on students' academic potential, especially at-risk students. With an established support network, students are encouraged to seize every opportunity to maximize learning. A strong family support framework encourages students to master content and to make educated choices to participate in academically demanding courses. Clayton and Teasley's data shows that student outcomes are negatively affected by the absence of familial support.

While the family structure may take numerous forms, according to Fletcher and Moore's (2021) case study findings of the lived experiences of low-income African American males, fatherless households have a negative impact. The case study analyzed the 51% male population of Johnson Academy. The Science, Technology, Arts & Math (STEAM) school had a population of 98% African American students, and 100% came from economically disadvantaged households. The image of the father as a strong leader, provider, and role model not only serves as an anchoring influence but also provides a sense of stability and a motivation to obtain high goals and meet higher expectations. While the findings conclude that male students place greater emphasis than female

students on the need for fatherly influence and presence, the data indicates a disparity between performance from students without a consistent father figure and those with a stable father (Fletcher & Moore, 2021). It is clear that adolescents perceive fathering through a gendered lens and view themselves as lacking in the absence of a positive and stable father figure.

Despite educational reform efforts, African- American males are at increased risk for lower educational outcomes (Clayton & Teasley, 2022). African American male adolescents are still more likely to underachieve in school (Fletcher & Moore, 2021; Clayton & Teasley, 2022), so there is a pronounced need for contextual support. "African American male students tend to rely heavily on others, including kin and nonkin, to guide them and assist in the development of their beliefs about adulthood. Generally speaking, adolescents often perceive fathering through a gendered lens, and males—including those from communities of color—tend to see themselves as lacking when they do not have a positive and stable father figure in their households" (Fletcher and Moore, 2021, p. 2). African American males need behavioral support "(conceptualized as actions or behaviors that positively or negatively reinforced, monitored, rewarded, disciplined/punished, and pushed; and no action at all), *social support* (perceptions of support related to affiliations, interactions, and participation), and *guidance* (defined as advice or direction from others)" (Teasley & Clayton, 2022, p.85). Research shows family structure and support contribute to student achievement and academic outcomes.

Student Characteristics

Student characteristics build the construct of student identity. Valuing the definitions and descriptors of the learner and of the student population aids in

understanding the journey to enrolling in challenging STEM courses in secondary learning. Using data from the North Carolina Department of Public Instruction, Corra et al. (2011) argued if SATs are used as an indicator of honors and accelerated course future enrollment, African American students are less likely to meet expected projections, while Caucasian students meet and exceed expectations. "The results generally reveal race as a stronger predictor of class enrollment than gender. White students, regardless of gender, tend to enroll in advanced academic courses at a higher rate than Black students" (Corra et al., 2011, p.33). Looking at the intersection of race and gender, a greater number of African American females are motivated to enroll in honors and advanced courses as compared to African- American males. "Schools need to address issues of choice, motivation, and values as aspects of students' identities, and this was attempted in our science community" (Seiler, 2001, p.1005). Seiler's ethnography revealed that African American students' cultural styles and patterns have developed in the context of domination and oppression (Seiler, 2001). Students value their cultural and language differences. A form of social capital, the students use the differences as personal identifiers and badges of group identity. However, the school devalues the identifiers and is unsupported by school culture. Thus, it leads to negative self-perceptions and low achievement. Students who have positive self-perceptions tend to become the initiative-taking, high-achieving segment of the class. The options are quite limited for those on the opposite spectrum. "Self-efficacy is a significant predictor of achievement and persistence" (Krakehl & Kelly, 2021). While there is a vast body of research outlining the multiple student characteristics that affect student outcomes, achievement gaps,

intersections of race and gender, and stereotyping have impactful effects on STEM achievement.

Many obstacles and hurdles characterize the academic success of African American adolescent males. As compared to their Caucasian counterparts, there are growing disparities in achievement and dropout rates. According to the NCES, in 2008, almost 47% of African American adolescent males dropped out of school (Orrock & Clark, 2018). Because of these trends, there is a demand for educators to increase understanding and awareness of minority cultures. Incorporating cultural norms into intervention plans can improve retainment and academic performance. Understanding how African American males in at-risk schools learn is key to their success. Orrock and Clark (2018) conducted a qualitative study examining factors supporting successful academic achievement for African American males from at-risk populations. Using the students' lived experiences to outline contributors, researchers explore African American boys' lived experiences to determine what contributes to their success in school. The researchers analyzed where African American males received positive messages leading to academic engagement and success. Based on their findings, Orrock and Clark (2018) argue that understanding the roles and interdependence between family, school, and community explains African American male students' sense of belonging and academic engagement.

Orrock and Clark explain that pedagogy is a driving factor in promoting academic achievement. The need to be cool and show effortless learning is a strong component of the learning mindset. Educators can use caring attitudes and culturally sensitive pedagogy to create a classroom climate that encourages student involvement and critical thinking.

While discussions of socioeconomic class and single-parent households are common factors shaping the educational experience, traditional perceptions of masculinity not showing weakness or asking questions limit success outcomes. Gender identity and role conflict have powerful holds on African American boys. Many find themselves rejected by their schools because they believe they receive unfair treatment and discipline because of their identities. “This further perpetuates the academic disengagement and drop-out rates for African American males. Due to their perceived inferiority, African American males experience a sense of rejection and feel targeted by administrators” (Orrock & Clark, 2018, p.1019).

Using qualitative research to study the lived experiences of at-risk African American males, Orrock and Clark (2018) interviewed six students from two schools. Analysis of results revealed dominant themes relating to African American performance and family values, self-concept, belonging to the school community, and community support and outreach. The strongest factor was family values. “Family values such as drive, motivation, independent thinking, and strong work ethic encouraged basic skills that are required to be successful academically” (Orrock & Clark, 2018, p. 10030). The support of family was linked to both academic focus and motivation. In addition to family support, having a sense of identity, self-esteem, and confidence were important motivators. A positive self-image helps African American students overcome society’s stereotypes of “being cool” or “acting out” in school and instead ask for help and achieve more. Having a positive self-image helps African American students positively engage in academics. The third emerging theme was the sense of belonging to a school community. From relationships with students and staff to participating in athletics or active

membership in organizations, African American students who were embedded in school culture were motivated to strive for academic success. Having the support of the outside community was also important. African American males gained a sense of belonging and self-worth when neighbors and community members expressed support. African American males are motivated to achieve more because their academic success is rooted in the hope for better and change for the community.

Research Questions

While numerous factors affect the educational outcomes of African American students, the research focuses on analyzing the relationship between school leadership and student STEM outcomes. Whether honors or AP Biology, Chemistry, Physics, or Environmental Science, the research aims to identify the critical factors in school leadership that may impact STEM student outcomes. Building the framework of research are the following guiding questions:

a. How does a principal's leadership affect the school climate?

b. From the principal perspective, how does a principal's demographics affect school management?

c. From the principal perspective, what support has been provided concerning teaching STEM?

d. Controlling for confounding factors (such as student motivation, parent characteristics, etc.), what school leader factors affect student achievement?

A plausible hypothesis connecting these components is that if school leaders support diverse environments that incorporate students' interests, experiences, and needs into the learning process, then student outcomes will increase. The study will seek to

identify the influence of educational leadership on students' access to STEM courses in the secondary setting. The study will find the baseline of comparison to further analysis with the African American male subgroup.

CHAPTER 3

METHODOLOGY

Introduction

Using research questions focusing on the direct and indirect relationships of educational leadership on student outcomes, secondary data from the National Center for Education Statistics (NCES) High School Longitudinal Study of 2009 (HSLS:09) was used to study student outcomes. The study's surveys were used to identify principal characteristics that impact students who enroll in STEM courses. The surveys were analyzed to decipher pertinent principal, school, and student characteristics. School leadership characteristics included race, gender, leadership style, and more. School characteristics included location, course offerings, and supplemental programs. Student characteristics included gender, race, and course selection. Using crosstabs, ANOVAs, and regressions, relationships between principal characteristics and student achievement were studied. Descriptive analysis was used to explain and visualize relationships. The methodology leads to recommendations to inform school leader practice and policy formation.

National Center for Education Statistics

Policy and Research

To address the issue of transitioning into secondary math and science courses, HSLS:09 was divided into three research categories: math and science education, the changing environment of high school, and postsecondary education. The longitudinal study focused on how incoming 9th graders were led to early math and science courses, which affect future courses leading to STEM careers. The ongoing study seeks to inform

educational policy and practice by identifying the secondary education factors that predict STEM pipeline participation and which can be targeted to improve via policy change.

Survey Framework

The HSLS:09 study focused on 9th-grade students from across the United States enrolled in regular public, Catholic, and private schools, which contained 9th and 11th grades. Students were randomly selected to participate in the study. Accordingly, the selected students' parents, math and science teachers, and school personnel were invited to participate. An average of 25 students from each of 944 high schools were selected to be study members. While over 24,000 students were invited, 21,000 participated.

The period of the longitudinal study spans multiple years. Ninth-grade students were surveyed in the fall of 2009, and the first follow-up occurred during the spring of their eleventh-grade year. In 2016, three years after their expected graduation, the participants were surveyed to learn about their postsecondary choices. NCES has a tentative plan to survey the participants in 2025 to gather data on choices, attainment, and adulthood experiences. The survey was designed to include base-year questionnaires for multiple groups: students, parents, teachers, school counselors, and school administrators. First-year follow-up questionnaires were administered to students, parents, counselors, and school administrators. The last follow-up included a student/parent questionnaire with the projected 2025 follow-up to focus on student responses.

The Math and Science Education component of the HSLS:09 seeks to study two primary issues: the transition into math and science courses in secondary schools and the underrepresentation of high schoolers going into STEM fields. By looking at the factors

affecting early course selection and the effects of specific math and science courses on high school progression, future coursework, and postsecondary careers, HSLS:09 collected valuable data that can help policymakers boost STEM-line participation and address race and gender disparities. (NCES.ed.gov, 2023).

HSLS:09's Changing Environment of High School addresses changing demographics and educational needs. The landscape of America is changing and demanding a responsive educational system. Addressing secondary students' cultural and linguistic diversity is a primary concern in ensuring a quality education for all Americans. The HSLS:09's role was identifying and document current high school strategies to address the issue and track student outcomes.

The final component of the HSLS:09 study focuses on post-secondary education. To decipher which factors affect how students and parents make decisions about postsecondary education, the study critically examines the collegiate decisions of first-generation students. The roles of the HSLS:09 study are numerous. First, the study identifies the primary factors affecting the decision to attend college and those affecting college retention. Second, the study looks at factors affecting the selection of specific colleges. Third, the study provides information to educate parents and students on their collegiate options. And lastly, HSLS: 09 explores parental uncertainty about the college experience. HSLS:09 provides a comprehensive look at the dynamics of secondary education in response to changing demographics and societal needs. From course selection to postsecondary plans, from classroom environments to high school culture, from students to parents, teachers, counselors, and administrators, HSLS:09 provides a multiyear depiction of the state of American education.

This research aims to inform policy and practice by identifying and analyzing contributing factors that affect secondary student outcomes. More specifically, the study aims to research the relationship of school leadership with student achievement in science.

Data Collection

As the data was previously collected and made publicly available (by request), this study was exempt from the Temple University Institutional Review Board standards. The secondary analysis from a national data set did not include any descriptive or personally identifiable information. The National Center of Education Statistics, under the authority of the U.S. Department of Education, provided the relevant data under the supervision of the dissertation chair.

Data was organized into six files: School, School Administrator, Counselor, Teacher, Parent, and Student. Each of these files was composed of multiple domains with many variables. The surveys covered various topics: school STEM staffing, STEM programming and support, school demographics, school climate perceptions, principal preparation, experience, and support. The surveys were linked together to allow for comparisons between student, teacher, counselor, parent, and principal responses (NCES, 2024). Responses to these surveys were compiled using the IBM Statistical Package for Social Sciences (SPSS). The data was cleaned to address missing values and data errors deemed impossible. In several cases, items with numeric responses were recoded into grouping categories for cross-tabulation analysis. The School Administrator or Principal domain is shown in Figure 3.1 below.

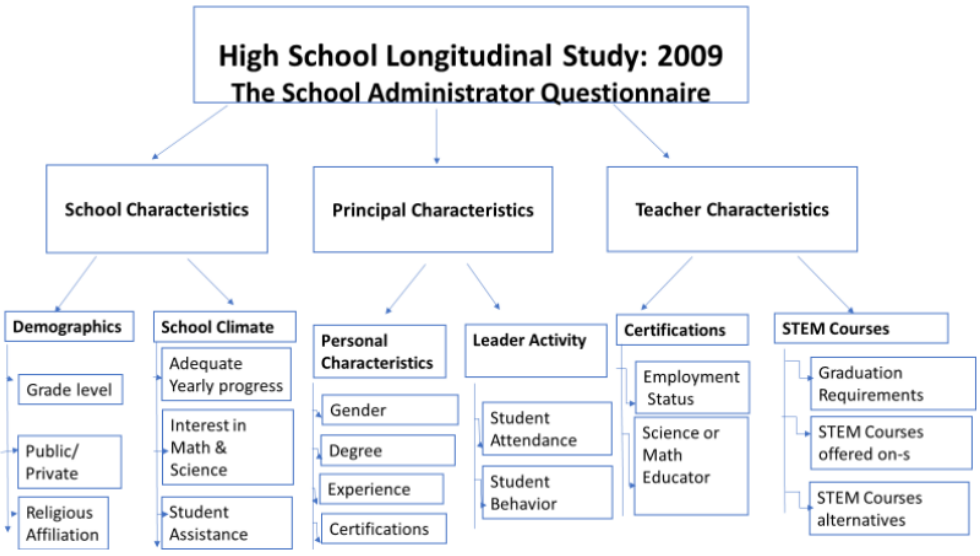

Figure 3.1.Principal/School Administrator Questionnaire

The unit of analysis was the School Administrator or Principal. The student data file provided student outcomes and was aggregated to the school to capture student achievement, especially in science related to student gender/race.

Population Descriptions

The student population was composed of a majority of White students (11,855, 56.0%), of which female students (5846, 56.0%) slightly outnumbered the male students (6009, 55.9%). African American (4130,19.5%) students comprised the second highest percentage of male students (2120,19.7%), outnumbering female students (2010, 19.3%). Hispanic students (3515, 16.6%) were the third largest group, with female students (17,51, 16.8%) outnumbering male students (1764,16.4%). Asian students (1671, 7.9%) comprised the smallest group in the study's population, with equal percentages of male (847, 7.9%) and female students (824, 7.9%). See Table 3.1 for more details.

Table 3.1. Student Population Demographics: Race and Gender

	African American	Asian	Hispanic	White	Total
Male	2120 (19.7%)	847 (7.9%)	1764 (16.4%)	6009 (55.9%)	10740 (100%)
Female	2010 (19.3%)	824 (7.9%)	1751 (16.8%)	5846 (56.0%)	10431 (100%)
Total	4130 (19.5%)	1671 (7.9%)	3515 (16.6%)	11855 (56.0%)	21171 (100%)

$X^2 = 1.03$, $p<.796$

White principals (90.3%) dominated the principal population, with male (10,061, 91.3%) principals and female (3319, 87.4%) composing the largest percentages of their respective groups. African American principals (750, 5.1%) composed the second largest group, with male principals (511, 4.6%) and female principals (239, 6.3%) representing the second largest percentage groups. Hispanic principals (590, 4.0%) comprise the third largest group, with male principals (351, 3.2%) and female principals (239, 6.3%) representing the third largest group. Asian principals (27.2%) and Native American principals (70, 0.5%) represented less than 1% of the principal population. See Table 3.2 for more details.

Table 3.2. Principal Race and Gender

	Hispanic	**White**	**African American**	**Asian**	**Native American**	**Total**
Male	351 (3.2%)	10061 (91.3%)	511 (4.6%)	27 (.3%)	70 (.6%)	11020 (100%)

Female	239 (6.3%)	3319 (87.4%)	239 (6.3%)	0 (0%)	0 (0%)	3797 (100%)
	590 (4.0%)	13380 (90.3%)	750 (5.1%)	27 (.2%)	70 (.5%)	14817 (100%)

$X^2 = 122.04$, $p < .001$

Using the Base Year (2009) data from the longitudinal study, the distribution of school administrators was disaggregated by race and gender across school locations. The principals were distributed across four location domains: city, suburb, town, and rural. The greatest percentage of principals were found in suburban (5,366, 36.2%) schools, while the least was in town (1,882, 12.7%) settings. A greater percentage of White females (1241, 37.4%) and White males (3473, 34.5%) were found in the suburbs than in the city, town, or rural locations. Hispanic female (147, 61.5%) and Hispanic male (149,42.5%) principals were found in suburban settings, while African American female (95, 39.7%) principals were found in the city. In the study's population, a greater percentage of African American male (166, 32.5%) principals were found in suburb settings. Table 3.3 outlines the distribution of school leaders by locale.

Table 3.3. *Principal Race and Gender by School Locale*

	City	Suburb	Town	Rural	Total
Hispanic Female	76 (31.8%)	147 (61.5%)	0 (0.0%)	16 (6.7%)	239 (100%)
White Female	1015 (30.6%)	1241 (37.4%)	386 (11.6%)	677 (20.4%)	3319 (100%)
African American Female	95 (39.7%)	83 (34.7%)	0 (0.0%)	61 (37.2%)	239 (100%)
Hispanic Male	133 (37.9%)	149 (42.5%)	18 (5.1%)	51 (14.5%)	351 (100%)

White Male	2480 (24.6%)	3473 (34.5%)	1452 (14.4%)	2656 (26.4%)	10061 (100%)
African American Male	166 (32.5%)	254 (49.7%)	0 (0.0%)	91 (17.8%)	511 (100%)

$X^2 = 442.28$, $p < .000$

The distribution of students was disaggregated by race and gender across school locations. The students were distributed across four location domains: city, suburb, town, and rural. The greatest percentage of students were found in suburban (7556, 35.7%) schools, while the least was in town (2532, 12.0%) settings. The city's second-largest student population was found (5,995, 28.3%), followed by rural settings (5088, 24.0%). All student races and gender groups have larger percentages of students in the suburbs than in city and rural schools. Table 3.4 outlines the distribution of students by locale.

Table 3.4. *Student Race and Gender by School Locale*

Student Race & Gender	City	Suburb	Town	Rural	Total
African American Female	591 (29.4%)	719 (35.8%)	212 (10.5%)	488 (24.3%)	2010 (100.0%)
Asian Female	256 (31.1%)	335 (40.7%)	70 (8.5%)	163 (19.8%)	824 (100.0%)
Hispanic Female	542 (31.0%)	654 (37.4%)	166 (9.5%)	389 (22.2%)	1751 (100.0%)
White Female	1582 (27.1%)	2035 (34.8%)	799 (13.7%)	1430 (24.5%)	5846 (100.0%)
African American Male	602 (28.4%)	765 (36.1%)	251 (11.8%)	502 (23.7%)	2120 (100.0%)
Asian Male	251 (29.6%)	317 (37.4%)	73 (8.6%)	206 (24.3%)	847 (100.0%)
Hispanic Male	545 (30.9%)	615 (34.9%)	165 (9.4%)	439 (24.9%)	1764 (100.0%)
White Male	1626 (27.1%)	2116 (35.2%)	796 (13.2%)	1471 (24.5%)	6009 (100.0%)

Total	5995 (28.3%)	7556 (35.7%)	2532 (12.0%)	5088 (24.0%)	21171 (100.0%)

X^2=99.88 , p<.001

Looking at the race of student respondents by the race and gender of the principals shows that Hispanic female principals had the highest percentage of Hispanic students (93, 38.9%). White female principals had the highest percentage of white students (1928, 58.1%). African American female principals had the highest percentage of African American students (98, 41.0%). Hispanic male principals had the highest percentage of Hispanic Students (179, 51.0%). White male principals had the highest percentage of white students (6265,62.3%). African American male principals had the highest percentage of white students (195,38.2%).

Table 3.5. *Principal Race and Gender by Student Respondent Race*

	African American Students	Asian Students	Hispanic Students	White Students	Total
Hispanic Female	43 (18.0%)	26 (10.9%)	93 (38.9%)	77 (32.2%)	239 (100.0%)
White Female	542 (16.3%)	312 (9.4%)	537 (16.2%)	1928 (58.1%)	3319 (100.0%)
African American Female	98 (41.0%)	30 (12.6%)	41 (17.2%)	70 (29.3%)	239 (100.0%)
Hispanic Male	50 (14.2%)	16 (4.6%)	179 (51.0%)	106 (30.2%)	351 (100.0%)
White Male	1663 (16.5%)	739 (7.3%)	1394 (13.9%)	6265 (62.3%)	10061 (100.0%)
African American Male	150 (29.4%)	65 (12.7%)	101 (19.8%)	195 (38.2%)	511 (100.0%)

X^2= 737.48, p<.001

The greatest percentage of the student respondent sample was found in the highest socioeconomic bracket or fifth quintile (5479, 25.9%), followed by the fourth quintile

(4502, 21.3%). The lowest percentage of students was found in the first quintile or lowest socioeconomic category (3375, 15.9%). White students (3585, 30.2%) had the largest percentage in the fifth quintile, the highest. The largest percentage of Asian students (703, 42.1%) were also in the highest SES category. The largest percentage of African American students (829, 20.1%) were in the second quintile, while the Hispanic students (1297, 36.9%) largest percentage were in the first quintile, the lowest socioeconomic group).

Table 3.6. *Student Respondents by Socioeconomic Quintile*

	First quintile (lowest)	Second quintile	Third quintile	Fourth quintile	Fifth quintile (highest)	Total
African American	751(18.2%)	829 (20.1%)	890 (21.5%)	873 (21.1%)	787 (19.1%)	4130 (100.0%)
Asian	182 (10.9%)	195 (11.7%)	245 (14.7%)	346 (20.7%)	703 (42.1%)	1671 (100.0%)
Hispanic	1297 (36.9%)	760 (21.6%)	600 (17.1%)	459 (13.0%)	399 (11.4%)	3515 (100.0%)
White	1145 (9.7%)	1862 (15.7%)	2439 (20.6%)	2824 (23.8%)	3585 (30.2%)	11855 (100.0%)
Total	3375 (15.9%)	3646 (17.2%)	4174 (19.7%)	4502 (21.3%)	5474 (25.9%)	21171 (100.0%)

X2= 2218.04, p<.001

Student Self Perceptions

Student Science Identity indicates how a student sees him/herself reflected in or embedded in science. Asian female students had the highest mean (2.04), while Hispanic female students had the lowest mean. The analysis is statistically significant with an F stat = 31.35 and p <0.001. Student Science Utility measures how useful or purposeful the student views science. Asian female (0.25) and male (0.25) students had the highest mean, while Hispanic male (0.22) students had the lowest mean. The findings are

statistically significant, with an F stat = 34.34 and a p<0.001. Student Science Efficacy measures students' perception of science as useful in future outcomes. Asian American male (0.25) students had the highest mean, while Hispanic females (2.33) had the lowest mean. The measure is statistically significant with an F stat = 34.29 and p<.001.

Table 3.7. *Student Self-Assessment*

		Mean	Standard Deviation	Standard Error	Minimum	Maximum	F	p
Student Science Identity	African American Female	1.73	0.95	0.021	0.00	3.60	31.36	<0.001
	Asian American Female	1.94	0.94	0.033	0.00	3.60		
	Hispanic Female	**1.61**	0.89	0.021	0.00	3.60		
	White Female	1.78	0.95	0.012	0.00	3.60		
	African American Male	1.78	0.91	0.020	0.00	3.60		
	Asian American Male	**2.04**	0.91	0.031	0.00	3.60		
	Hispanic Male	1.69	0.87	0.021	0.00	3.60		
	White Male	1.87	0.91	0.012	0.00	3.60		
	Total	1.79	0.93	0.006	0.00	3.60		
Student Science Utility	African American Female	0.23	0.06	0.001	0.00	0.33	34.35	<0.001
	Asian American Female	**0.25**	0.06	0.002	0.00	0.33		
	Hispanic Female	0.23	0.06	0.001	0.00	0.33		
	White Female	0.23	0.06	0.001	0.00	0.33		
	African American Male	0.23	0.06	0.001	0.00	0.33		

	Asian American Male	**0.25**	0.06	0.002	0.00	0.33		

Table 3.7 *(continued)*

	Hispanic Male	**0.22**	0.07	0.002	0.00	0.33		
	White Male	0.23	0.07	0.001	0.00	0.33		
	Total	0.23	0.06	0.000	0.00	0.33		
Student Science Efficacy	African American Female	2.47	0.91	0.020	0.00	4.11	34.29	<0.001
	Asian American Female	2.46	0.91	0.032	0.00	4.11		
	Hispanic Female	**2.33**	0.86	0.021	0.00	4.11		
	White Female	2.43	0.93	0.012	0.00	4.11		
	African American Male	2.62	0.86	0.019	0.00	4.11		
	Asian American Male	**2.70**	0.80	0.027	0.00	4.11		
	Hispanic Male	2.49	0.86	0.020	0.00	4.11		
	White Male	2.59	0.91	0.012	0.00	4.11		
	Total	2.51	0.90	0.006	0.00	4.11		

CHAPTER 4

RESULTS

Results

This study addressed four research questions related to principal leadership using the data from the 2009 HSLS:

1. How does a principal's leadership affect school climate?

2. From the principal perspective, how does a principal's demographics affect school management?

3. From the principal perspective, what supports have been provided concerning teaching STEM?

4. Controlling for confounding factors (such as student motivation, parent characteristics, etc.), what school leader factors affect student achievement?

Research Question #2: Leadership Demographics and School Management

Background

Shapiro and Stefkovich (2022) describe the educational leaders' ethics of profession should be centered upon the best interests of the students. Awareness of student histories and current realities and caring about student experiences and opportunities demonstrate a principal's critique, justice, care, and professionalism ethic. Leadership style and approach create spaces of acceptance, inclusion, and support. Victimized by stereotypes and oppressed by stereotype threats, African American students have demonstrated achievement gaps and limited academic opportunities. A supportive network of teachers and leaders who appreciate the African American experience can positively affect African American student experiences. Seiler (2001)

wrote, “Mainstream science and science education can benefit and grow from the recognition and inclusion of distinctly African American ways of thinking, being, and knowing.” (p.1012).

RQ2 Results

Principal Certification

African American female principals (227, 95%) had the highest certification percentage. White female (3025, 91.1%) principals and Hispanic male (320, 91.2%) principals had the second largest percentages of certification. Hispanic female (193, 80.8%) principals had the lowest percentage. The results are statistically significant (X^2= 49.48, p<0.000). See Table 4.4 for more details.

Table 4.4. *Principal Certification*

	No	Yes	Total
Hispanic Female	46 (19.2%)	193(80.8%)	239 (100%)
White Female	294 (8.9%)	3025 (91.1%)	3319 (100.0%)
African American Female	12 (5.0%)	227 (95.0%)	239 (100.0%)
Hispanic Male	31 (8.8%)	320 (91.2%)	351 (100.0%)
White Male	935 (9.3%)	9126 (90.7%)	10061 (100.0%)
African American Male	63 (12.3%)	448 (87.7%)	511 (100.0%)
Total	1381 (9.3%)	13436 (90.7%)	14817 (100.0%)

$X^2 = 49.481$, $p < .000$

Principal Experience

White female (11.87) principals had the highest mean of secondary experience with the highest standard deviation (10.32). White male (11.23) principals had the second

highest mean. Hispanic females (5.42) and African American males (5.93) had the lowest means for secondary experience. African American males had the lowest dispersion (4.97). The results are statistically significant (F stat = 54.11, p<.000). See Table 4.5 for more details.

Table 4.5. *Principal Secondary Experience*

	N	Mean	Standard Deviation	Minimum	Maximum	F	p
Hispanic Female	239	5.42	5.33	0.00	16.00	54.11	<.001
White Female	3319	11.87	10.33	0.00	39.00		
African American Female	239	9.66	9.16	0.00	26.00		
Hispanic Male	351	9.68	8.84	0.00	32.00		
White Male	10061	11.23	9.64	0.00	45.00		
African American Male	511	5.93	4.97	0.00	34.00		
X^2= 29715.69							

Principal's Focus on Discipline

African American female (6.47) principals had the highest mean and standard deviation (11.99). African American male (3.32) principals had the lowest mean. The results were statistically significant (F stat = 22.25, p <0.000). See Table 4.6 for more details.

Table 4.6. *Principal Hours Spent on Discipline*

	N	Mean	Standard Deviation	Minimum	Maximum	F	p
Hispanic Female	239	3.59	3.86	1.00	12.00	22.25	0.000

Table 4.6. *(continued)*

White Female	3319	4.14	3.77	0.00	20.00		
African American Female	239	6.47	11.99	0.00	60.00		
Hispanic Male	351	3.36	3.58	0.00	14.00		
White Male	10061	4.49	5.51	0.00	75.00		
African American Male	511	3.32	4.04	0.00	25.00		

$X^2 = 3632.28$

Principal Focus on Teacher Instruction

African American female (13.69) principals had the highest mean and standard deviation (13.63). African American male principals (11.77) had the second highest mean for hours spent on teacher instruction. The results were statistically significant (F stat = 97.78, $p<0.000$). See Table 4.7 for details.

Table 4.7. *Principal Hours Spent on Teacher Instruction*

	N	Mean	Standard Deviation	Minimum	Maximum	F	p
Hispanic Female	239	7.79	6.30	2.00	30.00	97.78	0.000
White Female	3319	9.42	6.29	0.00	50.00		
African American Female	239	13.69	13.63	0.00	60.00		

Hispanic Male	351	8.21	5.01	2.00	20.00
White Male	10061	7.81	5.64	0.00	30.00

Table 4.7. *(continued)*

African American Male	511	11.77	8.45	0.00	35.00

X^2=

21,847.66

Principal Focus on Student Meetings

African American female (7.66) principals had the highest mean and dispersion (11.80). Hispanic male (4.49) and White male (4.80) principals had the lowest hours spent with students. Hispanic male (2.57) principals had the lowest standard deviation. The results were statistically significant (F stat = 42.12, p <.000). For more details, see Table 4.8.

Table 4.8. *Principal Hours Meeting with Students*

	N	Mean	Standard Deviation	Minimum	Maximum	F	p
Hispanic Female	239	5.19	3.23	1.00	15.00	42.12	0.000
White Female	3319	5.21	3.58	0.00	20.00		
African American Female	239	7.66	11.80	0.00	60.00		
Hispanic Male	351	4.49	2.57	2.00	13.00		
White Male	10061	4.80	3.30	0.00	20.00		
African American Male	511	5.76	7.42	0.00	35.00		

X^2=

3724.64

RQ2 Conclusion

Principal demographics have a relationship with school culture. While White male and female principals had the highest amount of secondary building leadership experience, African American female principals had the highest means for certification. African American female principals had the highest means of focus on school discipline, teacher instruction, and hours spent with students. White male principals had a low mean with high dispersion when meeting with students. Certified African American female principals invested significant hours in teacher and student management to lead to positive student outcomes.

Research Question #3: Principal STEM Support

Background

STEM courses require high engagement and a large amount of critical thinking. Marrying mathematical operations with scientific concepts in an Engineering mindset to inform technology requires a knowledgeable instructor with informed STEM instructional practices and instructional resources such as anchoring texts, lab materials, and inquiry-based activities. Classrooms that support individual and group-based activities and schedules that accommodate extended lab activities are needed to give students full access to STEM activities. Principals influence building structure, classroom resources, and staff resources.

RQ3 Results

Math and Science Teachers

Hispanic male (28.33) and Hispanic female (25.70) principals had the highest means for percent of math and science teachers in their buildings. Hispanic males had the lowest standard deviation, while White male (11.50) and African American female (11.77) principals had the highest dispersion. The results were statistically significant (F stat = 9.05, p<.000). For more details, see Table 4.9.

Table 4.9. *Percent Math and Science Teachers*

	N	Mean	Standard Deviation	Minimum	Maximum	F	p
Hispanic Female	239	25.70	4.34	17.92	34.29	9.05	0.0000
White Female	3319	24.61	9.68	0.00	411.25		
African American Female	239	24.14	11.77	3.40	61.37		
Hispanic Male	351	28.33	4.14	22.61	36.59		
White Male	10061	24.48	11.50	0.00	548.33		
African American Male	511	23.32	5.03	8.33	35.45		
X^2= 6263.24							

STEM Support

Study variables measuring STEM supportive activities such as math/science fairs, STEM summer programming, afterschool STEM programs, STEM mentors, speakers, and field trips were made into a scale. African American female (6.29) principals had the highest mean. Hispanic male (6.10) principals had the second highest mean. White male

(4.90) principals had the lowest means, and white female (2.70) had the highest standard deviation. The results were statistically significant (F stat =49.14, p <.000). For more details, see Table 4.10.

Table 4.10. *Extra STEM Support*

	N	Mean	Standard Deviation	Minimum	Maximum	F	p
Hispanic Female	239	5.34	2.44	1.00	11.00	49.14	0.000
White Female	3319	5.40	2.70	0.00	11.00		
African American Female	239	6.29	2.66	1.00	11.00		
Hispanic Male	351	6.10	1.67	3.00	10.00		
White Male	10061	4.90	2.42	0.00	11.00		
African American Male	511	5.95	2.53	2.00	11.00		
X^2 = 1801.35							

Structural Support

HSLS 09 variables describing school programming designed to assist struggling students, such as tutoring, block scheduling, skills seminars, teacher assistance, and other programs to support students who may not be thriving in academic courses, were made into a scale to measure academic structural support. African American male (11.07) and female (10.98) principals had the highest means. African American females (2.33) had the lowest standard deviation. The results were statistically significant (F stat = 33.27, p<0.000). See Table 4.11 for details.

Table 4.11. *Academic Structural Support*

	N	Mean	Standard Deviation	Minimum	Maximum	F	p
Table 4.11. *(continued)*							
Hispanic Female	239	10.07	3.17	5.00	16.00	33.27	0.000
White Female	3319	10.45	3.02	2.00	18.00		
African American Female	239	10.98	2.33	5.00	14.00		
Hispanic Male	351	9.27	2.33	5.00	15.00		
White Male	10061	9.86	3.19	0.00	18.00		
African American Male	511	11.07	3.26	6.00	18.00		
X^2= 1940.33							

RQ 3 Conclusion

Minority principals offer more support to students. Hispanic male and female principals have the highest means for full-time math and science teachers. The percentage of full-time teachers describes school size and emphasizes STEM academic culture. Focusing on math and science programming, African American female and Hispanic male principals offer more science and math fairs and competitions, afterschool programs, and pair students with math and science mentors. White male principals have the lowest means. With low dispersion, African American male and female principals also offer greater student support for students struggling to thrive in their academic courses. From courses to study skill seminars to teachers of struggling students' assistance and additional tutoring, Hispanic female principals take additional measures to increase student outcomes in math and science. Overall, minority principals have

increased STEM staffing, supportive academic and extracurricular programs, and services to help students who demonstrate the need to reach positive academic outcomes.

Research Question # 4: Leadership Effect on Student Achievement

Background

Student achievement in high school is the prerequisite for enrollment in postsecondary learning institutions. From school culture to course offerings and supportive academic and extracurricular programming, high school preparation shapes student experience and self-perceptions to progress to additional learning opportunities after graduation. The HSLS-09 longitudinal study followed students from their 9th-grade year past graduation. Correlating multiple leadership factors to postsecondary enrollment provides an understanding of the effect of leadership on student achievement.

Variables Entered into Regression

The regression included 16 independent variables against the dependent variable of the percentage of students attending postsecondary educational institutions. The descriptive statistics for the variables entered in the regression are listed below in Table 4.12. See below.

Table 4.12. *Variables Studied in Regression Related to the Percent Postsecondary*

	Mean	Standard Deviation	Range
Percent Postsecondary	61.50	35.53	99.00
Hispanic Female Principal	0.01	0.11	1.00
White Female Principal	0.16	0.36	1.00
African American Female Principal	0.01	0.11	1.00
Hispanic Male Principal	0.02	0.13	1.00
African American Male Principal	0.02	0.15	1.00
Principal's Outside Support Programs of Science	3.39	2.27	8.00

Student Science Identity	1.79	0.93	3.60
Principal's Support of Teachers	1.08	0.99	3.00
Principal's Support of 9th Graders	3.25	2.09	9.00
Principal Certification	0.76	0.43	1.00

Table 4.12. *(continued)*

Rural School Location	0.36	0.48	1.00
50% Free and Reduced Lunch	0.26	0.44	0.44
5% 9th Grade Repeaters	0.18	0.38	1.00
Percent Math and Science Teachers	24.19	11.45	548.33
Percentage of Teachers Who Are Full-Time Science Teachers	8.90	5.65	40.00

Correlation Between Regression Variables

Pearson correlation coefficients were calculated to check whether multi-collinearity is an issue. The four largest coefficients were measured between the Principal's Outside Support Programs of Science and the Principal's Support of 9th Graders (0.58); Public Schools and Principal Perceptions of School Problems (0.48), Principal's Support of Teachers and Principal's Outside Support Programs of Science (0.48), Principal's Outside Support Programs of Science and Percent Postsecondary (0.41). See Table 4.13 for more details.

Table 4.13. *Variable Correlation*

Pearson correlation coefficients between variables studied in regression related to percentage of students in postsecondary																		
Variable	Hispanic Female Principal	White Female Principal	African American Female Principal	Hispanic Male Principal	African American Male Principal	Asian American Male Principal	Principal's Outside Support Programs of Science	Student Science Identity	Principal 's Support of Teachers	Principal's Support of 9th Graders	Principal Certified	Rural School Location	50% Free and Reduced Lunch	5% 9th Grade repeaters	Percent Math and Science Teachers	Public School	Principal Perceptions of School Problems	Percentage of Teachers Who Are Fulltime Science Teachers
Percent Postsecondary	0.01	0.13	-0.01	0.01	0.04	-0.04	**0.41**	0.05	0.23	0.29	**0.34**	-0.11	-0.18	-0.07	0.09	**-0.35**	**-0.33**	0.00
Hispanic Female Principal		-0.05	-0.01	-0.01	-0.02	-0.01	0.03	0.00	0.04	0.06	0.01	-0.07	0.03	0.01	0.01	-0.01	0.03	0.03
White Female Principal			-0.05	-0.06	-0.07	-0.03	0.13	0.00	0.11	0.13	0.15	-0.04	0.05	-0.01	0.02	-0.04	-0.01	0.05
African American Female Principal				-0.01	-0.02	-0.01	0.06	0.01	0.05	0.05	0.05	-0.02	0.09	0.03	0.00	0.04	-0.01	-0.01
Hispanic Male Principal					-0.02	-0.01	0.06	-0.01	0.08	0.00	0.05	-0.04	0.06	-0.01	0.05	0.01	0.01	0.06
African American Male Principal						-0.01	0.05	0.01	0.11	0.07	0.04	-0.06	0.05	0.06	-0.01	0.04	0.05	0.07
Asian American Male Principal							-0.01	-0.02	0.02	0.01	0.04	0.01	0.01	0.03	0.01	0.03	0.00	-0.03
Principal's Outside Support Programs of Science								0.02	**0.47**	**0.58**	**0.39**	-0.06	-0.02	0.01	0.04	0.03	-0.02	0.18
Student Science Identity									-0.01	-0.02	-0.03	-0.03	-0.06	-0.02	0.01	-0.05	-0.06	0.00
Principal's Support of Teachers										**0.49**	0.31	-0.06	0.13	0.10	0.01	0.11	0.10	0.13
Principal's Support of 9th Graders											**0.48**	-0.07	0.17	0.17	0.05	0.18	0.18	0.20
Principal Certified												0.08	0.12	0.09	0.02	0.26	0.18	0.09
Rural School Location													0.04	0.03	-0.04	0.18	0.12	-0.25
50% Free and Reduced Lunch														0.22	0.00	0.24	0.36	-0.03
5% 9th Grade Repeaters															0.08	0.20	0.27	0.17
Percent Math and Science Teachers																0.01	0.00	0.23
Public School																	**0.48**	0.29
Principal's Perceptions of School Problems																		0.06

Regression Findings

The regression resulted in R^2= .450, Fstat = 960.651, and p<.001. The findings were statistically significant, but the independent variables studied affect 45.0 % of the post-secondary students. Controlling for all other variables, all other things constant, the regression identified the following variables with positive relationships to postsecondary pathways with a statistical significance of p<0.001.

- If the school principal is a White Female, the percentage of students going to post-secondary education increases by 1.68 percentage points than if led by a non-white female principal.
- If the school principal is an African American Female, the percentage of students going to post-secondary education decreases by 8.48 percentage points to a non-African American female principal.

- If the school principal is an African American male, the percentage of students going to post-secondary education increases by 7.78 percentage points to a non-African male principal.
- If the school principal is an Asian male, the percentage of students going to post-secondary education decreases by 19.76 percentage points to a non-Asian Male principal.
- For everyone with more outside support activity in science, the percentage of students going to post-secondary education increases by 3.11 percentage points.
- For every degree of student science identity, the percentage of students going to post-secondary school increases by 0.63 percentage points.
- For everyone's percentage of the Principal's Support of teachers, the percentage of students going to post-secondary increases by 1.747 percentage points.
- For everyone with a higher percentage of 9th graders, the percentage of students going to post-secondary increases by 1.53 percentage points.
- Having a certified principal increases the percentage of students going to post-secondary education by 28.21 percentage points over what would be the case with a non-certified principal.
- Being located in a rural location decreases the percentage of students going to post-secondary education by 1.87 percentage points over what would be the case for urban and suburban schools.
- A school with 50% of the students eligible for free and reduced lunch decreases the percentage of students going to post-secondary education by 6.47 percentage points over what would be the case for schools with less than 50%.

- A school with 5% 9th-grade repeaters increases the percentage of students going to post-secondary education by 1.34 percentage points over what would be the case with more than 5%.
- A school with a high percentage of math and science teachers increases the percentage of students going to post-secondary education by .23 percentage points than a school without a high percentage of math and science teachers.
- A school being a public school decreases the percentage of students going to post-secondary education by 30.83% over what would be the case for nonpublic schools.
- Suppose the principal has perceptions of the school as having problems. In that case, it decreases the percentage of students going to post-secondary education by 1.50 percentage points compared to the principal, who does not perceive the school to have problems.
- For everyone with a higher percentage point increase in the number of full-time science teachers, the percentage of students going on to post-secondary schooling decreases by .074 percentage points. The percentage of students going to post-secondary education by .074%. See Table 4.14 for details.

Table 4.14. *Regression of Percent Secondary Enrollment by Variable*

Regression Variable	Regression Coefficient (B)	Beta	t
Hispanic Female Principal	0.12	0.00	0.07
White Female Principal	1.68	0.02	3.26***
African American Female Principal	-8.48	-0.03	-4.88***

Hispanic Male Principal	-2.56	-0.01	-1.78
African American Male Principal	7.78	0.03	6.48***
Asian Male Principal	-19.76	-0.04	-7.34***
Principal's Outside Support Programs of Science	3.11	0.20	29.22***
Student Science Identity	0.63	0.02	3.21***
Principal's Support of Teachers	1.75	0.05	7.87***
Principal's Support of 9th Graders	1.55	0.09	12.75***
Principal Certification	28.21	0.34	55.20***
Rural School Location	-1.87	-0.03	-4.56***
50% Free and Reduced Lunch	-6.47	-0.08	-14.07***
5% 9th Grade Repeaters	1.34	0.01	2.63****
Percent Math and Science Teachers	0.23	0.07	14.17***
Table 4.14. *(continued)*			
Public School	-30.83	-0.33	-51.18***
Principal's Perceptions of School Problems	-1.50	-0.22	-34.91***
Percentage of Teachers who are Full Time Science Teachers	-0.07	-0.01	-1.96*

R2= .450 , Fstat = 960.651,

p <.001

* = .05, ** =.01, ***= .001

****0.008

RQ4 Conclusion

Using percent enrollment in postsecondary institutions as a measure of student achievement, school leader factors affect student outcomes. A positive correlation exists between principal certification or preparation for a school leadership role and a positive effect on post-secondary enrollment. The principal's ability to supplement school programming and activities with outside partnerships and opportunities also positively impacts student post-secondary enrollment. Compared with non-public school categories, school public school classification negatively affects postsecondary enrollment. If internal problems characterize the school, there is a negative relationship with student post-secondary enrollment.

Summary

Principal leadership has an impact on the school climate. White principals composed most of the HSLS09 base year study survey respondents. Minority principals made significant efforts to produce positive student outcomes in math and science. Hispanic And African American female principals required specific math sequences on the secondary level that met or exceeded state requirements. Hispanic and African American male principals required specific science sequences that met state requirements. African American male principals invest in professional development to not only build teacher capacity on how students learn math and science but also how to spark interest in STEM courses. White principals have the lowest means for professional development investment. Data indicates that high schools led by both African American and Hispanic principals suffered from a lack of parental involvement and teacher resources. Adverse school culture and climate were also seen at higher rates in minority-

led schools. Hispanic and African American principals saw higher incidents of student abuse of teachers, student verbal abuse of teachers, and student racial tension. White principals did, however, experience a higher average of student disrespect. Correspondingly, Hispanic, and African American principals experienced the highest efflux of math and science teachers in the study's baseline.

Principal demographics affect school culture and climate. White male principals had the most experience teaching on the secondary level before entering a school leadership position. African American females had more middle school teaching experience before entering high school leadership. Minority principals had specialized student groups. African American female principals had higher percentages of Advance Placement students but higher percentages of free and reduced lunch students, Hispanic male principals had higher percentages of ELL students, and African American male principals had higher percentages of special education students. African American principals spent the most time on school management. African American female principals collaborated with teachers on instructional issues, focused on student discipline and meetings, and invested significant time in internal and external management. African American principals invested the highest means of time collaborating with the teachers on instructional quality and monitoring the halls and school lunchrooms. African American and Hispanic principals invested more time in establishing and maintaining a positive school culture and climate.

Principal demographics also had a relationship with math and science support structures. Hispanic male principals offered the most support for math and science teaching. From math and science fairs to college summer programs, afterschool

programs, and STEM mentors, Hispanic male principals demonstrated higher means for implementing STEM academic supports and applications. Hispanic females, African American females, and male principals also showed higher levels of STEM programming support. White principals demonstrated lower means and higher dispersion. They were inconsistent. Hispanic female principals also offered the most support for struggling students. From courses to study skills seminars, tutoring, and teacher assistance, Hispanic females demonstrated higher levels of support for 9th-grade students in need. African American female and male principals also strongly focused on assisting struggling freshman students.

To increase minority presence in STEM, principals support the availability of more advanced placement courses. While African American male principals have more teachers and larger schools, Hispanic male principals have more math and science teachers. While the principals support general high school science courses, general Biology, Chemistry, and Physics, African American male principals had higher AP Biology and AP Chemistry, Hispanic male principals offered AP Chemistry and AP Physics more, and Hispanic females offered AP Environmental Science and AP Physics. To increase minority presence in STEM, minority principals support offering greater higher-level science courses.

CHAPTER 5

DISCUSSION

Introduction

African American students are underrepresented in STEM-related collegiate majors and fields (Quinn & Crooc, 2015; Seiler, 2001; Krakehl & Kelly, 2021). This study sought to analyze the influence of educational leadership on access to STEM courses in the secondary setting for African American students. Student outcomes will increase if school leaders support diverse environments incorporating African American students' interests, experiences, and needs into the learning process. The study found that African American and Hispanic principals invested greater time, resources, and energy into meeting the needs of struggling students, increasing student exposure to STEM content, and extending opportunities within STEM education.

Summary of the Study

This study is a secondary analysis of the High School Longitudinal Study 2009 conducted by the National Center for Education Statistics. The fifth and only ongoing longitudinal study of school-based education, HSLS-09, surveyed students, parents, math and Science teachers, school counselors, and school administrators to gather perspectives and experiences of secondary learning. With a math and science focus, HSLS-09's math and science education focused on the issues of transitions into math and science courses in high school and the underrepresentation of high school graduates in STEM.

The principal perspective was used to analyze four research questions in this dissertation. The School Administrator Questionnaire, separated into five components outlining school characteristics, student population, teachers, course offerings, and

principal goals and background, was provided by building leaders in 944 schools representing over 23,000 students. Fourteen thousand eight hundred seventeen school administrators returned surveys, and answers were used to construct understanding through 265 variables. The variables were used to conduct a statistical analysis of four research questions to analyze the relationship between building leadership and student achievement.

Summary of Findings

The secondary analysis found statistically significant findings about building-level leadership and student achievement. The first question was focused on how principal leadership affects school climate. Hispanic female principals and African American male principals had the highest perceptions of school problems within their buildings. African American male and Hispanic male principals provided the most teacher support, while African American female and Hispanic female principals provided the most student support. The statistically significant results showed that White male principals held the highest percentage of respondents but did not provide the highest teacher and student support.

The second research question focused on the effects of principal demographics on school management. The study found that while White male and female principals had greater amounts of secondary experience, African American female principals had the highest means of certification. African American female principals spent the most hours on discipline, the most hours on improving teacher instruction, and the highest number of hours meeting with students. The statistically significant results showed that White male

principals held the highest percentage of respondents but did not provide the highest teacher and student support.

The third research question focused on building level support for teaching STEM. The results found that Hispanic male and female principals had the highest amount of full-time math and science teachers. This could provide information on the size of the school or the emphasis on math and science in their schools. The study also showed that African American female and male principals had the highest means of structural support to help struggling 9th-grade students through tutoring, block scheduling, and skills seminars. African American female principals also had the most STEM support (programs, mentors, speakers, and field trips. The statistically significant results showed that while White male principals held the highest percentage of respondents, they did not provide the highest amount of STEM or structural support.

The fourth research question focused on school leader factors that affect student achievement. The results show high degrees of correlation between Principal Outside Support Programs and Support of 9th graders, public schools and principal perception of school problems, principal support of teachers and principal outside support programs, and Principal's Outside Support of Science and Percent Enrollment in Postsecondary schools. In general, principal support of expanded or enhanced programming is related to teacher and student support, affecting post-secondary enrollment. Regression-supported variables that have the greatest effects on the percentage of students going to postsecondary institutions include having a certified principal increase enrollment by 28.21% and being enrolled in a public-school decreasing enrollment by 30.83%.

Implications

The findings from this study highlighted several key areas that school administrators can learn from the relationship between leadership and student STEM achievement. The HSLS-09 school administrator survey data has provided substantial principal perceptions of factors affecting secondary landscaping and student achievement. Educational leaders should consider these components when building effective math and science programs.

Infrastructure Affects Achievement

***School Programming*.** The School Administrator survey gathered information on school characteristics to gather information on Math and Science education. Inquiring whether or not the school has a specific math and science course sequence gives information on the strength of STEM programming in schools. The survey inquires if each school meets or exceeds minimum state requirements. To increase STEM achievement, secondary institutions must offer courses beyond minimum expectations. “Access to STEM courses in high school has been advocated as a lever by which the STEM workforce can be expanded and diversified. The idea is that exposure to more advanced STEM courses in high school will lead to more interest and success in STEM in college, which, in turn, will translate to a more robust STEM workforce” (Darolia et al., 2019, pp.22-23).

Extracurricular Programming. The HSLS Survey asks building leaders to provide information on their efforts to raise student achievement in math and science. The presence of math and science-based student-driven fairs, STEM summer programs, afterschool programs, field trips, speakers, and mentors reinforces the importance of STEM in the classrooms. It shows the importance of STEM in the real world by focusing

on its applications. Building leadership must show STEM's importance by providing learning opportunities beyond curriculum confines and district mandates. To increase the number of students, particularly students underrepresented in STEM, schools should provide students "with experiences that equip them academically and attitudinally to enter and stay in the STEM pipeline" (Means et al., 2017, p. 682).

Professional Development. School leaders are responsible for building the capacity of not only students but staff as well. The HSLS 09 questionnaire surveyed principals on their efforts to provide professional development to assist teachers in knowing how students learn math and science and how to increase interest in math and science. Effective professional development builds teachers' instructional capacity and students' learning opportunities. "These STEM instructional improvement programs boost student outcomes" (Hill et al., 2020, p.56). From state policymakers, district leadership, and building leaders, Title II funding to local funds should be invested in programs that enhance teachers' ability to recognize and meet math and science students' needs.

Paradigms of Leadership

Educational Leadership. The findings of this research can be used to inform educational policy and to build educational leadership. The findings can be used to plan and implement professional development on cultural sensitivity and meet diverse student populations' instructional needs. An ethical leader is attentive to the paradigms of leadership. Analytical building leaders must acknowledge and respond to their student populations and communities. Understanding the demographics of their population and its relationship to disaggregated course and test performance is critical to identifying instructional needs. School leaders must actively "challenge the status quo by seeking an

ethic that will deal with inconsistencies, formulate hard questions, and debate and challenge issues" (Shapiro & Stefkovich, 2022, p. 13). The findings of this study support the need for district leadership and building leadership to go beyond superficial observation and to make data-based decisions based on program offerings.

Ethics of Critique and Justice. The paradigm of justice requires leaders to create learning communities that provide students with equity in treatment, equity in opportunity, and equity in supportive programming to reach their full potential. Using the paradigms of critique and justice, school leaders must analyze the current district and school policies that may be restrictive to underrepresented minority groups to foster the maximum amount of fairness and equity. After identifying curriculum gaps and limitations across student populations, the information can be used to inform course mapping and curriculum development. The findings can be used by building and central administration to create strategic planning for personnel placement and informing programming, leading to elevated student performance on standardized testing and overall student achievement.

Ethics of Care. An ethical leader's alignment with the care paradigm helps the leader plan services to address the learning and opportunity gaps identified by the data and operationalize the findings. Using local, state, and federal funding to create and implement supportive programs, corrective programs, and extension opportunities is linked to a building leader's ability to recognize building needs and develop solutions. Being responsive to the students and incorporating the educational community's voices and experiences into the process is important. From offering afterschool tutoring or summer collegiate STEM programming, policy must be established outlining the

expectancy of going beyond the offerings of traditional course offerings to motivate students to achieve higher outcomes.

Guidance for Educational Leaders

Educational administrators can use the abovementioned implications to implement school leadership practices to increase student academic achievement and growth. Professional development is a requirement for building capacity. Principal certification is impactful on student achievement. From theory to practice, instructional leadership to managerial leadership, pedagogical preparations to experiential reflections and learning opportunities, principal certification programs build leadership capacity and impact student achievement. Hiring and supporting certified principals supports positive student outcomes.

Educational institutions should outline and provide ongoing professional development for management, instruction, and practice. The HSLS 09 study showed that professional development to increase student interest in STEM and learning STEM was not universal. In response to 21st-century workforce needs, school districts should prioritize professional development to build instructional practice and be responsive to community and societal needs.

Diversity of leadership is a key factor in being responsive to student and community needs. African American and Hispanic principals exhibited management styles that provided higher degrees of support for their teaching and student populations to achieve greater academic success. District leadership should consider their students' demographics and learning needs in hiring and principal selection. Principals should be aware and responsive to student needs.

Administrators should choose and provide instructional support at the school level inside and outside the classrooms. Building leaders are instructional leaders as well as building managers. All learning does not occur within the four walls of the classroom. School leaders should prioritize forming community partnerships to extend academic offerings and extracurricular activities beyond that defined in the traditional program of study.

Building leadership requires differentiation to meet the needs of the students. Just as gifted or honors students have opportunities to excel past the mandated STEM courses for graduation, struggling students should have support and opportunities to master missed standards and learn through a multi-faceted repertoire of academic programs.

Strengths

This research utilized a quantitative analysis of secondary data to arrive at the findings and answers to the four research questions. The data was collected via a longitudinal national study involving many high schools nationwide. The large and diverse sample size leads to significant findings and the generalizability of results. Nine hundred and forty-four principals responded to the school administrator survey during the 2009 data collection, which allowed for chi-square tests to be run using SPSS Statistical software. In five sections focusing on student characteristics, student population, schoolteachers, STEM courses offered, and principal goal and background, the questionnaire generated hundreds of data points, translating into 265 variables. The quantitative analysis of the variables produced findings and answers to research questions that can support schools in developing effective leadership approaches to increase student academic achievement and enrollment in post-secondary learning institutions.

Limitations

The National Center for Education Statistics HSLS -09 high school administrator study was used as the basis of the study. The base year questionnaire (See Appendix) contained questions that captured information about school characteristics, student population, schoolteacher courses offered, principal leadership behaviors, and principal background. The secondary analysis was limited by the information collected by the pre-selected survey questions. The survey questions resulted in 265 variables, which were analyzed using crosstabs and ANOVA tests to study means, dispersions, and relationships between principal variables. The resulting patterns were used to answer the four research questions.

The number and demographics of respondents also limited the findings of the secondary analysis. While over 944 schools were in the study, the respondents limited the reflected percentages of the principals' races and genders and the school locale. Whether suburban, urban, rural, male, female, African American, Hispanic, or White, the white male principal population was the main information provider in the returned surveys. The number of minority respondents was limited.

Further Research

The findings of this study reveal the space and need for further research. Principal race and gender were treated as 1 independent variable. Separating race from gender could reveal new understandings about the impact of each of the two independent variables. While the study reveals patterns between principal sex and gender and school climate, services, and offerings, to address the effect on African American male studies, the information should further be longitudinally studied concerning African American

male enrollment in STEM courses, relationship to school climate and culture, and student achievement. Understanding the intersection of principal leadership and student needs by race and culture will not only give a measurement of investment efficiency but also give guidance on how to increase minority enrollment in STEM courses and enhance the STEM pipeline.

Further research could involve analyzing teachers' perspectives on principal influence on students' STEM achievement. As administrators provide guidelines and frameworks for instructional programming, teachers operationalize principal directives and are in direct contact with the students. Understanding the teacher's perspectives on principal direction and support and student academic options and achievement could give additional insight into how principal leadership relates to student opportunities.

The High School Longitudinal Study is an ongoing national research project. With the base year survey administered to 9th graders in the fall of 2009, multiple data collection waves monitored student experiences. The first follow-up was given in the spring of 2012, an update was taken in the spring of the students' senior year in 2013, the second follow-up was given three years post-graduation in 2016, and another follow-up is planned for 2025 to gauge adult choices, decisions, and experiences. The opportunities for further research are limitless. Analyzing principal support across grade levels will provide information on the effects of consistency and fidelity and the changing instructional needs and support across the high school experience. Studying the students in college and adult stages could give an understanding of the principal influence on long-term applications of STEM. The dissertation study analyzed the principal influence

on STEM access at the beginning of the longitudinal study. Further research could provide information on long-term effects.

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APPENDICES

A. HSLS09 SCHOOL ADMINISTRATOR SURVEY

U.S. Department of Education High School Longitudinal Study of 2009
National
Center for Education Statistics OMB No: 1850-0852

* Questions marked with an asterisk (*) were not asked of all respondents.

SECTION A: School Characteristics
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First, we have a few questions about your school's characteristics. Some questions may request information that is time-consuming to report with exact numbers. For those questions, informed estimates are acceptable.
~~~~~~
What grades are included in [your school]?
(Check all that apply.) Pre-kindergarten Kindergarten
1st Grade
2nd Grade
3rd Grade
4th Grade
5th Grade
6th Grade
7th Grade
8th Grade
9th Grade
10th Grade
11th Grade
12th Grade
Any grade level higher than 12 Ungraded
~~~~~~

Our records indicate that [your school] is a [public/private] school. Is this correct?
No
Yes
~~~~~~

* Does this school have a religious orientation or purpose?
No
Yes
~~~~~~

* What is this school's religious orientation or affiliation?
Catholic
Christian
Jewish
Muslim or Islamic
~~~~~~

Other religious affiliation
~~~~~~

Is [your school] a single-sex school?
No
Yes
~~~~~~

Which of the following best describes [your school]? Would you say...
a regular school[-- not including magnet or charter schools]
a charter school (a school that, in accordance with an enabling state statute, has been granted a charter exempting it from selected state or local rules and regulations)
a special program school [or magnet school] --such as a science or math school, performing arts school, talented or gifted school, or a foreign language immersion school
a vocational or technical school or an alternative school (a school that offers a curriculum designed to provide nontraditional education to students -- for example, students at risk of school failure or dropout in a traditional setting)?
~~~~~~

* Is [your school]'s special focus on...
math or science or something else such as performing arts, education for talented or gifted students, or foreign language immersion?
~~~~~~

* Does [your school] participate in a public-school choice program? Do not include public school choice that is mandatory due to Adequate Yearly Progress requirements.
No
Yes
~~~~~~

* In which of the following types of public-school choice programs does your high school
participate? (Check all that apply.)
Students assigned to [your school] can choose to enroll in [your school] or another school within the district
Students can enroll in a public school in another district at no tuition cost to themselves or their families.
Students from other districts can enroll in [your school] at no tuition cost to themselves or their families
Students assigned to [your school] can choose to enroll in a private school using state or district funds
Any other public school choice program
~~~~~~

Is [your school] a year-round school?
No
Yes
~~~~~~

What kind of academic calendar does [your school] have for grades 9 through 12?
~~~~~~

Semester calendar
Trimester calendar
Quarter calendar
Other calendar
~~~~~~

How are courses scheduled in [your school] for grades 9 through 12? Would you say...
traditional scheduling only (no block scheduling)
block scheduling only, such as 4x4 or A/B, or
both traditional and block scheduling?
~~~~~~
~
* How many minutes long are courses on the traditional schedule at [your school] for grades 9 through 12?
~~~~~~

* Which of the following types of courses are block scheduled for grades 9 through 12? (Check all that apply.)
Academic courses
Vocational or technical courses
Other courses
~~~~~~

* How many minutes is each block for academic courses for grades 9 through 12?
~~~~~~

* How many minutes is each block for vocational or technical courses?
~~~~~~

* How many minutes is each block [for all other courses]?
~~~~~~

On average, how many hours of instruction per day, excluding study hall and lunch, do high school students receive at [your school]?
~~~~~~

What was the average daily attendance (ADA) for high school students in your school last year?
~~~~~~
When high school students are absent without an excuse, are parents notified?
No Yes
~~~~~~

What percentage of students attending [your school] in the 2008-2009 school year were transferred out to an alternative program or school?
~~~~~~

* Is [your school] currently identified as needing improvement due to Adequate Yearly Progress (AYP) requirements?
No Yes
~~~~~~

~~~~~~

* As of the beginning of the 2009-2010 school year, in what year of AYP improvement is [your
school]?
Year 1 School Improvement
Year 2 School Improvement
Year 3 Corrective Action
Year 4 Restructuring
Year 5 Implementation of Restructuring
~~~~~~

* At the end of the 2008-2009 school year, did [your school] make AYP?
No
Yes
~~~~~~

Does your school do any of the following to raise high school students' interest and achievement in math or science?
(Check all that apply.)
Hold school-wide math or science fairs, workshops, or competitions
Partner with community colleges or universities that offer math or science summer programs or camps for high school students
Sponsor a math or science after-school program
Pair students with mentors in math or science
Bring in guest speakers to talk to students about math or science
Take students on math- or science-relevant field trips, such as to a city aquarium or planetarium
Tell students about regional or state math or science contests, math or science websites and blogs, or other math or science programs online or in your community, such as a 21st
Century Community Learning Center program or Girls Incorporated Operation SMART
Partner with Mathematics Engineering Science Achievement (MESA) or a similar enrichment-model program in your community or state that provides math or science academic development activities and services to students
Require teacher professional development in how students learn math or science
Require teacher professional development in increasing student interest in math or science
Something else
This school does not offer any of these programs, activities, or anything similar.
~~~~~~

Does your high school offer the following programs to assist 9th graders struggling academically?
(Check all that apply.)
Summer program before entry into high school that provides supplemental instruction in reading and math
Small learning communities or Achievement Academies for over-aged students who have not met high school entry criteria
Small 9th-grade learning communities or academies separate from the rest of the school

Block scheduling, also called double-block or extended-block scheduling
Catch-up courses or “double dosing” of classes
9th grade seminar or class(es) in study skills
Specific professional development, coaches, or technical assistance for teachers working with struggling 9th graders
Tutoring
Another program
There are no programs to assist 9th graders who are struggling academically.
~~~~~~

* On what basis are 9th graders struggling academically? Is it recommended that they receive assistance?
(Check all that apply.)
Absentee record
Having poor or failing grades
Being behind on credits
Having disciplinary problems
Teacher’s referral
Counselor’s referral
Parental request
Student request
Another way
~~~~~~

SECTION B: Student Population
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We would like to ask you some questions about your school's student population. Some questions may request information that is time-consuming to report with exact numbers. For those questions, informed estimates are acceptable.
~~~~~~

What is your high school's current enrollment expressed as a percentage of capacity, such as 90 percent filled or 105 percent filled?
~~~~~~

Which of the following programs or courses does [your school] offer on-site?
(Check all that apply.)
Alternative program
Dropout prevention program
College Board Advanced Placement (AP) courses
None of these
~~~~~~

What percentage of the total student body in [your school]...
receives free or reduced-price lunch.
Are English language learners?
Receives Special Education services for students with disabilities?
Are enrolled in an alternative program [either at your school or] off-site?
Are enrolled in a dropout prevention program [either at your school or] off-site?

Are enrolled in College Board Advanced Placement (AP) courses [either at your school or] off-site?
~~~~~~

What percentage of the total student body in [your school] are members of the following groups?
Please count each student only once.
Hispanic or Latino/Latina White, non-Hispanic
Black or African American, non-Hispanic
Asian or Pacific Islander
American Indian or Alaska Native
~~~~~~

What percentage of [your school]'s 2009-2010 9th-grade class is repeating 9th grade?
~~~~~~

What percentage of 9th-grade students who were enrolled in your school in September of 2008 returned to your school in September of 2009?
~~~~~~

For the following question, your answers should sum to 100%. Please round to whole numbers and answer '0' if there are no students in a category. What percentage of last year's 12th-grade class...
went on to 4-year bachelor's degree-granting colleges?
went on to 2-year associate's degree-granting colleges or technical institutes?
entered the labor market?
joined the military? did something else?
~~~~~~

SECTION C: School's Teachers
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Now, we have a few questions about the teachers at your school. Some questions may request information that is time-consuming to report with exact numbers. For those questions, informed estimates are acceptable.
~~~~~~

How many teachers work full-time, and how many work part-time at [your school]?
full-time teachers
part-time teachers
~~~~~~

For each of the following subject areas, please indicate the number of full-time teachers and
part-time teachers that instruct high school students in [your school]. Please give your best
estimate. If a teacher works full-time in [your school] but divides their time between subject areas, consider that teacher to be part-time in each subject area.
Math (full-time)
Math (part-time)

Science (full-time)
Science (part-time)
All other subjects (full-time)
All other subjects (part-time)
~~~~~~

Of the [X] full-time and [X] part-time math teachers in [your school], how many are certified by
your state to teach math at the secondary school (9-12) level?
certified full-time high school math teachers (If none, enter 0)
certified part-time high school math teachers (If none, enter 0)
~~~~~~

Of the [X] full-time and [X] part-time high school science teachers in [your school], how many are
certified by your state to teach science at the secondary school (9-12) level?
certified full-time high school science teachers (If none, enter 0)
certified part-time high school science teachers (If none, enter 0)
~~~~~~

For the school year 2008–2009, were there high school teaching vacancies in either your math or
science departments for which teachers were recruited and interviewed?
Math vacancies only
Science vacancies only
Both math and science vacancies
No math or science vacancies
~~~~~~

* How easy or difficult was it to fill the high school teaching vacancies in the mathematics
department in your school? Would you say...
easy
somewhat difficult
very difficult or
you could not fill the vacancies in the math department?

~~~~~~

* How easy or difficult was it to fill the high school teaching vacancies in the science department
in your school? Would you say...
easy
somewhat difficult
very difficult or
Could you fill the vacancies in the science department?
~~~~~~

Does your school or district offer signing bonuses or incentives, for example, monetary bonuses,

tuition aid or tax credits to attract qualified full-time high school math teachers?
No
Yes
~~~~~~

Does your school or district offer signing bonuses or incentives, for example, monetary bonuses,
tuition aid or tax credits to attract qualified full-time high school science teachers?
No
Yes
~~~~~~

How many full-time high school math teachers who taught in your school last year (2008-2009) did
not return to teach at your school this year (2009-2010)?
~~~~~~

How many full-time high school science teachers taught in your school last year (2008-2009),
did not return to teach at your school this year (2009-2010)?
~~~~~~

What percentage of your school’s high school teachers are absent on an average day? (Please enter 0
if none.)
~~~~~~

SECTION D: Courses Offered
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Now we have a few questions about courses offered by your high school.
~~~~~~

Which of the following math and computer sciences courses are offered onsite at your high school?
(Check all that apply.)
Prealgebra
Review or Remedial Math
Integrated Math I
Integrated Math II or above
Algebra I, part 1 and part 2
Algebra I
Algebra II
Geometry
Trigonometry
Algebra III
Analytic Geometry
Calculus
AP Calculus, AB
AP Calculus, BC
~~~~~~

Calculus IB
Computer Science
AP Computer Science, A
AP Computer Science, AB
Statistics or Probability
AP Statistics
~~~~~~

* Which of the following courses are offered for credit to your school's students through other
means, such as at another high school, community college, or as an online course. (Check all that apply.)
PreAlgebra
Review or Remedial Math
Integrated Math I
Integrated Math II or above
Algebra I, part 1 and part 2
Algebra I
Algebra II
Geometry
Trigonometry
Algebra III
Analytic Geometry
Calculus
AP Calculus, AB
AP Calculus, BC
Computer Science
Calculus IB
AP Computer Science, A
AP Computer Science,
AB Statistics or Probability
AP Statistics
None of these
~~~~~~

Which of the following science courses are offered onsite at your high school? (Check all that apply.)
General Science
Physical Science
Earth Science
Environmental Science
Principles of Technology
Biology I
Life Science
Chemistry I
Physics I
Integrated Science I
Integrated Science II or above
Anatomy or Physiology
AP Environmental Science
AP or IB Advanced Biology or Biology II

AP or IB Advanced Chemistry or Chemistry I
AP or IB Advanced Physics or Physics II
Other biological sciences such as botany, marine biology, or zoology
Other physical sciences, such as astronomy or electronics
Other earth or environmental sciences, such as ecology, geology, oceanography, or meteorology
~~~~~~

* Which of the following courses are offered for credit to your school's students through other
means, such as at another high school, community college, or as an online course. (Check all that apply.)
General Science
Physical Science
Earth Science
Principles of Technology
Biology I
Life Science
Chemistry I
Physics I
Integrated Science I
Integrated Science II or above
Environmental Science
Anatomy or Physiology
AP Environmental Science
AP or IB Advanced Biology or Biology II
AP or IB Advanced Chemistry or Chemistry II
AP or IB Advanced Physics or Physics II
Other physical sciences, such as astronomy or electronics
Other biological sciences such as botany, marine biology, or zoology
Other earth or environmental sciences, such as ecology, geology, oceanography, or meteorology
None of these
~~~~~~

Does your high school offer an International Baccalaureate (IB) program?
No
Yes
~~~~~~

For the graduating class of 2013, does your high school require the completion of a specific math course or courses for graduation?
No
Yes
~~~~~~

* How would you describe the specific math course or courses your school requires for graduation?
Would you say...
the same as the math course or courses required by your State Department of Education, more advanced

than the math course or courses required by your State Department of Education or your State Department of Education does not require specific math courses for graduation?
~~~~~~

For the graduating class of 2013, does your high school require the completion of a specific
science course or courses for graduation?
No
Yes
~~~~~~

* How would you describe the specific science course or courses your school requires for
graduation? Would you say...
the same as the science course or courses required by your State Department of Education, which are more advanced than the science course or courses required by your State Department of Education, or does your State Department of Education not require specific science courses for graduation?
~~~~~~

Does your high school offer different levels of Algebra I for students who vary in ability or in
academic background, such as prior 8th-grade coursework in math?
No
Yes
~~~~~~

SECTION E: Goals and Background

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What is your sex?
Male
Female
~~~~~~

Are you of Hispanic or [Latino/Latina] origin?
No
Yes
~~~~~~

[In addition to learning about your Hispanic background, we would also like to know about your
racial background.]
Which of the following choices describes your race? You may choose more than one. (Check all that apply.)
White
Black or African American Asian
Native Hawaiian or other Pacific Islander
American Indian or Alaska Native
~~~~~~

~~~~~~

What is the highest degree you have earned?
Associate's degree
Bachelor’s degree
Master’s degree
Educational Specialist diploma
Ph.D., M.D., law degree, or other high-level professional degree
You do not have a degree
~~~~~~

* What was your major field of study for your [highest degree earned]?
(Please type your major in the space below and click on 'Search for major.' Do not enter
abbreviations.)
~~~~~~

* What was your major field of study for your bachelor’s degree?
(Please type your major in the space below and click on 'Search for Major.' Do not enter
abbreviations.)
~~~~~~
* Have you started, but not completed, any work on a degree beyond [highest degree earned]? (If you have started more than one of the degrees listed below, please select the higher degree.)
No, have not started any other degree
Yes, started, but not completed an associate’s degree
Yes, started, but not completed a bachelor’s degree
Yes, started, but not completed a master’s degree
Yes, started but not completed an Education Specialist diploma
Yes, started but not completed a Ph.D., M.D., law degree, or other high-level professional degree
~~~~~~

Before you became a principal, did you have any management experience outside of the field of education?
No
Yes
~~~~~~

Did you become a principal through alternative prep programs like New Leaders for New Schools?
No
Yes
~~~~~~

Are you currently certified as a principal in your state?
No
Yes
~~~~~~

Including this school year, how many years have you served as the principal of [your school] or any other school?
~~~~~~

Including this school year, how many years have you served as the principal of [your school]?
~~~~~~

In addition to serving as principal, are you currently teaching at [your school]?
Note: Question wording was customized in the survey instrument such that the respondent's school name appeared in place of "your school."
No
Yes
~~~~~~

[Including this school year, how /How]many years of middle school and high school teaching
experience do you have?
Middle (6-8)
Secondary (9-12)
~~~~~~

* What was the main subject that you taught at the middle school level?
English
Math
History or social studies or social science
Natural or physical sciences
Foreign languages
Physical education
Vocational education
Business
Other subject
~~~~~~

* What was the main subject that you taught at the high school level?
English
Math
History or social studies or social science
Natural or physical sciences
Foreign languages
Physical education
Vocational education
Business
Other subject
~~~~~~

In an average work week, how many hours do you spend on the following activities?
Working with teachers on instructional issues
Internal school management, such as creating weekly calendars, dealing with vendors, office
management, or writing memos

External school management, such as district or superintendent meetings, financial operations,
public relations, or communicating with decision-makers outside the school community
Student discipline or attendance
Monitoring hallways, campus, or lunchroom
Your own teaching assignments
Talking and meeting with parents
Meeting with students
Paperwork required by local, state, or federal authorities
Other work-related activities
~~~~~~

To what degree is each of the following matters a problem at [your school]?
Student tardiness
Not a problem
Minor problem
Moderate problem
Serious problem
Student absenteeism
Not a problem
Minor problem
Moderate problem
Serious problem
Student class cutting
Not a problem
Minor problem
Moderate problem
Serious problem
Teacher absenteeism
Not a problem
Minor problem
Moderate problem
Serious problem
Students dropping out
Not a problem
Minor problem
Moderate problem
Serious problem
Student apathy
Not a problem
Minor problem
Moderate problem
Serious problem
Lack of parental involvement
Not a problem
Minor problem
Moderate problem
Serious problem
Students come to school unprepared to learn
Not a problem
Minor problem
~~~~~~

Moderate problem
Serious problem
Poor student health
Not a problem
Minor problem
Moderate problem
Serious problem
Lack of resources and materials for teachers
Not a problem
Minor problem
Moderate problem
Serious problem
~~~~~~

To the best of your knowledge, how often do the following types of problems occur in your high school?
Physical conflicts among students
Daily
At least once a week
At least once a month
On occasion
Never happens
Robbery or theft
Daily
At least once a week
At least once a month
On occasion
Never happens
Vandalism
Daily
At least once a week
At least once a month
On occasion
Never happens
Student use of illegal drugs while at school
Daily
At least once a week
At least once a month
On occasion
Never happens
Student use of alcohol while at school
Daily
At least once a week
At least once a month
On occasion
Never happens
The sale of drugs on the way to or from school or on school grounds
Daily
At least once a week
At least once a month
On occasion
~~~~~~

Never happens
Student possession of weapons Daily
At least once a week
At least once a month
On occasion
Never happens
Physical abuse of teachers Daily
At least once a week
At least once a month
On occasion
Never happens
Student racial tensions
Daily
At least once a week
At least once a month
On occasion
Never happens
Student bullying
Daily
At least once a week
At least once a month
On occasion
Never happens
Student verbal abuse of teachers Daily
At least once a week
At least once a month
On occasion
Never happens
Student in-class misbehavior Daily
At least once a week
At least once a month
On occasion
Never happens
Student acts of disrespect for teachers Daily
At least once a week
At least once a month

On occasion
Never happens
Student Gang Activities Daily
At least once a week
At least once a month
On occasion
Never happens
~~~~~~
~~~~~~

B. SCALED VARIABLES

			Mean	SD	Min	Max
compute **a125ExtraSTEMSupportsacle**	A1MTHSCIFAIR	Holds math or science fairs/workshops/competitions	4.55	2.92	0	11
	A1MSSUMMER	Partners w/ college/university that offers math/science summer program.				
	A1MSAFTERSCH	Sponsors a math or science after-school program				
	A1MSMENTOR	Pairs students with mentors in math or science				
	A1MSSPEAKER	Bring in guest speakers to talk about math or science.				
	A1MSFLDTRIP	Takes students on math- or science-relevant field trips				
	A1MSPRGMS	Tells students about math/science contests/websites/blogs/other programs				
	A1MESA	Partners with MESA or a similar enrichment-model program				
	A1MSPDLEARN	Requires teacher prof development in how students learn math/science				
	A1MSPDINTRST	Requires teacher prof development in increasing interest in math/science				
	A1MSOTHER	Raises students' math/science interest/achievement in another way				
compute **a126ExtraSupportsacle**	A1G9SUMMER	pre-HS summer reading/math instruction for struggling 9th graders	9.14	4.56	0	18
	A1G9OVERAGE	Offers learning communities for over-age students lacking HS prerequisite				
	1G9COMMUNTY	Offers 9th-grade learning communities separate from the rest of the school.				
	A1G9BLOCKSCH	Offers block scheduling to assist struggling 9th graders				
	A1G9DOUBLE	Offers catch-up courses/double-dosing to assist struggling 9th graders				
	A1G9STUDY	Offers study skill seminar/class for struggling 9th graders				
	A1G9TEACHER	Offers assistance for teachers working with struggling 9th graders				
	A1G9TUTOR	Offers tutoring to assist struggling 9th graders				
	A1G9OTHRPROG	Offers another program to assist struggling 9th graders				
	A1G9NOPROG	School has no programs to assist struggling 9th graders.				
	A1G9ABSENTEE	Grade 9 academic assistance recommended based on absentee record				
	A1G9GRADES	Grade 9 academic assistance recommended based on poor/failing grades				
	A1G9BEHIND	Grade 9 academic assistance recommended based on being behind on credits				

	A1G9BEHAVE	Grade 9 academic assistance recommended based on disciplinary problems				
	A1G9TCHREF	Grade 9 academic assistance recommended based on teacher referral				
	A1G9CNSLREF	Grade 9 academic assistance recommended based on counselor referral				
	A1G9PRNTREF	Grade 9 academic assistance recommended based on parental request				
	A1G9REQUEST	Grade 9 academic assistance recommended based on student request				
	A1G9OTHER.	Grade 9 academic assistance recommendations based on something else				
Compute **prinsupprtoutsci**	A1MTHSCIFAIR	Holds math or science fairs/workshops/competitions	3.42	2.31	0	8
	A1MSSUMMER	Partners w/ college/university that offers math/science summer program.				
	A1MSAFTERSCH	Sponsors a math or science after-school program				
	A1MSMENTOR	Pairs students with mentors in math or science				
	A1MSSPEAKER	Bring in guest speakers to talk about math or science.				
	A1MSFLDTRIP	Takes students on math- or science-relevant field trips				
	A1MSPRGMS	Tells students about math/science contests/websites/blogs/other programs				
	A1MESA.	Partners with MESA or a similar enrichment-model program				
compute **prinsuprttchr** =	A1MSPDLEARN	Requires teacher prof development in how students learn math/science				
	A1MSPDINTRST	Requires teacher prof development in increasing interest in math/science				
	A1MSOTHER .	Raises students' math/science interest/achievement in another way				
compute **prin9thsupport**	A1G9SUMMER	Offers pre-HS summer reading/math instruction for struggling 9th graders	3.43	2.16	0	9
	A1G9OVERAGE	Offers learning communities for over-age students lacking HS prerequisite				
	A1G9COMMUNTY	Offers 9th-grade learning communities separate from the rest of the school.				
	A1G9BLOCKSCH	Offers block scheduling to assist struggling 9th graders				
	A1G9DOUBLE	Offers catch-up courses/double-dosing to assist struggling 9th graders				
	A1G9STUDY	Offers study skill seminar/class for struggling 9th graders				
	A1G9TEACHER	Offers assistance for teachers working with struggling 9th graders				
	A1G9TUTOR	Offers tutoring to assist struggling 9th graders				
	A1G9OTHRPROG.	Offers another program to assist struggling 9th graders				

Principal's perception of problems in the school (SchlProbPrin)	A1TARDY	Student tardiness is a problem at this school	21.34	4.66	10	36
	A1STUABSENT	Student absenteeism is a problem at this school.				
	A1CUT	Student class cutting is a problem at this school.				
	A1TCHRABSENT	Teacher absenteeism is a problem at this school.				
	A1DROPOUT	Students dropping out is a problem at this school.				
	A1APATHY	Student apathy is a problem at this school.				
	A1PRNTINV	Lack of parental involvement is a problem at this school.				
	A1UNPREP	Students coming unprepared to learn is a problem at this school.				
	A1HEALTH	Poor student health is a problem at this school.				
	A1RESOURCES.	The lack of teacher resources and materials is a problem at this school.				