# Improving African American Achievement in Geometry Honors

Submitted by

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## Abstract

This case study evaluated the significance of implementing an enrichment mathematics course during the summer to rising African American ninth graders entitled, "Geometry Honors Preview". In the past, 60 to 70 percent of African American students in this school district had withdrawn from Geometry Honors by the second academic quarter. This study seeks to understand the impact of pre-teaching core geometry concepts essential to success in Geometry Honors prior to the students' enrollment into the Geometry Honors course.

This mixed methods case study involved the researcher as a participant observer. Qualitative data in the form of questionnaires administered to teacher assistants, students, and their parents comprised a significant part of the data collection. Additional qualitative data collection included field notes, teacher's comments from report cards, and informal interviews of the instructor of the Geometry Honors Preview course. Quantitative data gathered from the four quarterly report cards completed the data collection process.

The study concluded that all of the students who enrolled in the Geometry Honors Preview course successfully completed Geometry Honors during the school year. Students felt more confident about enrolling into Geometry Honors after taking the preview course. Finally, African American students who enrolled in the Geometry Honors Preview course outperformed a group of African American students who enrolled into Geometry Honors, but did not attend the summer course. Using current research into the topic of closing the achievement gap, the study suggested that these findings would help improve the practice of teachers and implement policy that will provide all students with an equal opportunity to learn in an environment of high-stakes testing.

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# Chapter 1

## Overview of the Study

### I. Introduction

One of the most complex problems facing public education today is closing the achievement gap that exists between various ethnic groups. Beneath the achievement gap umbrella lies multiple disparities in areas such as reading, writing and access to technology. This study will analyze the achievement gap in mathematics, in particular, a ninth grade Geometry Honors course offered at an urban-suburban high school.

According to the National Council of Teachers of Mathematics (NCTM) Achievement Gap Task Force, the achievement gap is defined as, "An indicator of disparities between groups of students usually identified (accurately or not) by racial, ethnic, linguistic, or socioeconomic class with regard to a variety of measures (attrition and enrollment rates, drug use, health, alienation from school and society, attitudes towards mathematics, as well as test scores)" (Force, 2004). More importantly, the task force further states, "It is important to recognize that the achievement gap is not a result of membership in any group, but rather is the result of the systematic mistreatment of learners caused by racial and class bias – conscious and unconscious, blatant and subtle, personal and institutionalized." (Force, 2004)

The origin of the achievement gap can be traced as far back as the first day Africans were brought to America during the slave trade. Slaves were not educated because plantation owners were in constant fear of slave revolts. Hence between 1800 and 1835 southern states made it a crime to educate slaves (Spring, 2007). Moreover, African Americans endured many acts by Whites after the Civil War to limit their opportunity to learn, that included underfunding their schools and educational segregation (Spring, 2007).

One of the defining moments in Civil Rights history that impacted public education for African Americans was the ruling by the United States Supreme Court in 1954 to end racial segregation in public schools with their landmark decision in Brown vs. The Board of Education of Topeka, Kansas (Ogbu, 2003). The unanimous ruling sent a strong message to the country that segregating students in public schools based on race was a violation of the 14th Amendment to the United States Constitution because separate educational facilities are inherently unequal. Although guidelines for eradicating segregation were outlined and school boards were advised to proceed "with all deliberate speed", it took several years before integration came to fruition. This was evident three years later in 1957 when the governor of Arkansas, Orval Faubus, took action to deny Black students from attending Little Rock's Central High School. As a result, the federal government had to intervene and deploy military troops to ensure the safety of nine brave students who were among the first to break the barrier of segregation in the South. These Black students later became known as the "The Little Rock Nine".

The goal of integrating schools was to provide African American students with an opportunity to learn in an educational environment equal to that of their white counterparts. Based upon African Americans' dismal performance on standardized mathematics tests such as the National Assessment of Educational Progress (NAEP) and Scholastic Aptitude Test (SAT) and their low enrollment in advanced level mathematics courses, this goal has not been achieved. These facts coupled with high dropout rates for African American students have created a sense of urgency to act immediately.

In fact, President George Bush signed the "No Child Left Behind" Act of 2001 into law on January of 2002 in an effort to close the achievement gap that has plagued public education since its inception. Unfortunately, "No Child Left Behind" has been very divisive amongst

policymakers, educators, parents and students. This criticism from most educators is due in part to the lack of funding that was promised, goals and expectations that most public educational leaders believe are unattainable given their circumstances, and the punitive consequences that does more harm to students than good. While numerous studies have shown significant disparities between the academic performances of African American and White students, there is no clear consensus on the causes. Moreover, the explanation as to the root of the problem lies within one's ideological beliefs.

According to Mano Singham, ideological beliefs regarding the achievement gap fall into three models: socioeconomic, sociopathological and the genetic (Singham, 1998). The socioeconomic model attributes the cause of the disparities in academic performance to socioeconomic disparities. Followers of the socioeconomic model believe there is a direct correlation between educational achievement and economic status. They contend that once economic disparities are eliminated, educational disparities will end as well (Singham, 1998).

The sociopathological model is generally embraced by conservatives who are not convinced that economic factors are the primary cause of under-achievement for black students (Singham, 1998). This model concludes that various social pathologies are at fault in the black community. Singham asserts that believers of this model have a "pull yourself up by your bootstraps" mentality and tend to lecture black communities about personal accountability. Singham writes, "This group concedes that, while racial prejudice still exists, it is essentially a personal matter that should be dealt with on a personal level." (Singham, 1998) Reg Weaver, president of the National Education Association (NEA) embraces both models. He states, "Financial uncertainty; divorce and separation; lack of child supervision services, teenage pregnancy, and family instability play major roles in altering the quality of life children enjoy.

These factors are even more acute in the Black community where, in many cases, systemic poverty, poor learning facilities and resources, limited access to pre-school, and the low expectations of some teachers for Black students exacerbate the education challenges Black families and communities face." (Department, 2004)

The genetic model is the third view. Charles Murray and Richard Hernstein, who are authors of the Bell Curve (Singham, 1998), concluded that the disparity in African American achievement stems from inferior genes and is a fact of nature. Murray and Hernstein (Singham, 1998) argue that the best thing to do is to accept the situation and then determine how to minimize the effects in society. While the Bell Curve created a wealth of controversy, there was little evidence that proved African American students were genetically inferior to whites.

Part of the solution to closing the achievement gap lies in addressing the perceptions and attitudes of African American children. Researcher Signithia Fordham found a significant difference in attitudes toward academics and career success with black students attending a Washington, D.C. high school (Fordham, 1988). Fordham discovered that young black people do not embrace the beliefs of young black people during the civil rights era. For example, during the civil rights struggle, African Americans believed that if one black person in any new field succeeded, everyone in the entire African American community succeeded. Trailblazers such as Thurgood Marshall who was appointed to the Supreme Court and Arthur Ashe who became the U.S. Open and Wimbledon tennis champion are just a couple of examples (Fordham, 1988).

Fordham believes that trailblazers during this time realized that all eyes were on them to see if they consistently met or exceeded expectations. Successful African Americans knew that in order for other African Americans to follow in their footsteps, they would have to conform to the dominant white culture by "acting white". Most African Americans found this behavior of

"acting white" acceptable because it was a temporary strategy for one to advance professionally and for the greater good of the community. In essence "acting white" meant behaving in a manner that White people found acceptable and non-threatening according to their standards.

Her study found that most young African Americans believe that "acting white" was a flawed strategy because it did not accomplish the goal of widespread success for other African Americans (Fordham, 1988). Hence the only way for African American communities to advance is to stick together. If this happens, everyone can remain true to their ethnic identity. Black people who continue to embrace the strategy of conforming to White culture to get ahead are often labeled as "sell outs" by African Americans who reject this idea. Singham believes this view is extemely problematic because any African American seeking academic success may be viewed as a traitor to his or her race because it would involve conforming to white behavior and attitudes (Singham, 1998).

Fordham states that African American students develop a strategy she calls "racelessness" when they are torn between their desire to achieve academic success because of their parents' expectations and sacrifices, and their longing to remain with their peers (Fordham, 1988). Students knowingly or sometimes unknowingly fail to reach their full academic potential because they choose to navigate their social and academic interactions in a "race neutral" manner according to Fordham. This means that they earn respectable grades to keep their parents happy while maintaining relationships with their friends. African American students who adopt this behavior generally study alone in private. This approach to academic success leads to the development of bad study habits which tend to have a negative impact on a student's post-secondary education.

Claude Steele of Stanford University has a different rationale as to why black students underperform. Steele conducted research with the help of Joshua Aronson on college students at Stanford and the University of Michigan. They observed that when students were placed in a situation wherein a poor performance on a standardized test would support a stereotype of inferior abilities due to a student's ethnicity or gender, then the student's performance suffers when compared with those who do not experience this preconception (Steele & Aronson, 1995). For example, Steele gave black and white students tests that they were told measured their academic abilities. Black students did worse than whites on the tests; however, when a control group of black and white students were given the same test but were told the test did not matter, the difference in performance disappeared. Steele describes this phenomenon as "stereotype threat (Steele & Aronson, 1995).

Steele furthered his research into this phenomenon by comparing men with women and white men with Asians. The women's performance decreased when they were told the standardized mathematics test they were taking showed gender differences. Once again the discrepancy disappeared between males and females in the control group when the women were told that the identical test had not shown any differences in gender (Steele & Aronson, 1995). When white men, who outperformed black and female students, were told the same tests were being used to compare their knowledge with Asians, their performance declined (Steele & Aronson, 1995). The results of Steele's and Aronson'study indicate women and white men are not immune to the effects of the phenomenon "stereotype threat".

Steele believes that the fear of a poor performance on a test will confirm a stereotype in the mind of a student, therefore creating anxiety which is difficult to overcome in a testing situation. The fact that these assumptions of academic inferiority are reinforced through various

media outlets make it hard for women to escape statements that men perform better in mathematics. One may argue that the challenge for African Americans to combat this perception of inferiority is harder to overcome due to years of disturbing news about the achievement gap. Steele contends that the catalyst for suppressing academic performance as a result of the "stereotype threat" may involve a request on a test as simple as asking the examinee to state his or her gender and ethnicity (Steele & Aronson, 1995). Steele asserts that the fear created from this anxiety creates a disconnect between these two groups and their education. As a result, these students rarely invest the time needed for mastering content. This allows students to blame a poor performance on lack of interest in the content instead of the inablility to master the material (Singham, 1998).

## II. Response to the Problem

The Town of Peake enjoys a unique reputation as an urban/suburban community of 57,107 residents (2000 Federal Census) in a geographic area of just over five square miles surrounded by a major northeastern city on three sides. The proximity to the city, in conjunction with a history of educational excellence, attracts a diverse population to Peake. The town ranks 55$^{th}$ in the state for per pupil spending at an average of $11,107 per student. Data gathered by the state indicates 86% of students from Peake high school were reading and writing at an advanced or proficient level. On the mathematics section of the state test, 84% of the students at Peake high school tested at the advanced and proficient level. The average reading and writing score for the state was 70% while the score in mathematics was 67%. According to recent census data, the median household income in Peake is $18,116 more than the state median of $57, 184.

The Public Schools of Peake provide education to pre-school through twelfth grade students in eight elementary schools and one comprehensive high school. In addition to

traditional academic programs, the Public Schools of Peake offer continuing education courses, summer school, enrichment programs, and numerous athletic opportunities.

Peake High School serves 1,825 students who come from 76 nations and speak 57 languages. The high school celebrates several accomplishments in academia. Approximately 40% of the senior class of 2008 was inducted into the National Honor Society—the highest percentage in the history of the school. Thirteen percent of the students in the class of 2008 were named National Merit Semi-Finalists or Commended Students in this national competition. From 2005-2007, all sub-groups improved their performance dramatically narrowing the "achievement gap" for historically under-performing groups. Although Peake High School is recognized as one of the top public schools in the Northeast region, it struggles to close the achievement gap among minority students. Academic classes in all major disciplines range from standard to advanced, with a large percentage of African American students taking standard level classes.

The researcher will analyze the impact of implementing a Geometry Honors Preview course during the summer session. The goal of the course is to teach incoming freshmen the theorems and postulates necessary to successfully prove geometry concepts before they take Geometry Honors their freshmen year. The researcher hypothesizes that the primary barrier hampering success in Geometry Honors is the fact that students do not adequately learn the theorems and postulates. Hence they do not learn how to appropriately implement the theorems and postulates to prove geometry concepts. The researcher contends that in addition to pre-teaching the theorems and postulates to give the freshmen a solid geometry foundation for the first quarter, incorporating study and test-taking strategies will prove invaluable. Furthermore,

the successful completion of a portfolio of their work will allow the freshmen an opportunity to reflect on their summer work and use it as a resource during the academic school year.

The course was offered during two sessions throughout the summer. Each session met two hours each day Monday through Friday for three weeks. The class was comprised of students who were scheduled to take Geometry Honors their freshmen year. Although it was suggested that the class was designated for students recommended for Geometry Honors, it was available to any student who aspired to take Geometry Honors even against the recommendation of their eighth grade teacher.

The class was taught by an experienced lead teacher and one to three teacher assistants. The teacher assistants were high school students who have successfully completed the Geometry Honors course with a final grade of "B+" or higher. The teacher assistants helped facilitate the cooperative learning, helped struggling students one-on-one, and offered their personal insight for success in the class. Students did not receive a grade for the course; however, each student received a summary of strengths and weaknesses that they could share with their parents and geometry teacher. The lead teacher believed that if the students, teachers and parents knew the students' weaknesses prior to taking the course in September, supportive measures can be implemented by the parents and teachers.

Historically, 60 to 70 percent of African American freshmen enrolled in Geometry Honors withdrew from the course. Indeed, by the end of the second quarter, only 30 to 40 percent of the original number of African American students remained in Geometry Honors, while the other students splintered off into a standard level geometry class or an alternative mathematics program called IMP (Interactive Mathematics Program).

The researcher will also compare and contrast the academic performance of the African American freshmen who enrolled in the summer course with those who chose not to take the Geometry Honors Preview course. This information should help the researcher assess the impact of pre-teaching mathematical concepts during the summer.

The results of this project will provide important information about closing the achievement gap because it will address some of the structural and curriculum barriers that have underserved African Americans for years. For example, academic tracking is a systemic problem in practically every public school system because students are sorted based upon a perceived knowledge base interpreted by teachers. In most cases the teacher's interpretation of a student's knowledge is subjective and inconsistent with fellow teachers. Jeff Howard states, "American Educators are paid to decide who can learn at high levels, and who cannot. Norm-referenced tests declare half of our children below average by age seven." (Howard, 1995) This flawed practice is compounded by the fact that we segregate students we believe to be smarter and expose them to a more robust and rich curriculum. A large percentage of students in urban settings are identified as "slow" or "learning disabled" at the beginning of their educational careers (Howard, 1995).

Howard believes that the current educational system that is in place for public schools only compounds academic and societal problems. Howard states, "Many children face serious social and economic obstacles outside the classroom, too, but our schools, instead of offerng haven and hope, exacerbate the problems with pervasive labeling and exclusion. The failures we deplore are directly attributable to the insrtuctional practices we support." (Howard, 1995)

Several educators, including Howard, believe that the key to closing the achievement gap is through reforming education by overhauling a systemic structure that has been in place since

the inception of public education. The resistance to making the modifications that Howard and others suggest is signficant and even if the changes were made, it would take years for reform to happen. During the interim, African American students will continue to be negatively impacted by the current system.

This project is also significant because it provides a blueprint for improving African American achievement using a similar concept introduced by Uri Treisman in 1974 at the University of California Berkeley (Treisman, 1992). Uri Treisman noticed that African American students were underperforming in an Introduction to Calculus class despite entering college with comparable grade-point averages and SAT scores with their white counterparts. Treisman embarked on creating a mathematics workshop that involved preteaching Calculus to an ethnically diverse group of students with the focus on recruiting African Americans for the workshop (Treisman, 1992). They worked cooperatively completing problems that were more challenging than the problems they would face in an Introduction to Calculus class. The result was a drastic improvement in academic performance by African Americans in the Introductory Calculus class.

## III. The Study of the Project

This study is an attempt to analyze the impact of implementing a Geometry Honors Preview course during the summer session. The research questions that will guide my study and research design are as follows:

1) Will African American students who took the summer course complete Geometry Honors during the school year?
2) How do students believe the Geometry Honors Preview course helped them prepare for an honors level course in mathematics?

3) What factors in the summer school preview course seemed particularly influential in student success in the Geometry Honors course?

The research design of the project will incorporate quantitative and qualitative data. This descriptive quasi-ethnographic case study will assess the impact of an effort that seeks to increase the number of African American students who successfully complete a Geometry Honors math course. A descriptive quasi-ethnographic case study is appropriate for the research because according to Merriam, "A case study focusing on, for example, the culture of a school, a group of students, or classroom behavior would be an ethnographic case study." (Merriam, 1998, p.34) Merriam also states, "A descriptive case study in education is one that presents a detailed account of the phenomenon under study – a historical case study that chronicles a sequence of events." (Merriam, 1998, p.38) The researcher is seeking to uncover the motivational dynamics of the learner and the various instructional strategies that work to promote mathematical understanding as the summer enrichment classes unfold. This research design will enable the researcher to document in rich detail the activation of the learning process of these learners.

Success of the Geometry Honors Preview class will be partially measured by comparing grade-point averages of African American students who attended the class over the summer with grade-point averages of African American students who did not attend. Additionally, the researcher will conduct surveys and interviews with math teachers, students and their parents to gain greater insight as to what aspects of the summer course proved helpful.

There will be two categories of students taking either Geometry Honors Preview during the Summer and/or the Geometry Honors course offered during the school year. The categories are students recommended to take Geometry Honors by their eighth grade teacher or students

taking the course against their eighth grade teacher's recommendation. The prerequisite for taking Geometry Honors Preview is algebra. Some students enrolling in Geometry Honors during their freshmen year have exhibited mastery in algebra, while some students have not mastered algebraic concepts. For these students, either Geometry Standard or IMP I (Interactive Mathematics Program) is recommended. Some students and parents override the eighth grade teacher's recommendation because if the course is too hard, it is easier to drop down from Geometry Honors to Geometry Standard or IMP than to advance a level to Geometry Honors.

The research conducted for this study will only include students recommended for Geometry Honors. The researcher will compare the African Americans in the Geometry Honors Preview cohort with the African American students who did not attend the summer class. The researcher will use a four-point grading scale to calculate their respective grade-point averages for each of the four quarters. The researcher is cognizant that grades do not reflect the entire story regarding a student's success or failure; therefore, careful attention will be directed towards the students' work habits and the perceptions and beliefs of their teachers by analyzing the teacher comments each quarter.

## IV. Rationale Behind the Study

The theoretical rationale for this study will bring interpretive frameworks to bear about the achievement gap phenomenon. The absence of an opportunity to learn undergirds the achievement gap. When what is fair and just is nonexistent in the school culture, particularly for African American students, their self-motivation may be at stake. Perkins asserts in his Theory One that, "People learn much of what they have a reasonable opportunity and motivation to learn." (Perkins, 1992, p. 45).

Perkins' Theory One provides a clear blueprint on good teaching practice. Perkins contends, "For any performance we want to teach, if we supply clear information about the

performance by way of examples and descriptions, offer learners time to practice the performance and think about how they are handling it, provide informative feedback, and work from a platform of strong intrinsic and extrinsic motivation, we are likely to have considerable success with the teaching." (Perkins, 1992, p. 46). Pre-teaching mathematical concepts to students prior to their enrollment into the subsequent class embraces this teaching practice and supports the rationale behind the study.

## V. Significance of the Study

Efforts to close the achievement gap in mathematics will require educational leaders, teachers and policymakers to rethink current policies, curriculum and structures that comprise the American educational system. The battle for closing the achievement gap will have to be fought on two fronts. The first requires a concerted effort from all stakeholders to implement measures and strategies to help African Americans change their attitudes about academic success and improve motivations to learn mathematics. Stakeholders include: students, educators, parents and the community at large. The second requires school systems to provide improved motivation and opportunities to learn mathematics for students who have traditionally underperformed in this subject. Whether the results support the theories of the researcher or not, documenting and analyzing the kinds of initiatives associated with the study can make a difference in how educators and policymakers address the achievement gap. If the project proves to be successful, school systems can replicate the strategies in their respective school districts.

Indeed, the stakes for the United States are high if our educational system fails to provide an equal opportunity to learn for all students. Despite increased demands for an educated workforce, approximately 69% of high school students earned a standard diploma in 2000. This

is down from 77% in 1960 (Barton, 2005). The educational outlook grows dimmer in regards to completing college. According to Darling-Hammond, of the 60% of graduates who attend college, approximately half graduate from college with a degree (Darling-Hammond, 2007). In 2005, about 17% of African Americans between the ages of 25 and 29 earned a college degree in comparison to 34% of White students in the same age category (Bureau, U.S Census, 2005). Statistical data suggests that the educational ailments of America have a more pervasive impact in the lives of African Americans.

## VI. Limitations of the Study

There are several limitations to the study. First, the size of the sample consists of five students. Although a total of 17 students enrolled in the Geometry Honor Preview course, only five of them were African American. Comparing these statistics with the yearly enrollment statistics for Geometry Honors is compelling. On average, approximately 190 students enroll in Geometry Honors which translates into eight class sections. Roughly sixteen of the 190 students are African American. It is also important to note that although a student is scheduled to take Geometry Honors in the ninth grade, it does not mean he or she was recommended by their eighth grade math teacher. However, the researcher verified the recommendations of the participants in the sample via the student database.

Second, all eighth grade teachers are currently working on implementing common assessments for Algebra. While the teachers cover the same topics in Algebra, the level of teacher autonomy is extremely high. This results in some teachers going into greater depth teaching the same topics as their colleagues. Also, it translates into some teachers differentiating instruction when others may not. This problem is exacerbated by the fact that the math teachers

at the eight elementary schools rarely meet together to discuss teaching strategies or share student's work.

Third, teacher quality can have a positive or negative impact on the sample. Although all of the eighth grade teachers are considered highly qualified because they have met the state's requirements, teacher experience and efficacy is a major factor. This is extremely crucial because each math teacher at each elementary school uses his/her own criteria to determine whether a student should take Geometry Honors freshmen year. These inconsistencies in eighth grade math assessments and criteria for teacher recommendations translate into grade inflation. For example, a student earning a "B" in one school may translate into the same student earning a "C" in a different school.

Fourth, researcher bias may have a significant influence on this study because of the researcher's role as both participant-observer and Summer School Director. The researcher is responsible for creating the curriculum for the Geometry Honor Preview course, hiring the teacher, hiring the teacher assistants, and recruiting students to take the course. Hence the researcher is committed to the success of the course. Additionally, the researcher is responsible for collecting the quantitative data from the school's student database system. Qualitative data will be gathered from the researcher's reflective journal, surveys and interviews. The researcher will rely on his experience as a math teacher to help interpret the results of his intervention. Merriam writes, "Because the primary instrument in qualitative research is human, all observations and analyses are filtered through the human being's worldview, values, and perspective." (Merriam, 1998, p.22)

Lastly, a further limitation to this study is the time period in which the study will be conducted. The Geometry Honor Preview course will be taught during the summer and data will

be collected throughout the school year. The surveys and interviews require the participants to comment on the impact of the Geometry Honor Preview course. Some of the participants may not fully understand the impact of the course because they have not completed the sequence of math courses at the high school. Also, it is possible that participants may divulge information to satisfy the researcher instead of disclosing their actual beliefs. In an effort to alleviate the potential bias, the researcher has implemented multiple data sources to address this limitation by triangulating the findings.

## VII. Definition of Terms

***Achievement Gap:*** An indicator of disparities between groups of students usually identified (accurately or not) by racial, ethnic, linguistic, or socioeconomic class with regard to a variety of measures (attrition and enrollment rates, drug use, health, alienation from school and society, attitudes towards mathematics, as well as test scores

***Norm referenced tests:*** Tests that show how a student's performance or test results rank when compared to the work of his peers. These assessments assume that some students will do very well, some will do very poorly, and most will fall somewhere in the middle. They focus on providing information about which child knows most and which knows lest and how to rank the work of everyone in between.

***Tracking:*** The practice of grouping students together according to their perceived ability in the classroom.

## VIII. Overview of the Study

The first chapter of the dissertation provides an introduction to the study. The introduction entails a brief summary of the achievement gap from a historical perspective. The second chapter provides an overview of the relevant bodies of literature that influences the

direction and design of the study. The literature review in chapter two expands on the achievement gap phenomenon introduced in chapter one from a historical perspective, discusses the multiple implications of the achievement gap and outlines strategies to eliminate the problem. The third chapter illustrates the research design in greater detail, outlines the research methodology, explains the data collection procedure and details the sample used in the study. The fourth chapter presents the results of the study utilizing tables, charts and coding to summarize responses from surveys, interviews and the researcher's journal. The fifth chapter summarizes the findings and compares and contrasts them with the theoretical rational and relevant literature. The researcher will make recommendations based upon the conclusions drawn from the study and suggest further research ideas.

# Chapter 2

## Review of the Relevant Literature

### Introduction

In Chapter Two the researcher will review literature related to the history of the achievement gap with pedantic attention in the area of mathematics. Following a detailed chronological account of the achievement gap, the researcher will review literature that focuses on the following: (1) Academic tracking; (2) Student course selections; (3) Stereotype threat; (4) Teacher instruction; (5) Culturally relevant pedagogy and curriculum; (6) Cooperative learning; (7) Student and teacher attitude/behavior; and (8) Teacher quality. All of these topics are interwoven into the fabric of the achievement gap.

### History of the Achievement Gap

All aspects of African American history in the United States involve despicable acts of racism and violence. Unfortunately, African Americans who sought to make a better life for themselves and their families by obtaining an education were not spared the harsh realities of discrimination. In the minds of plantation owners, a literate slave was a dangerous slave, which is why southern states made it illegal to educate them. Plantation owners believed that if slaves were able to access abolition literature, it would spark widespread revolts (Spring, 2007).

The abolition of slavery after the Civil War gave freed slaves hope for a better life; however, the opportunity to learn still eluded them. African Americans were denied educational opportunities by educational segregation and the underfunding of their schools. In fact, Joel Spring contends that African Americans and other minority groups are victims of deculturalization. He describes deculturalization as, “The educational process of destroying a people’s culture and replacing it with a new culture.” (Spring, 2007, pg. 6) According to Spring,

there are six methods to deculturalizing a group of people. The methods of deculturalization are: 1) Segregation and isolation; 2) Forced change of language; 3) Curriculum content that reflects culture of the dominant group; 4) Textbooks that reflect culture of dominant group; 5) Denial of cultural and religious expression by dominated groups; 6) Use of teachers from dominant group

(Spring, 2007, pg 6)

African American community leaders in Boston petitioned the legislature for schools in 1787 (Schultz, 1973). After the passage of the Massachusetts Education Act of 1789, which allowed African Americans to attend school, Boston organized the first comprehensive system of urban schools (Spring, 2007). Although these events are important milestones in the history of African American education, the struggle for an opportunity to learn was entering a new phase.

Now that African Americans had the opportunity to attend school and receive a formal education, many did not attend school due to poor economic conditions and frequent harassment from white students and teachers. As a result of the constant mental and sometimes physical abuse African American students experienced, their parents requested segregation in 1798 (Spring, 2007). The Boston school committee rejected the request and did so a second time in 1800, because they were concerned other groups would request separate schools as well (Spring, 2007). In the meantime, philanthropists provided funds to start separate schools but they rarely lasted longer than a year.

Finally in 1806, the school committee gave their approval of a separate school for African Americans funded by contributions from white philanthropists and public funds. By 1812, the school committee agreed to allocate permanent funds and establish direct control over the school (Schultz, 1973). However, it was not until 1820 that the African American

community realized that separate did not mean equal and as a result, their children were not receiving an adequate education (Spring, 2007). Parents observed their children being taught by unqualified teachers who were appointed by the board. Furthermore, the school was not conducive to learning and had deteriorated into a delapidated building. A report written by a subcommittee in 1833 concluded that segregation did not benefit either race and that all aspects of a public education for African Americans were inferior to other schools (Schultz, 1973).

The Boston School Committee rejected the findings of the report and instead, chose to focus on assuring that separate schools were equal. David Walker, a local abolitionist, was adamant that the Boston School Committee move toward integrating Boston's public schools. He believed there was a conspiracy to suppress academic achievement amongst African Americans. A major part of the conspiracy stemmed from the fact that the black commuities had loss control over the black schools (Spring, 2007). The black communities found themselves in a conundrum. If their children remained in segregated schools, they had no power.

The Massachusetts Supreme Judicial Court heard one of the first separate but equal rulings in American judicial history in 1849 (Schultz, 1973). Benjamin Roberts sued the City of Boston because his daughter had to travel out of her way to attend an all-black school while traveling past closer white primary schools (Spring, 2007). Although Benjamin Roberts lost the case, the groundwork had been laid for future cases that strived for the integration of public schools.

Segregation finally ended in Massachusetts in 1855 when the governor signed into law a stipulation that students cannot be excluded from schools based on race or religious opinions (Spring, 2007). Although the walls of segregation had fallen in Massachusetts without violent altercations, the hearts of several white Americans remained cold and resistant to change. In

fact, segregation throughout the United States remained in tact during the nineteenth and twentieth centuries. According to Spring, "Whites who considered Africans a threat to their racial purity and culture, and who believed Africans were "inferior", wanted the "civilizing" or education of African Americans to occur in segregated schools." (Spring, 2007, pg. 50)

Perhaps the ratification of the fourteenth Amendment in 1868 had the greatest impact on public schools. The first section of the fourteenth Amendment "Forbids the states to abridge the privileges and immunities of U.S. citizens, to deprive any person of life, liberty, or property without due process of law, and to deny any person the equal protection of the laws." (Curtis & Nelson, 2007). The equal protection clause affords each citizen the right to an equal education and an opportunity to learn. However, in 1896 the equal protection clause under the fourteenth Amendment was impeded by the United States Supreme Court. The United States Supreme Court declared in the *Plessy v. Ferguson* case that if segregated facilities were equal and the law was reasonable, one group was not inferior to the other (Spring, 2007). This case was decided in an astounding eight to one vote with Justice John Marshall Harlan dissenting. Justice Henry Billings Brown wrote the majority opinion stating, "Separate but equal laws did not imply the inferiority of one race to another." (Curtis & Nelson, 2007). The ruling was ambiguous because the Supreme Court failed to define reasonable and what constitutes equal with regards to facilities.

In the 1890s the black communities became more divided over the means to achieve educational equality and an equal opportunity to learn. Most historians consider Booker T. Washington and W.E.B. Du Bois the two most outspoken black leaders for the two contrasting opinions within the black communities (Spring, 2007). Du Bois was a key figure in establishing the National Association for the Advancement of Colored People (NAACP) in 1909, which led

the successful movement to eradicate segregation (Spring, 2007). Du Bois was critical of Washington and claimed that his compromise with white southerners would result in the "disfranchisement of the Negro," the "legal creation of a distinct status of civil inferiority for the Negro," and the "steady withdrawal of aid from institutions for the higher education of the Negro." (Spring, 2007, pg. 61). Du Bois believed that education should be used as a mechanism to create leaders to protect the political and social rights of the black community. Furthermore, Du Bois wanted to merge the African and American culture to create an Afro-American culture (Spring, 2007). Hence Du Bois wanted to empower African Americans to become activists to support the struggle for equality.

Washington worked hard to compromise with white demands and embraced the creation of segregated schools that focused on industrial education. He believed that if African Americans received an industrial education, they could prove their economic value to whites. Washington frequently made the argument that blacks would provide better manual labor than any other group (Spring, 2007). Southern industrialists supported Washington's position because it promised cheap labor and the avoidance of labor unions. Indeed, an anti-union culture is still alive and well in the South as teacher and manufacturing unions are virtually non-existent.

Historians have various opinions as to whether Washington's approach to advance African Americans was meritorious. Booker T. Washington, who was born into slavery, attended the Hampton Institute after the Civil War, which was founded by General Samuel Armstrong (Spring, 2007). Armstrong had a tremendous influence on forming Washington's philosphy on educating African Americans. He viewed African Americans as savages who did not deserve the right to vote nor to be integrated within white society. Armstrong's goal was to help former slaves adjust to a free, but a subordinate role in the South. To achieve this goal, he

believed blacks needed to develop appropriate work habits and moral behavior (Spring, 2007). It is unclear as to whether Washington embraced all of Armstrong's views regarding blacks, but their interpretation of "industrial education" emphasized hard manual labor and the devlopment of good work and moral habits.

Several philanthropists believed that African Americans serving in this sub-servant role made the United States more competitive and stronger economically. The most noted philanthropist was Andrew Carnegie who gave the first major endowment to Tuskegee. Moreover, a segregated industrial education gained support from major educational conferences and private foundations (Spring, 2007).

Investing in the industrial education of African Americans practically came to an immediate halt after a report written by Horace Mann Bond in the 1870s was released. In his report, Bond showed Alabama spent more money educating blacks than whites from 1875 to 1876 (Spring, 2007). Southern planters were at the core of the resistance to educating African Americans. They believed an education posed a threat to their livelihood because if black students were in the classroom, they were not in the fields working. Hence by 1900 the per capita expenditure for white students was four to five times higher than that for blacks. Some planters took extreme measures such as forcing schools to begin their school year in December (Spring, 2007).

It was not until approximately half a century later that the landmark case of *Brown vs. The Board of Education of Topeka Kansas*, that the wall of segregation was obliterated (Patterson, 2001). This victory for public education provided an alternative interpretation of the Fourteenth Amendment other than the interpretation used to justify the *Plessy vs. Ferguson* ruling. In the *Plessy vs. Ferguson* case, enforcers of the law believed equal protection addressed

political and not social equality (Curtis & Nelson, 2007). The *Brown* ruling extended the interpretation to include social equality. In fact, opponents of the decision complained that the Supreme Court's decision were based on nonlegal arguments based on social science research and called for the impeachement of Chief Justice Earl Warren (Spring, 2007).

Although the *Brown* ruling was rendered in 1954, it took almost a decade for true integration to occur. The Supreme Court asked the states to "proceed with all deliberate speed" to integrate the schools without providing them with deadlines or a system to ensure that the large numbers of segregated school districtgs complied (Spring, 2007). The Supreme Court sought to resolve this problem by utilizing the federal district courts to oversee the desegregation process. Unfortunately for African Americans, the federal judges deliberately delayed any attempts to integrate the schools in a timely manner because they embraced the flawed ideology of segregation.

It was not until the Civil Rights Act of 1964 that the *Brown* ruling came to fruition. Under the this law, Titles four and six of the Civil Rights Act were specifically aimed at ending school segregation. Title four specifically called for desegregation while the power of Title six lies in its ability to withhold federal money from school systems (Spring, 2007).

Robert Moses, the founder of the Algebra Project, insists economic access is the most urgent social issue affecting poor people and people of color (Moses & Cobb, 2001). Moses founded the Algebra Project in the early 1980s based on the ideology that the ongoing struggle of minority people for citizenship and equality was linked to an issue of science and math literacy (Moses & Cobb, 2001). Moses contends that in African American culture, math illiteracy is acceptable failure is tolerated in math. However, he identifies mathematics instruction as a key problem to difficulties African Americans experience in mathematics. Moses stated, "Math

instruction weeds out people and you wind up with what amounts to priesthood, masters of the arcane secrets of math through what appears to be some God-given talent or magic." (Moses & Cobb, p. 9, 2001).

Public education is still experiencing residual effects from centuries of segregation. White students continue to attend schools that are eighty one percent white (Spring, 2007). Lingering effects of segregation are also evident when analyzing low standardized testing results, increased high school dropout rates, low achievement across all traditional academic disciplines and dismal post-secondary options for African Americans.

President George Walker Bush's response to closing the academic achievement disparities that exist between African Americans and their White counterparts is The No Child Left Behind Act of 2001 (NCLB). While the law holds school systems accountable for providing an adequate education for all, some critics believe that one of the biggest problems with the law is that it makes a single culture the norm of schooling. This problem is significant because it disregards languages and minority cultures (Spring, 2007). Another unfortunate issue with the law is the fact that states are mandated to implement high-stakes standardized tests to measure the students' knowledge. If enough students do not show profeciency over time, then the school may face punitive sanctions. These punitive sanctions ultimately hurt the students the law is supposedly trying to protect.

A historical perspective of the achievement gap is important because similar issues that impacted the education of African Americans still exist today. For example, African American students in an urban setting are still more likely to have an underqualified teacher than white students who live in more affluent suburbs. Significant disparities in funding and access to resources are still prevalent for African American students. Some people in the African

American community contend that tracking students is racially motivated. This perception deserves special attention because it stems from the cynicism some African Americans developed about public schools as a result of years of discrimination. Indeed, part of the solution to improving African American achievement lies in changing the behavior and attitudes African Americans have toward education. These issues only encompass a fraction of the problems that comprise the achievement gap.

## Academic Tracking

Academic tracking has been a catalyst for expanding the achievement gap in mathematics and is a very contentious topic. Most parents of high-achieving students want their children in classes with other students with comparable abilities and interests. They believe that if too many students with lower mathematical skills occupy the same classroom as their child, he will receive an inferior education and the curriculum will be "watered-down".

The Eisehnower Southwest Consortium for the Improvement of Mathematics and Science Teaching (ESCIMST) outlined the criticisms surrounding tracking. They are:

- Tracking disproportionately assigns to lower tracks students from certain ethnic and lower socio-economic groups.
- It fosters segregation by race and class and permanently labels students.
- Parents with higher incomes or more education pressure schools to put their children in high-ability tracks. Parents who do not partcipate in the informal power relations of the school, or do not have the ability to take time from work to discuss scheduling with teachers, can not advocate for their children when tracking decisions are made.

- Parents from cultures that value trusting teachers' expertise might be less likely than other to push for re-assigning their children to advanced classes
- Once assigned a track high or low students find it nearly impossible to move either up to higher tracks or down to more appropriate levels (even if they are not doing well in higher-track classes and might do better in a less-intense class).
- A disproportionate share of resources, especially well-prepared and experienced teachers, teach high-track classes.
- The curriculum and instruction in low-track classes are frequently dead-end and boring for both students and teachers
- High-ability students need to collaborate wit those different from themselves in culture, class, ability, and interests. This is more possible in detracked classes. (Teaching, 2000, p. 2)

According to (ESCIMST) proponents of tracking make the following arguments:

- Students learn better in classes where everyone is learning more or less the same material at the same pace
- Teachers find it time-consuming and comnplex to teach intricate material to students at different levels of understanding.
- Certain subjects, like mathematics and foreign languages, often require that students master basic material before they advance to higher levels.
- Students of average ability will perform better in the company of their peers than they will in daily competition with above-average students
- Better resource allocation is addressing the inequities of tracking.

- Mixed classes depress achievement levels by holding high achievers back. (Teaching, 2000, p. 2)

Although tracking tends to benefit higher achieving students, the distribution of resources may still impact the learning of above average students. For example, if a school has a higher demand from students to enroll in an honors or advanced level mathematics class than sections available, the above-average ability students may not be able to enroll (Teaching, 2000). Some schools narrow the pool of students who are requesting the class by requiring them to take a test and earn a certain score that would either qualify or disqualify them.

Jeff Howard believes that our current educational system needs a complete overhaul because our current system sorts out students (Howard, 1995). Howard states, "American educators are not in the business of preparing all children for the twenty-first century. Instead, they are paid to decide who can learn at high levels, and who cannot." (Howard, 1995, p. 85) Elementary schools in particular, often create "gifted and talented" programs to challenge students they believe are capable of learning at an above-average level. Challenging only a select few of the student population only serves the purpose of making the gap wider.

Howard also believes in many cases that most schools do more harm than good. According to Howard, "Many children face serious social and economic obstacles outside the classroom, too, but our schools, instead of offering haven and hope, exacerbate the problems with pervasive labeling and exclusion. The failures we deplore are directly attributable to the instructions practices we support." (Howard, 1995, p. 86).

The labeling and exclusion Howard describes is the result of an ideology that intelligence is innate, fixed at birth and distributed unequally. Howard calls this ideology the " innate ability paradigm." which was introduced by Lewis M. Terman, H.H. Goddard, and Robert M. Yerkes in

an endeavor that implied genetic intellectual inequality controlled destiny (Gould, 1981). Several people, in particular social conservatives, embraced this belief because it provided a quick and easy diagnosis to societal ills in a manner that exonerated society from any responsibility. Opinions such as, "The congenitally stupid are strongly inclined toward immorality." and "The poor are poor because they are too dim for work of more than marginal value." are examples of the stereotypes that were created from this ideology (Howard, 1995).

Goddard's irresponsible research of World War I army recruits justified racism and anti-immigrant sentiments by declaring that African Americans and Southern European immigrants were mentally defective. Hence justifying the scientific management of individuals and groups who were considered "defective" (Howard, 1995). Goddard believed the school was responsible for identifying those considered intellectually capable, separating them from the laborers and clerical workers and training each group specifically to the job they are supposed to perform. This method of tracking individuals based upon intellectual potential was implemented well before World War II and has been the mechanism for educating students ever since (Howard, 1995).

Howard believes that true educational reforrm cannot begin until teachers who were socialized in institutions that tracked students abandon the traditional practice of sorting students based upon perceived ability. Howard states, "Disbelief in the intellegence of our people, rooted in the innate ability paradigm, has effectively blocked education reform in the United States." (Howard, 1995, p. 88). Rebuffing the "innate abilty paradigm" means that teachers believe all the children in their classrooms can learn at high levels if they can be motivated to work hard. Teachers will have to translate their beliefs into good deeds by creating an environment where students can increase their confidence, hone their skills, and reach their full potential.

Tracking is also referred to as leveling and has evolved over the years. Around the early 1960s, high school students enrolled in separate academic tracks that under the following titles: Honors, Remedial, Essential and Basic (Lucas, 1999). Very few school systems voluntarily eliminated tracking in the 1960s or 1970s and the ones that did were under pressure from the black community, as was the case in Stockton, California (Ogbu, 2003). According to John Ogbu, course tracks replaced academic tracks. Hence creating a modified version of tracking that means a student enrolled at a given level of a course in the same subject. Presently, little research has been conducted around the evolution of course tracking and stratification because detracked schools are a relatively recent phenomenon (Teaching, 2000). Until a long-term study involving several schools analyzing the costs and benefits of tracking or detracking is complete, research-based statements will be insufficient.

John Ogbu's research conducted in Shaker Heights, an affluent suburb, located in Ohio indicates that tracking may result in academic disengagement (Ogbu, 2003). The Shaker Heights School district engaged in course tracking which resulted in de facto tracking along racial lines because most African American students were enrolled in lower level classes. His research suggests that tracking was instituted at the Woodbury upper elementary school which had grades five and six. There, the curriculum differentiated into three categories: (a) skills or remedial, (b) regular and (c) academic enrichment classes (Ogbu, 2003). Based upon Ogbu's observation, "Pronounced racial differences in enrollment between the remedial programs (mostly Black) and the academic enrichment programs (mostly Whites) began here." (Ogbu, 2003, p. 111). As students matriculated to the middle and high schools course tracking evolved into four curriculum levels: (a) skills or general education, (b) college prep, (c) honors, and (d) advanced placement (AP) classes (Ogbu, 2003). These classes were divided along racial lines

with most African American students in the skills and college prep classes and most of the White students in honors and AP classes.

Besides institutionalized course tracking, Ogbu believed it was important to point out that, "Black parents contributed to the uneven racial distribution at the middle and high schools in part because they did not seem to understand the leveling system." (Ogbu, 2003, p. 112). In fact, the failure of some African American parents to act quickly in getting academic help for their children as early as first grade--despite teacher's initiating communication--placed them at an early disadvantage.

Ogbu discussed the scheduling of African American students with the guidance counselors at the high school and discovered that they had little time to explain the importance of enrolling in honors or AP classes. The guidance counselors appeared overburdened with scheduling students for classes or mediating problems between students and their teachers. Black students interpreted this to mean that counselors did not care (Ogbu, 2003). Further, some students felt they were dissuaded from participating in the higher level courses until their parents interceded.

The dismal respresentation of African American students in the honors and AP classes is also linked to what Ogbu describes as self-elimination (Ogbu, 2003). Self-elimination, according to Ogbu, existed in three forms: (1) students avoiding the honors and AP classes because most of the other students in the classes were White; (2) lack of effort which translated into students not working hard enough to make good grades to qualify for those courses; (3) student's personal decision not to enroll in honors or AP class although he or she was qualified to be in the class based on his or her academic records. (Ogbu, 2003). The third self-elimination description Ogbu observed appeared to happen despite the insistence of the guidance counselor.

Ogbu's finding regarding course selection is signficant because according to Secada's study, after controlling for demographic factors, one-third of the achievement gap in mathematics was due to course-taking differences (Secada, 1992).

Tracking impedes the opportunity to learn for low-achieving, low income students because they are mostly tracked into dead-end math courses in high school (Gamoran, Porter, Smithson, & White, 1997). Since many educators and parents believe tracking promotes inequality, one may question why it remains a near universal practice in American high schools. However, the tracking dilemma has two possible outcomes: (1) eliminate tracking; (2) improve instruction for low-achieving students without attempting to teach all students in the same learning context (Gamoran, Porter, Smithson, & White, 1997)

Both outcomes present a different set of problems. First, if tracking is eliminated, all students would be placed in mixed-ability classes where expectations would be high, the curriculum robust and the instruction will be the same caliber as college preparatory classes. This would require educators to undergo professional development to learn effective strategies for differentiating instruction for students who are at various performance levels. Research indicates that curriculum content does not become less rigorous when students of mixed-abilities are included in college-preparatory classes (Porter, Kirst, Osthoff, Smithson, & Schneider, 1993). Second, improving instruction while keeping the same tracking structure would not eradicate the problem of sorting students of various social backgrounds. Ultimately, this approach could lead to creating new low tracks that would negate opportunities for advanced study (Gamoran, Porter, Smithson, & White, 1997).

## Course Selection

Courses selected by students at the secondary level appears to be another factor contributing to the achievement gap. There is a direct realtionship between the quantity of mathematics instruction and student achievment in mathematics (Fullilove & Treisman, 1990; Thomas, 2000). African Americans usually enroll in fewer higher-level mathematics courses than either Whites or Asian Americans (Powell, 1990). Powell stresses the significance of this finding since the most important predictor of scores on standardized achievement tests in mathematics is the number of high school algebra and geometry courses completed (Powell, 1990). Further, research suggests that disparities in math achievement among various racial groups were significantly decreased when rigorous course work in adanced level mathematics was incorporated into the curriculum (Moore & Smith, 1985; Thomas, 2000). Earlier research indicates that increasing enrollment in advanced level courses is not feasible without improving home and school environmental factors and motivational variables (Thomas, 2000).

Relatively little research has been conducted on the amount of mathematics courses students take. (Ma & Willms, 1999). However, some of the findings suggest exposure may be one of the most important factors. Lee and Bryk uncovered that higher levels of achievement and more opportunities to learn along social class lines were attainable in schools where students took more academic courses and there was less latitude in selecting courses (Lee & Bryk, 1989).

## Stereotype Threat

In addition to tracking, schools can further exacerbate the achievement gap by utilizing "gate-keeper tests" to determine course placements. Many public schools, parents make the final decision as to what course their child will take; however, teachers use the results of "gate-keeper" tests to support their course recommendations. If parental involvement is non-existent,

and the guidance counselor adheres strictly to the recommendation of the teachers, African American students may easily be excluded from enrolling in challenging mathematics courses.

Claude Steele contends that African Americans are at a disadvantage when it comes to taking high-stakes tests. He calls this impediment the "stereotype threat" (Perry, Steele, & Hillard III, 2003). The "stereotype threat" as defined by Steele is, "The threat of being viewed through the lens of a negative stereotype, or the fear of doing something that would inadvertently confirm that stereotype." (Perry, Steele, & Hillard III, 2003, p. 111).

Steele conducted a series of experiments with Joshua Aaronson to test his theory that test scores for African American students were negatively impacted by the stereotype threat. Steele and Aaronson brought White and Black students who attend Stanford—mostly sophomores of equal ability—into the laboratory one at a time to take a thirty-minute section of the Graduate Record Exam (GRE) in English literature. Since the stereotype regarding African Americans is that they possess inferior intellectual ability, the participants were told the test was a measure of verbal ability (Perry, Steele, & Hillard III, 2003). According to Steele the Black participants scored one standard deviation lower than their White counterparts under the stereotype threat.

In order to determine if it was indeed the stereotype threat that suppressed the scores of the African American students, the same test was administered to a comparable sample of Black and White students. However, this time, Steele and Aaronson stressed that the test did not measure their intellectual ability. Under these conditions the test results for Black students were practically identical to the test scores for white students (Perry, Steele, & Hillard III, 2003).

Steele and Aaronson took their research a step further to gather direct evidence of the stereotype threat. They wanted to know if simply taking a difficult test was a catalyst for making students mindful of their race (Perry, Steele, & Hillard III, 2003). Steele believed the best way

to test their hypothesis was to give the participants a list of words, each with two letters missing. The participants completed the words on the list as fast as they could. Twelve of the eighty words could be completed in such a manner as to relate to the stereotype of inferior intellectual ability of African Americans. Steele believed that if taking a difficult test evoked stereotypes about their race, African American students would complete more fragments with stereotype-related words. The results of the experiment revealed that African American students completed the fragments with significantly more stereoyped-related words when they were told it was a measure of their ability than when they were told it was not a measure of their ability. Their White counterparts; however, completed very little stereotype-related fragments (Perry, Steele, & Hillard III, 2003).

Steele and Aaronson sought to find out what kind of anxiety served as a catalyst for race consiousness. To analyze this concept, they asked participants to discuss their preferences in music and sports prior to taking a difficult test. When African American students expected to take a test that measured their ability they disassociated themselves with sports and music that are stereotypically associated with African American imagery such as basketball, jazz, and hip-hop. When the test was not related to ability, Black students embraced ideals associated with African American culture. Steele and Aaronson concluded that Black students wanted to avoid any spotlight that could garner negative attention (Perry, Steele, & Hillard III, 2003).

As Steele and Aaronson conducted more experiments, more questions developed. One such question was, "Do the effects of stereotype threat come entirely from the fear of being stereotyped, or do they come from something internal to Black students—self-doubt, for example?" (Perry, Steele, & Hillard III, 2003, p. 116). George Herbert Mead's concept of the "looking glass self" is based upon the assumption that one's self-image stems from how one is

viewed by others. If the opinions are negative, low self esteem or self hatred may develop as a result of self-internalization. Gordon Allport, Frantz Fanon, Kenneth Clark, and others according to Steele theorized, "Black students internalize negative stereotypes as performance anxiety and low expectations for achievement, which they then fulfill." (Perry, Steele, & Hillard III, 2003, p. 116).

Were the results of Steele's and Aaronson's experiments a function of the "self-fulfilling prophecy" phenomonen or the "stereotype threat"? To answer this question Steele and Aaronson conducted an experiment with white male students and Asians. They gave white males who were strong in mathematics a difficult math test and informed them that Asians usually performed better than whites. Since white males are part of the dominant culture and is not considered an inferior group, they had no negative stereotype of inferiority to combat (Perry, Steele, & Hillard III, 2003). The white males who were told Asians faired better on the mathematics test scored significantly lower than comparable white males, who were not informed that Asian students generally performed well. Steele and Aaronson concluded that the stereotype threat hindered white male achievement--a group that does not have to contend with inferiority perceptions (Aaronson, 1997).

Steele and Aaronson continued to extend their research to include gender comparisons. Female and male students at the University of Michigan who were good in math according to their SAT scores were the selected participants this time. The students were given a twenty-five minute section of the GRE subject exam in mathematics. They allowed the mere difficulty of the test and eventual frustration kindle the stereotype threat for the women. In the first experiment the women were outperformed by the men in mathematics. However, in the second trial that involved a difficult English test, the women's scores were comparable to the men. When another

difficult math test was given, once again, the women significantly lower than the men. The final math test given to both men and women participants was easier and did not initiate a great deal of frustration from the women. On this test, their scores were comparable (Perry, Steele, & Hillard III, 2003).

Although the results of the gender stereotype threat experiment showed females underperforming their male counterparts, the results did not indicate it was a result of the stereotype threat. A second round of testing ensued wherein the participants were told that women always performed as well as men, hence making the stereotype regarding women's inferiority in mathematics insignificant. The scores for both females and males were comparable. Further, the women from this test performed drastically better than the women who were told the test showed gender differences (Perry, Steele, & Hillard III, 2003).

Everyone is not equally threatened by a stereotype. Steele and Aaronson concluded that the most conscientious and confident students were hindered the most by the stereoytpe threat and not weaker performing students. Steele states, "Black students under stereotype threat seemed to be trying too hard rather than not working hard enough." (Perry, Steele, & Hillard III, 2003, p. 121). Through their observations of Black students taking their tests on computer under the presumption it measured ability, African American students wasted too much time rechecking their answers. This flawed inefficient approach to taking standardized tests results in poor scores.

The stereotype threat is difficult to overcome for some students—especially when conversation about the achievement gap permeates the media. Steele suggests that educators can help students overcome the stereotype threat by forming positive, trusting relationships with

students. In addition to forming positive relationships, educators should seize every opportunity to bolster a student's self-confidence (Perry, Steele, & Hillard III, 2003).

## Teacher Instruction

When analyzing the achievement gap in mathematics and why it is so pervasive in American education, one must examine teacher instruction. Several studies have shown that mathematics, in particular at the high school level, is mostly teacher-centered. Teacher-centered classes tend to have lecturing and textbooks at its core for instruction instead of encouraging students to think critically and applying what they have learned to real-world situations (Cobb, Wood, Yackel, & McNeal, 1992). Cuban described teacher-centered instruction as a preference for "teacher talk" over "student talk" (Cuban, 1984).

Butty adds that teacher-centered instruction adheres to a familiar routine, "Checking answers from the previous day's assignments, working some of the homework problems on the board, presenting new materials with examples, and assigning seatwork." (Manswell Butty, 2001, p. 20). According to Yair's research, this method of teaching is alienating for African American students (Yair, 1999). Classroom activities should incorporate multiple approaches to problem solving such as individual exploration, small group work, and peer instruction. Moreover, it is paramount that teachers establish a connection with mathematics in the daily lives of their students through active student inquiry (Manswell Butty, 2001). Presmeg contends that students who experience traditional mathematics instruction have difficulty connecting the relevance of mathematics outside the classroom (Presmeg, 1998). Instead, mathematics is viewed as an isolated subject by the students while teachers are under the premise that students will learn what has been covered.

The alternative to teacher-centered instruction is inquiry-based instruction, which is also supported by the National Council of Teachers of Mathematics (NCTM). NCTM has taken this approach because it believes inquiry-based instruction challenges a students' conceptual understanding by requiring them to resolve problematic situations (Manswell Butty, 2001). Many believe mathematics reform is long overdue and that mathematics teachers should reject curricula that promotes thinking about math in a fixed, rigid vacuum. More importantly, mathematics instruction should not have rules dictated by outside agencies that focus primarily on standards of accuracy, memory, and speed (Porter A. C., 1989; Stodolosky, 1988).

All of the research regarding African Americans' performance on standardized tests indicate that low mathematical achievement and poor scores as a group on standardized tests such as the Scholastic Aptitude Test has become the norm. However, one could argue whether this is a product of teacher instruction, tracking, or the stereotype threat that Claude Steele has researched extensively. Studies linking academic achievement and instructional practices have prescribed that the quality of a teachers' instruction impacts children's task involvement and subsequent learning in mathematics (Manswell Butty, 2001).

Effective teacher instruction must encompass culturally responsive teaching that utilizes curriculum as a tool to help students reach their full potential. According to Gay, "The fundamental aim of culturally responsive pedagogy is to empower ethnically diverse students through academic success, culturial affiliation, and personal efficacy." (Gay, 2000, p. 111). To make a positive impact, it is imperative that the information is accessible to students and is relevant to their lives and experiences in the community in which they live. The ideology that teachers need to prioritize both the student and the curriculum equally can be traced back to John Dewey. He believed that the idea of both the student and curriculum as mutually exclusive was

detrimental to quality teaching. Further, Dewey maintained their curricula must be "psychologized" if the content is to be relevant and effective (Dewey, 1902).

## Culturally Relevant Pedagogy and Curriculum

While it is important for teachers to differentiate instruction, it is equally important for teachers to create or utilize curricula that incorporate students' personal experiences and cultural heritage. Gay encourages teachers and students to pursue their own research on how various mediums such as: textbooks, the media and other curriculum content affect knowledge, behaviors and attitudes toward cultural and ethnic diversity (Gay, 2000). Shor and Freire interpret these learning experiences as the essence for high-quality teaching and describe it as "research-teaching". They contend, "It helps teachers to develop curriculum content that is intrinsically motivating; places students and teachers in closer interaction with each other and facilitates better collaboration between them; and produces grassroots knowledge and perspectives that challenge the official ideologies marketed by schools." (Shor & Freire, 1987, pp. 8-10).

Competent culturally responsive teaching cannot succeed if teachers do not understand how ethnically diverse students learn because, the processes of learning, not the intellectual capability to do so, is influenced by the students' cultural socialization (Gay, 2000). To avoid the perils of labeling, it is important to note that everyone within a particular ethnic group does not learn the same way. However, researchers have carefully analyzed characteristics of learning styles observing cultural value themes and behaviors that impact how children learn. These observations identify functional strategies for altering instructional practices to improve teaching for ethnically diverse students (Bennett, 1995). Learning styles should be utilized as a tool for

improving the performance of ethnically diverse students by providing more cultural continuity in instruction, not as a means for sorting them.

American schools' curricula are comprehensive, which is why instructional consistency as students matriculate is extremely vital to their success. Gay contends, "Establishing congruity between different aspects of the learning processes of ethnically diverse students and the strategies of instruction used by classroom teachers is essential to improving their academic achievement. This continuity requires that teachers contextualize the instruction of students of color in their various cultural forms, behaviors, and experiences." (Gay, 2000). Howe and Ormrod summarized some of these principles of learning in an effort to promote instructional bridging and contextualizing. The principles convey that teachers need to understand how students learn so that new knowledge can be taught through their own learning system. They articulate the following beliefs:

1) Students' existing knowledge is the best starting point for the introduction of new knowledge (principle of similarity)
2) Prior success breeds subsequent effort and success (principle of efficacy)
3) New knowledge is learned more easily and retained longer when it is connected to prior knowledge, frames of reference, or cognitive schematas (principle of congruity)
4) Reducing the "strangeness" of new knowledge and the concomitant "threat of the unfamiliar" increases students' engagement with and mastery of learning tasks (principle of familiarity)
5) Organizational and structural factors surrounding how one goes about learning have more powerful effects on the mastery of new knowledge than the amount of prior knowledge one possesses, per se (principle of transactionalism)

6) Understanding how students' knowledge s organized and interrelated—their cognitive structures—is essential to maximizing their classroom learning (principle of cognitive mapping)

(Gay, 2000, p. 148; Howe, 1984; Ormrod, 1995)

According to Gloria Ladson-Billings, "Some have argued African American childrens' poor mathematics performance is the result of a discontinuity that exists between students' home language and the perceived 'precision' of mathematics and mathematical language." (Ladson-Billings, 1997, p. 697). Schools that have not adhered to the guidelines for revamping mathematics education according to the National Council of Teachers of Mathematics (NCTM) continue to emphasize repitition, rote memorization and convergent thinking (Ladson-Billings, 1997). These acts fall under "the pedagogy of poverty" ideaology as described by Haberman (1991). Haberman contends, "This pedagogy of poverty includes such routine teaching acts as "giving information, asking questions, giving directions, making assignments, monitoring seatwork, reviewing assignments, giving tests, reviewing tests, assigning homework, reviewing homework, settling disputes, punishing noncompliance, marking papers, and giving grades." (Haberman, 1991, p. 290). Haberman highlights that these acts may appear "normal" when observed separately; however, incorporated into the classroom exclusively and systematically it has become the status quo in urban schools.

Haberman states that the pedagogy of poverty appeals to multiple constituencies for the following reasons (Haberman, 1991):

1) ***It appeals to those who themselves did not do well in school.*** "Too many of the teachers assigned to urban classrooms fail to enjoy intellectual pursuits. Their own work in school was mediocre, and teaching was a choice of convenience rather than one of

informed and reflective decision making. These teachers typically were not good mathematics students, and their orientation to mathematics is as a rule-governed, right-answer, "hard" disipline." (Ladson-Billings, 1997, p. 701)

2) ***It appeals to those who rely on common sense rather than on thoughtful analysis.***

"Teachers who practice this kind of pedagogy are more likely to suggest that students need to learn or do something because that is the way they learned or did it. Rather than make curricular and instructional decisions on the basis of empirical research or a systematic study of students' classrom performances, they do what "feels" right. Thus strictly following the mathematics textbook and completing problem sets become the rule." (Ladson-Billings, 1997, p. 701)

3) ***It appeals to those who fear people of color and the poor and who have a need for control.***

"Teachers and administrators sometimes become so consumed with the notion that African American children must be managed that they forget that they need to be taught. Maintaining order and keeping children under control become the preoccupation of the teachers." (Ladson-Billings, 1997, p. 702)

4) ***It appeals to those who have low expectations for children of color and the poor.***

"A notion prevails in American culture that academic excellence is a result of genetic good fortune. This concept—that some students 'have it' whereas other do not—is particularly pernicious when directed toward African American students. Teachers who presume that because students are of a particular race or ethnicity they cannot be expected to perform at high levels in mathematics fail to present those students with a challenging, intellectually rigorous mathematics curriculum. Instead, their mathematics

curriculum is best described as overly directive and controlling." (Ladson-Billings, 1997, p. 702)

5) ***It appeals to thoses who do not know the full range of available pedagogical options available.***

"It stands to reason that if teachers have not performed well in school, approach teaching unsystematically, fear their students, and hold low expectations for them, they are likely also to possess a limited teaching repertoire. Calling on past (bad) practices, these teachers tend to reproduce the kind of unimaginative, stifling pedagogy that has failed to serve students of color for many years." (Ladson-Billings, 1997, p. 702)

Perhaps the best opportunity for improving African Americans' achievement in mathematics is to modify our pedagogy. Scaffolding the instruction must be the main focus of the classroom because it is the most effective tool for extending the students' thinking and abilities beyond what they know. (Ladson-Billings, 1997). By the time a child starts kindergarten, rules and procedures for demonstrating their skills and acquiring knowledge have been internalized through their cultural socialization. The ethos of these culturally influenced rules solidify how individuals engage intellectual challenges their entire life (Gay, 2000).

A child's learning style is just as important to their acquisition of knowledge. A learning style is defined by More and Shade as the means one consistently uses for cognitive problem solving and for exhibiting one's knowledge and aptitude. (More, 1989; Shade, 1989). Gay contends that, "Some ethnic-group members exhibit 'purer' learning style characteristics than others." (Gay, 2000, p. 152). The "degree of purity" according to Gay is affected by variables such as, "levels of in-group ethnic identification and affiliation, education, social class, and gender." (Gay, 2000, p. 152).

While many mathematics educators debate about the type of mathematics pedagogy African Americans students need to utilize to be successful in school, Carter G. Woodson proposed mathematics education for African Americans based on tradition and experience (Tate, 1995). Woodson stated, "And even in the certitude of science or mathematics it has been unfortunate that the approach to the Negro has been borrowed from a 'foreign' method" (Woodson, 1990). Woodson believed that education founded on the experiences, desires and thought-processes of white people was inappropriate for African Americans (Woodson, 1990).

Asante is one of many researchers who has called for a more culturally relevant form of education called "Africentricity", which is based on African American students' traditions and experiences (Asante, 1991). Tate describes culturally relevant pedagogy as, "A pedagogy of opposition that builds on the thinking, experiences, and traditions of African American students." (Tate, 1995, p. 169) Through these traditions and experiences, Asante anticipates they will be better equiped to relate to other cultural perspectives. This ideology opposes traditional instruction that intends to transform students into the status quo of existing economic and social arrangements. The main objective of culturally relevant pedagogy is to enable students to analyze society and after reflective anlysis, attempt to promote change (Ladson Billings, 1992) .

Scholars such as Stanic have developed theories about culturally relevant methods to mathematics education (Stanic, 1991). Stanic believes that it is important to study the epistemological foundation of mathematics education if one is to create equity for all. Further, he asserts that the foundation for research and reform in mathematics education stem from culture practice theory and critical theory (Stanic, 1991). Culture practice theory is based on knowledge set within certain contexts while culture practice theory acknowledges the discontinuity between schooling and other aspects of one's life (Stanic, 1991).

According to culture practice theory, in-school knowledge is obtained by working in isolation solving well-defined problems and memorizing rules. This type of knowledge is difficult to transfer and is very narrow . Out-of-school knowledge, in contrast, is obtained by working to solve ill-defined problems in an effort to build personal meaning (Tate, 1995)

Stanic believes that culture practice theory lacks the analysis needed to evaluate the relationship between cultural discontinuity and social inequality (Stanic, 1991). However, culture practice theory does acknowledge the discontinuity prevalent between other contexts of our lives and schooling. Stanic asserts that the chasm created is filled by critical theory, which creates a blueprint to examine the relationship between econmic and political inequality and the school mathematics curriculum (Tate, 1995). Indeed, Stanic's blueprint suggests the primary objective of mathematics education is to equip citizens with the knowledge to participate in collective and individual social action. Hence African American students should be inspired to utilize mathematics as a means to promote change in their personal ives (Tate, 1995)

Research in linguistics has provided insight into the African American experience in mathematics. After collecting work from her students over a period of nine years, Orr determined that in order for African Americans to be successful in mathematics, they must be able to translate between standard English and mathematical constructs (Orr, 1987). She based her findings on the relationship between Black English venacular and the effect it has on a student's ability to understand specific quantitative relationships. Orr believes that mathematics teachers must be willing to incorporate the African American experience into their pedagogy (Orr, 1987). Hence teachers must also allocate time to understand the African American experience and culture.

Baugh opposes Orr's theory on the basis it reenforces the negative perception that Black English venacular lacks important linguistic content that is vital to success in mathematics (Baugh, 1994). Further, Baugh contends that Orr's hypothesis is based on the belief that nonstandard English is more primitive than English as a dialect and that English is more logical. According to Baugh, there is no historical information that suggests English was developed under the precept or principles of mathematics (Baugh, 1994). Baugh contends that educators should build on the language and culture of the student by incorporating culturally-relevant educational routines. Additionally, mathematics programs should make an effort to engage students by choosing problem-solving topics of interest and integrating team projects into the curriculum (Baugh, 1994).

**Cooperative Learning**

There is significant pedagogical power in cooperative learning. This instructional practice according to Gay, "Has similar positive effects for students across ethnic, gender, and ability groupings, achievement measures, and intervention scale." (Gay, 2000; p. 159). Indeed, the work of Uri Treisman with African American and Latino students at the University of California at Berkeley is a testament to the influence of cooperative or collaborative learning (Asera, 2001).

In 1973, the Special Scholarships Committee at the University of California at Berkeley proposed a new Professional Development Program aimed at identifying high-achieving minority students in high school. Once these students were identified, they were invited to join the Professional Development Program (PDP), which was created to provide academic support in mathematics for incoming freshmen (Asera, 2001).

While the faculty designers of the the PDP had good intentions, they did not anticipate that various social forces could impact their work with the students. This became evident to Treisman when he noticed more than sixty percent of the minority students failed freshman calculus (Asera, 2001). Minority students who earned high scores on the Standardized Aptitude Test (SAT) comparable to White and Asian-American students found themselves earning failing grades in calculus (Fullilove & Treisman, 1990). Treisman describes this phenomenon of minority students who appear well-prepared for calculus according to standardized test scores as "overprediction" (Asera, 2001).

In an effort to unearth the factors contributing to the failure of minority students in calculus, Treisman decided to spend a year and a half observing the academic and social lives of African and Asian American students at UC Berkeley (Fullilove & Treisman, 1990). Treisman believed that through his observation, he would attain better insight as to why Asian American and white students were so successful in calculus. As a result of his analysis, Treisman dispelled several misperceptions about African Americans. Those misperceptions were that minority students' failures were due to poor motivation, poor academic preparation, or lack of family support (Asera, 2001). In fact, Treisman discovered African American students were just as motivated, experienced comaparable preparation in high school, and received support from home. Further, some of the African American students were the children of college graduates, while others were the first generation to attend college. The family members of some students had attended historically black colleges or universities in the South, while others did not (Asera, 2001).

Treisman contended that part of the problem was the academic and social isolation of African American students on a predominantly White campus. This academic isolation resulted

in most African American students studying alone. Although African Americans managed to socialize and make friends, it was a separate activity with a different group of friends (Fullilove & Treisman, 1990).

In contrast, Asian American students studied in isolation first and then met in groups to review their work together. Treisman noted that Chinese Americans did not compartmentalize their academic and social interactions. In fact, they conducted informal study sessions that included food, music and at times, visits from family members (Asera, 2001). According to Steinberg, Dornbusch, and Brown, this type of socialization is common in Asian cultures and begins at an early age (Steinberg, Dornbusch, & Brown, 1992).

Within weeks of the semester starting, Asian Americans had organized themselves into informal study groups. The benefits for Asian American students working in groups were plentiful. Because they worked as a group, it allowed them to be efficient and complete several tasks that were vital to success at UC Berkeley (Fullilove & Treisman, 1990). In addition to the professor and the graduate student, who served as a teacher's assistant, working in groups provided the Asian American students an additional resource for solving complex calculus problems.

Perhaps the most important distinction between the Asian and African American students besides working in groups and in isolation respectively, is the fact that Asian American students spent approximately fourteen hours per week studying. This is in contrast to African American students spending approximately eight hours studying math at the recommendaton of mathematics professors at UC Berkeley (Fullilove & Treisman, 1990). Further, African American students rarely sought assistance from each other or their professor's teaching assistant (Fullilove & Treisman, 1990).

The functionality of the Asian American groups was impressive because it was the equivalent of an information hub of various strategies and techniques for solving calculus problems. Students checked each other's work and pointed out errors in their calculations. When one student met with a teaching assistant about a challenging problem, he or she shared that information with the group. African American students, in contrast, approached most difficult problems they could not solve by searching for computational errors in their work or by following the textbook examples (Fullilove & Treisman, 1990). The strategies Asian American students utilized reaped huge rewards because Asian Americans outperformed African Americans and other ethnic groups according to their final semester grades in calculus (Asera, 2001).

As a result of his findings, Treisman created the Mathematics Workshop Program (MWP), which incorporated the collaborative strategies Asian Americans utilized in their groups. Treisman realized that mathematics was hard through his own experience of spending hundreds of hours learning mathematics. He believed that if students did not have enough experience entering college, their mathematical experience needed to be intensified. The key to accomplishing this goal was to provide students with more time (Asera, 2001).

Treisman carefully examined the freshman calculus curriculum to identify the major objectives that were vital for understanding an introduction to calculus course, but subsequent mathematics courses as well (Asera, 2001). He knew that the students who had the ability to do well in mathematics, but lacked enough exposure, would need the mathematical concepts stated clearly. Quite often the typical student who attends UC Berkeley, who became mathematics majors, had been enrolled since middle school in advanced mathemtaics and science courses or who had grown up with family members skilled in mathematics (Asera, 2001).

Treisman knew that a robust curriculum incorporating well-crafted calculus problems could serve as a catalyst to the students' learning. For those students who did not have an intensive background in mathememathics, it would provide them the opportunity to learn mathematics in depth (Fullilove & Treisman, 1990). Further, as the students solved problems, they would become more familiar with the concepts through mastering the language of mathematics.

In 1977, Treisman and other mathematicians set in motion the first Mathematics Workshop based on his observations. Students attended the Workshop six hours each week and participation was voluntary (Fullilove & Treisman, 1990). Treisman and the workshop leaders spent a great deal of time creating calculus problems so challenging that it required students to work in groups. The problems were difficult because they incorporated several mathematical concepts from different chapters of the textbook. Some problems were designed specifically for some students to help them master different concepts, while other problems were written to expose gaps in a students' mathematical background (Asera, 2001). The workshop rejected incorporating remediation into the program except in cases where students needed to hone algebra and triogonometry concepts within the context of working on difficult calculus problems.

During the time Treisman began his mathematics workshop, UC Berkeley ran a learning center program which emphasized remediation. Treisman believed that addressing the achievement gap by creating remedial programs was counterproductive because they were based on assumptions and not derived from analysis or observation. The objective of the learning center was to deliver: individualized, self-paced, remedial instruction. This type of pedagogy exacerbated the academic isolation Treisman had observed as a major cause of African American failure (Asera, 2001).

One of the most distinguishing characteristics of the workshop was the emphasis on students collaborating in small groups. In addition to mastering mathematical content, students experienced what it was like to be a member of an academic community. The conversations derived from the group work were meant to help students articulate their mathematical ideas and listen to others (Asera, 2001). The instructor's role was to facilitate the group and individual by posing questions and pushing them to think harder. Because each students individual contributions to solving the problems were made public in the group, each student had the opportunity to analyze how his or her peers utilize various mathematical ideas (Asera, 2001).

While there were several motives for creating the calculus problems, one of the most significant lessons Treisman wanted to convey was to dispel the idea that doing well meant solving problems quickly and easily to the belief that doing well, meant working hard and perservering. In contrast, students in the program who struggled in mathematics, but who had learned the importance of working hard in high school, had the opportunity to see other students struggle and make mistakes (Asera, 2001). Additionally, for those students who frequently worked alone, working collaboratively within groups showed them alternative strategies for solving calculus problems. Indeed, one may conclude that the fact that the process of solving calculus problems is public and shared with an ethnically diverse group of students, the "stereotype threat" phenomenon described by Claude Steele may be insignificant (Asera, 2001).

The Mathematics Workshop created a culture of acheivement because it helped the students understand the academic culture and demands of the UC Berkeley. While several mathematics professors suggested that students should study at least two hours for each class contact hour, Asian American students who received "A's" in the class did not follow the advice of the professor. Instead, they sought advice from older siblings and friends who had taken

calculus (Fullilove & Treisman, 1990). As a result, they averaged at least fourteen hours of studying outside of class. This was duplicated in the mathematics workshop when students were able to triangulate their work in relation to the work of their peers. This proved vital in helping students understand what was truly required for them to succeed (Asera, 2001).

Data collected on 646 students who joined the mathematics workshop over nine years imply that the program was extremely successful. The facts are: (1) Two to three times as many of them earned grades higher than than their non-mathematics workshop peers (Improvement in students' course grades, collected at two different times, support this conclusion); (2) Only three percent of the students in 1978-1982 and severn percent in 1983-1984 rceived grades of "D+" or less; (3) The percentage attaining a "B-" or above was 54 in 1978-1982 and 58 in 1983-1984; (4) Individuals considered high-risk in the mathematics workshop performed better than non-mathematics workshop students who had stronger academic backgrounds; (5) The proportion of mathematics workshop participants from the lowest performance triad of the mathematics portion of the SAT (scores of 200-460) who earned grades of "B-" or above in an introduction to calculus course was equivalent to the number of non-mathematics workshop students who scored in the highest performance triad (scores of 560-800); (6) The graduation rates of African Americans in the mathematics workshop program was 65 percent, in comparison to 41 percent for their non-mathematics workshop peers (Gay, 2000, p. 161; Fullilove & Treisman, 1990).

**Student and Teacher Attitude/Behavior**

Teachers must develop a positive identification with African American students if they are to be more effective in their teaching practices. According to Ladson Billings, "Teachers must perceive them to be like them—that is fully human and possessing enormous intllectual

capacity." (Ladson-Billings, 1997, p. 704). This self-reflection among teachers is important because it is reported that teachers, perhaps unknowingly, favor students who they perceive to have the same interest and values (Spindler & Spindler, 1982). It is critical for teachers to know and understand the individuals in the classroom; however, it is more significant for teachers to understand the functionality of the group and how the students relate to, and operate within the group (Ladson-Billings, 1997).

In 1987, Garibaldi was asked to conduct a study on black males in the New Orleans Public School District and chair a task force of community leaders and educators (Garibaldi, 1992). The school district was concerned about African American males disproportinate representation in practically all categories of academic failure. Although academic failure and disengagement for African American students begin as early as the fourth grade, African American males appear to perform lower than African American females (Garibaldi, 1992). According to Carter and Wilson, African American female undergraduates outnumbered African American males by more than 240,000 in 1988 (Garibaldi, 1992; Carter & Wilson, 1991).

Garibaldi and the committee analyzed data for the New Orleans Public School District and unearthed some troubling data.The New Orleans Public School District was comprised of 86,000 students for the 1986 to 1987 school year, wherein 87 percent of the students were African American (Garibaldi, 1992). While African American males comprised 43 percent of the district's population, they accounted for 58 percent of the nonpromotions, 65 percent of the suspensions, 80 percent of the expulsions, and 45 percent of the dropouts (Garibaldi, 1992).

The Prince Georges County school system located in Maryland, conducted a similar study analyzing the performance African American males. They noticed the performance data for African American males and females on criterion-referenced tests in mathematics was

comparable to that of white studetns up to the third grade (Garibaldi, 1992). However, by the fourth grade black males experienced a steep decline in criterion-referenced mathematics.

This disturbing phenomenon surfaced in data collected during the 1988 to 1989 school year in Milwaukee's public school system. There, 45 percent of African American males scored at or above the national average in the second grade. By the fifth and seventh grade, that proportion had dropped to 33 percent and 22 percent respectively (Force, 1990). For African American females, 45 percent of them scored at or above the national average in the second grade. By the fifth and seventh grade, that proportion dropped to 37 percent and 26 percent respectively (Force, 1990). Data clearly suggests a national decline in mathematics performance for African Americans around the fourth grade.

Despite poor academic performance, 95 percent of 2,250 African American males surveyed in the New Orleans school district stated they expected to graduate from high school. Further, 40 percent stated that they believed their teachers did not set high expectations for them and 60 percent wanted their teachers to push them harder (Garibaldi, 1992). When 318 teachers responded out of a random sample of 500, six out of ten teachers believed their black male students would not attend college. What is more troubling about these results is that 60 percent of the teachers sampled taught in elementary schools, while 70 percent of them had 10 or more years of teaching experience. Perhaps the shocking statistic is that 65 percent of the teachers were black (Garibaldi, 1992). Hence teachers, regardless of race, are capable of holding negative stereotypes about children they teach.

When a sample of 3,523 African American parents were surveyed, eight out of ten believed their sons expected to go to college (in comparison to four out of ten teachers who answered the same question) (Garibaldi, 1992). It is also important to note that one-fourth of

the parents who responded never attended their child's parent/teacher conferences. During these conferences, report cards are distributed and the student's performance in class is discussed (Garibaldi, 1992). Perhaps the dismal parental involvement fuels the teachers' perceptions that the children of these parents are not interested in finishing school or pursuing education beyond high school. These incorrect assumptions are detrimental because some parents may care deeply about their child's success, but may not be able to attend for various reasons.

Researchers and educators have several opinions about the impact culture has on the attitudes and behaviors of African Americans towards mathematics. Ladson-Billings contends, "Mathematics functions as a feared and revered subject in our culture. We fear it because we believe that it is too hard, and we revere it because we believe that it signals advanced thinking reserved only for the intelligentsia." (Ladson-Billings, 1997, p. 698). Further, she believes the distortion and mystification of mathematics has lead to the perception that people successful in mathematics consist of, "white males with horn-rimmed glasses" (Ladson-Billings, 1997, p. 699). Hence making success in mathematics appear impossible and unsuitable.

Among major ethnic and language minority groups in the United States, African Americans have shown the least amount of improvement in mathematics (Cross, 1995). Hispanics have not fared well in mathematics achievenment either, which raises one major concern for several educators. If African Americans and Hispanics are the fastest growing ethnic groups, and a significant majority of them are not reaching their full potential in mathematics and science, it would subsequently have a negative impact on human resources provided in the United States (Thomas, 2000). In fact, the Bureau of the Census stated that 30 percent of the United States population will be ethnic minorities by 2005 and up to 50 percent by 2050 (Peng,

1995). Indeed, if African Americans and Hispanics continue to under-achieve, it may have a substantial negative impact on the economic strength and competitiveness of the United States.

Given the technological advancements and the analytical and reasoning skills required by most jobs, students with advanced mathematical thinking skills have more economic opportunities (Thomas, 2000). Moreover, studies have indicated that high school graduates who did not perform well in mathematics and decided to pursue post-secondary options, were less likely than other students to major in a mathematics or science-related fields in college (Peng, 1995; Thomas, 2000). Many educators believe this may elucidate the significant under-representation of African Americans and other ethnic minorities in these fields.

Studies conducted by Willig, Harnisch, Hill, and Maehr have addressed the effect of motivation variables on mathematics achievement based on race. They contend that test anxiety that resulted in poor academic performance was related to negative attributions and a lack of a sense of competence among Hispanic, African American and white students (Thomas, 2000; Willig, Harnisch, Hill, & Maehr, 1983). Other research has suggested that students can compensate for their deficiences in cognitive ability and aptitude if they are motivated to succeed and display perseverance (Gross, 1993; Ibe, 1994; Thomas, 2000).

Research suggests that the home environment has a significant impact on achievement. The home environment encompasses the parents' level of education, encouragement and expectations from relatives, and resources in the home (Gross, 1993; Thomas, 2000). Additionally, research suggests that when students have a home environment that is structured and nurtured, it positively impacts cognitive achievement (Benbow, Arjmand, & Walberg, 1991). Other researchers such as Ibe established that the home environment had minimal direct effect on mathematics achievement. However, Ibe stated that the home environment indirectly

affected mathematics achievement through its impact on students' motivational attributes and cognitive skills (Ibe, 1994; Thomas, 2000).

A careful analysis of the history of education in the United States indicates children from low income families are disproportionately placed at risk of acadmic failure (Borman & Overman, 2004). In addition to poverty, researchers have affiliated one's status as a cultural or racial minority with academic jeopardy (Gordon & Yowell, 1994). In a more systemic manner, schools may knowingly or unknowingly create risk factors for children of poverty by failing to provide them with a supportive environment, establishing low academic expectations, and providing inferior educational resources (Borman & Overman, 2004). Academic risks may be affiliated with students leaving low income and minority family communities and traveling to communities with signficant mainstream values embedded within the academic culture and curriculum (Borman & Overman, 2004; Delpit, 1995; Gordon & Yowell, 1994 ). For example, Ogbu and Fordham argued that African Americans have developed an "oppositional" attitude and culture that associated academic success with "acting white" or "selling out" (Ogbu, 2003). This belief stemmed from the fact that African Americans have historically had fewer opportunities in the United States. Hence individual and school characteristics and their interactions may increase the chance of academic failure (Borman & Overman, 2004).

Resilient children typically have the same individual characteristics. They have high self-efficacy, high self-esteem and autonomy (Borman & Overman, 2004). Further, they usually are active participants in their school, possess strong interpersonal skills, maintain healthy expectations (Borman & Overman, 2004; Finn & Rock, 1997). A signficant amount of the research on resilience in children has historically focused on disadvantaged minorites with a low socioeconomic status. In fact, Taylor identified additional risk factors linked with being an

African American. These risk factors include discriminatory behavior on a daily basis from individuals and institutions, and occupational, political and residential restrictions initiated due to race (Borman & Overman, 2004; Taylor, 1994).

Resilience research offers insight as to why some individuals achieve at high levels despite adversity. More importantly, it is the role of the school to adopt strategies to help African American students become more resilient. Researchers frequently cite the need for caring and supportive teachers, a safe and structured school environment, opportunities for students to become thoughtfully engaged, and improved efforts to strengthen partnerships between home and school (Borman & Overman, 2004). Perhaps the student teacher relationship is the most significant factor. According to Ferguson, the research he reviewed indicates that teachers' beliefs, behaviors, and expectations may affect African American students more than Whites.

## Teacher Quality

The achievement gap in mathematics will continue to exist as long as qualified teachers remain one of the most inequitably distributed resources. A significant percentage of the achievement gap consists of minority children who are poor and are continously exposed to inferior teaching and curricula (Darling-Hammond & Berry, 1999). Indeed, it is evident that the United States needs to do a better job helping a wide range of learners acquire sophisticated skills to navigate in a global and knowledge-based society.

The practice of recruiting and retaining quality teachers elludes a significant number of school districts due to idiosyncratic criteria, unnecessary procedures and highly variable standards (Darling-Hammond & Berry, 1999). According to the National Center for Education Statistics, as many as 30 percent of new teachers leave the teaching profession within five years

of entry (National Center for Education Statistics, 1993). However, the key to lowering attrition rates lies in the implementation of high quality preparation, induction, and mentoring programs. These programs need to be buttressed with a framework for policy that creates a clearly defined infrastructure of recruitment and preparation for teachers.

The manner in which the United States currently develops its human resources for education is defective (National Commission on Teaching and America's Future, 1996) . For example, The National Commission on Teaching and America's Future noted the following deficits: (1) Recruitment of teachers and other educational staff is frequently ad hoc; (2) There is a disconnect between the training that the teacher receives and the needs of a heterogeneous classroom; (3) There is a disconnect between the school district goals and expections and what constitutes quality teaching; (4) There is not enough emphasis on enhancing induction and mentoring programs. When districts experience budget cuts, these programs are usually the first to get eliminated (National Commission on Teaching and America's Future, 1996).

Given the increase in demand for qualified teachers, more ambitious school improvement objectives, and changing student demographics, the Commission contends the United States needs a more systemic approach to recruit, develop, and support teachers. The Commission has suggested incorporating these key elements to obtain this objective:

- Revamp preservice preparation programs that would heighten the overall competence of the teaching force by equipping teachers with the kinds of knowledge and skills they need to succeed once they are hired
- Create more innovative and coordinated approaches to teacher recruitment, selection, and hiring

- Implement a national system for licensing and distributing teachers that would enable teachers to transition from places they are prepared to the places they are needed
- Create more supportive induction procedures in the early years of teaching; and policies for teacher preparation, licensing, hiring, and recognition that reinforce well-grounded conceptions of teaching and that help teachers acquire the skills and knowledge implied by such standards, thus allowing educational policymakers and practitioners to use common measures in making decisions about who will teach and how they will be prepared and supported. (Darling-Hammond & Berry, 1999 p. 255; National Commission on Teaching and America's Future, 1996)

Minority students who are poor are usually concentrated in areas where schools are not adequately funded. Most of these schools are located in an urban areas that are underfinanced in comaprison to their neighboring suburban districts (Kozol, 1991). According to Darling-Hammond, "Policies associated with state school funding, district resource allocations, and school-level tracking generally leave minority students with fewer and lower quality books, curriculum materials, laboratories, and computers; significantly larger class sizes; less-qualified and less-experienced teachers; and less access to high quality curriculum." (Darling-Hammond & Berry, 1999).

There are several factors that contribute to the underperformance of poor minority children, but recent studies indicate teacher quality as the most important school resource differential between black and white students (Darling-Hammond & Berry, 1999). Several studies suggest that the differential in teacher quality and effectiveness is a reliable determinant of disparaties in student learning. Further, the most ineffective teachers are twice as likely to be assigned to African American students while the most effective teachers are about half as likely

to be assigned to African American students (Darling-Hammond & Berry, 1999). In fact, Ron Ferguson's analysis of 900 Texas school districts noted the large disparities in academic achievement between African American and white students were heavily accounted for by differences in the qualifications of their teachers after controlling for socioeconomic status (Ferguson, 1991).

Ferguson furthered his analysis of this phenomenon in Alabama with the help of Ladd. Together, they discovered that teacher qualifications and class size was responsible for more of the predicted disparities between districts scoring in the top and bottom quartiles in mathematics. The combined effects of parental education, race and poverty had less of an impact. Strauss and Sawyer echo Ferguson's findings with their research conducted in public schools in North Carolina. Strauss and Sawyer reported, "Of the inputs which are potentially policy-controllable (teacher quality, teacher numbers via the pupil-teacher ratio and capital stock) our analyses indicates quite clearly that improving the quality of teachers in the classroom will do more for students who are most educationally at risk, those prone to fail, than reducing the class size or improving the capital stock by any reasonable margin which would be available to policy makers." (Strauss & Sawyer, 1986, p. 47).

According to the National Center for Education Statistics (NCES),teachers of color comprised 15% of novice teachers in 1994 with one to three years of experience (National Center for Education Statistics, 1997). A decline in the numbers of African Americans entering the teaching profession in the 1990s offset the gains made by an increase in the recruitment numbers for Asian, Hispanic, and Native American teachers (Darling-Hammond, Dilworth, & Bullmaster, in press). While there is a meager supply of candidates of color, nonminority

applicants do not have the experience needed to successfully connect with students from culturally diverse environments (Darling-Hammond & Berry, 1999).

The National Council for Accreditation of Teacher Education (NCATE) has required the colleges it accredits to recruit a diverse student population and address issues pertaining to cultural responsiveness in teaching. Despite the efforts of NCATE, most colleges that train teachers are not accredited (Darling-Hammond & Berry, 1999). Many of these non-accredited schools have failed to modify the curriculum so that future teachers will acquire the necessary skills to effectively educate a culturally diverse student population (Darling-Hammond & Berry, 1999). This exacerbates the recruitment and retention problems that are prevalent in urban school districts. Further, the shortages created by unprepared teachers lead to larger class sizes, poor teaching and access higher level courses (Darling-Hammond & Berry, 1999).

Perhaps the most significant factor when it comes to recruiting and retaining teachers is administrative leadership. Studies support the belief that excellent schools located in high-poverty areas are effective because the princpals serve as instructional leaders (Darling-Hammond & Berry, 1999). Unfortunately, these successful schools are not widespread in low-income communities. According to Darling-Hammond, "Attrition rates are higher in high-poverty than low-poverty schools, and teachers who have left high-poverty schools are more than twice as likely as those in low-poverty schools to leave because of dissatisfaction with teaching." (Darling-Hammond & Berry, 1999, p. 259).

The plight to recruit highly qualified teachers in urban school districts has been well documented over the years. In fact, the National Commission on Teaching and America's future (NCTAF) believes that hiring practices instead of labor market shortages is the primary reason for the hiring of unqualified teachers. Wise, Darling-Hammond, and Berry supported NCTAF's

position in report written for The RAND Corporation. They wrote, "School districts fail to hire the most qualified and highly ranked teachers in their applicant pools due to inadequate information management systems and hiring procedures that discourage good candidates with cumbersome application steps, demeaning treatment, and lack of timely response and follow-up." (Wise, Darling-Hammond, & Berry, 1987; Darling-Hammond & Berry, 1999, p. 260). Additionally, late budget decisions at the state and local levels compounded with the bureaucracy associated with union contracts can hinder an expedient hiring process. In some cases, the hiring process extends until late August or September. Hence urban school districts lose good candidates to other districts or the private sector (Darling-Hammond & Berry, 1999).

Darling-Hammond and Berry outline additional state and school district practices that can undermine teacher recruitment and development:

- Most districts impose a cap on the salaries they offer experienced candidates; as a consequence, highly educated and experienced teachers are often forced to take a cut in pay if they move to a new locality and want to continue to teach. Many choose instead to change professions
- States maintain varying requirements for licensure, and few allow for reciprocity in licensing or the transfer of pension benefits
- Few districts provide reimbursement for travel and moving expenses
- Many districts place beginning teachers in the most difficult schools with the highest rates of teacher turnover, the greatest numbers of inexperienced staff, and the least capacity to support teacher growth and development. Without induction supports, many teachers leave

(Darling-Hammond & Berry, 1999, p. 261)

Ferguson's research in Texas led him to conclude that school districts with significant numbers of students from low-income families need to pay higher salaries to attract teachers comparable to more affluent school districts (Ferguson, 1991). Hence some school districts have implemented bonuses or salary increases to attract teachers in fields such as mathematics and hard-to-staff schools (Darling-Hammond & Berry, 1999). However, little research has been conducted to ascertain the effectiveness of such measures to recruit highly qualified teachers.

Research conducted by Bruno, who calls this type of reward "combat pay", contends that this type of strategy does not retain teachers nor does it improve teaching. Instead, Bruno believes these incentives fail to address deeper issues that result in teachers avoiding certain schools (Bruno, 1986). Bruno suggests that if retention and classroom performance are not addressed simultaneously, "combat pay" will not improve education (Bruno, 1986). Further, Bruno stated several problems that stem from "combat pay" incentives: (1) not all schools qualify for bonuses; therefore, good teachers will be lured away from other school in need of good teachers; (2) unpredictable budget cuts cannot insure that funds will be available to continue "combat pay" incentives; and (3) quite often teachers recruited using "combat pay" are not mentored or properly supervised (Bruno, 1986).

# Chapter 3

## Design of the Study

### Introduction

This chapter will elaborate on the research involved in the study by taking the reader through the research components of: Research Design, Research Questions, Research Methodology, Sample Description, Data Collection Procedures, Method of Data Analysis, Data Reporting Formats and Chapter Summary.

### Research Design

The study is designed as a qualitative case study incorporating a mixed methods approach using quantitative and qualitative data. This case study will assess the impact of an effort to increase the number of African American students who successfully complete a Geometry Honors math course. A descriptive qualitative case study is appropriate for this research because, according to Merriam, "A descriptive case study in education is one that presents a detailed account of the phenomenon under study—a historical case study that chronicles a sequence of events." (Merriam, 1998, p. 38) Merriam believes that "Innovative programs and practices are often the focus of descriptive case studies in education." (Merriam, 1998, p. 38) I am seeking to uncover the motivational dynamics of the learner and the various instructional strategies that work to promote mathematical understanding among African American students during enrichment summer classes. This research design will enable me to document in rich detail the activation of the learning process, as well as to identify obstacles that may hinder the learning process of the participants

Although the study entails significant quantitative data, the true nature of the study is a qualitative case study. Smith (1978) viewed the case study as a bounded system, while Stake

(1995) viewed it as an integrated system. Merriam concludes, "The single most defining characteristic of case study research lies in delimiting the object of study, the case." (Merriam, 1998, p.27) A case study will allow the researcher to analyze the phenomenon in greater detail by comparing quantitative and qualitative data provided by each of the participants. According to Merriam, "The case then, could be a person such as a student, a teacher, a principal; a program; a group such as a class, school, a community; a specific policy; and so on." The focus of this study is a group of African American students who have volunteered to take a three-week enrichment course over the summer to prepare them for the rigors of Geometry Honors.

## Research Questions

The study will attempt to answer the four research questions below.

1) Will African American students who took the summer course complete Geometry Honors during the school year?
2) How do students believe the Geometry Honors Preview course helped them prepare for an honors level course in mathematics?
3) What factors do the data suggest was particularly influential in student success in the Geometry Honors Preview course?
4) Will African American students who enrolled in the Geometry Honors Preview class outperform the African American students who did not attend?

## Research Methodology

This qualitative case study will utilize a mixed methodology incorporating quantitative and qualitative data to assess the effectiveness of a Geometry Honor Preview class. The class is comprised of incoming freshmen who have volunteered to learn the theorems and postulates prior to starting their freshman year at Peake High School. Particular attention and analysis will be given to the African American students who enroll in the course.

It is also important to note that although this is primarily a qualitative case study; a significant part of the information gathered to assess the impact of the Geometry Honor Preview class is quantitative. Although the summer class is purely enrichment and students are not assigned grades for their performance in the course, part of the success of the intervention will be measured by the students' grades during the school year in Geometry Honors. The researcher will gather the quarterly report cards and calculate the GPA's of the African American students individually and as a cohort. The same data will be compared and contrasted with African American students in the Geometry Honors course who chose not to attend the Geometry Honor Preview course over the summer.

Merriam warns of the potential error made by the researcher if the phenomenon is not observed from the participant's perspective. If the researcher fails to take appropriate measures to ensure the participant's perspective is the focus, it may result in limiting the study. It is important to note that the researcher is the primary instrument for data collection and analysis. Merriam states, "Data are mediated through this human instrument, the researcher, rather than through some inanimate inventory, questionnaire, or computer." (Merriam, 1998, p. 7). The researcher will oversee the retrieval of data from the student database. Additionally, he will issue and compile responses from the questionnaires completed by the teacher assistants, participants, and parents of the participants.

The researcher will conduct fieldwork that will entail observing the summer enrichment classes, meeting with the students, math teachers (summer and school year) and parents. Interviewing the students after they complete the questionnaires will allow the researcher to expand on the formal questions in an effort to delve deeply into the issues hindering the achievement of African Americans in Geometry Honors. Merriam describes the fieldwork,

"The researcher must physically go to the people, setting, site, institution (the field) in order to observe behavior in its natural setting." (Merriam, 1998, p. 7)

In addition to qualitative research, it is important to note that the researcher will incorporate quantitative research into the analysis of the performance of the participants. After the participants complete the summer course, their performance in Geometry Honors will be based on their grade point average (which equates to a letter grade). The researcher will use the participant's performance to triangulate qualitative data gathered from the field notes and questionnaires. Merriam elaborates on the stark differences between the two methods of research. Merriam writes, "In contrast to quantitative research, which takes apart a phenomenon to examine component parts (which become the variables of the study), qualitative research can reveal how all the parts work together to form a whole"

## Sample

### Sample Description

African-American students who participate in the Geometry Honors Preview course over the summer will be the primary sample observed by the researcher. Some of the African-American students included in the sample are residents of Peake, a suburb, while some students reside nearby in the inner city of a major city in New England. The African-American students who attend Peake High School, but do not reside in the town, participate in a program that buses inner-city students to suburban schools that are recognized for excellence in education. African-American students are bused to these schools as early as kindergarten.

The students are informed about the course by their eighth grade math teachers and guidance counselors. Summer school catalogs are sent to the guidance counselors at the elementary schools for distribution to interested students. Furthermore, students who are

scheduled to take Geometry Honors are contacted via mail and invited to participate by the summer school director. Eighth grade students scheduled to take Geometry Honors are recommended by their eighth grade math teachers. Although the course was created for students who are taking Geometry Honors in the ninth grade, the summer course is open to all students who would like to take the course.

A purposive sample of five African American students was chosen out of the 17 students who enrolled in the Geometry Honors Preview course because they were the only African Americans in the class. Out of the five African American students, two of them participate in the school district's bussing program (40%). Four out of the five students in the sample are male (80%).

The researcher will compare the primary sample of five African American students with a secondary sample that consists of eight African American students who did not take the Geometry Honors Preview course, but who enrolled in Geometry Honors during the school year. Although these eight African American students did not attend the summer course, they were recommended to take Geometry honors by their eighth grade math teacher. One out of the eight students participates in the district's bussing program (13%), while two out of the eight students in the secondary sample are male (26%). Both primary and secondary samples of African American students comprise 7% of the freshmen taking Geometry Honors (13 out of 188 students).

The researcher acknowledges that there are some differing influences on the sample. Although a student is scheduled to take Geometry Honors in the ninth grade, it does not mean he or she was recommended by their eighth grade math teacher. For example, if a student is recommended for a standard level Geometry class, the parent has the right to accept or reject the

teacher's recommendation. Although the decision whether to schedule a student into a Geometry Standard class or Geometry Honors class may be discussed, ultimately, the parent/guardian makes the final decision as to what math course their child takes.

Another important influence on the sample is that all eight elementary schools are currently working on implementing common assessments for Algebra. Additionally, each math teacher at each elementary school has his/her own criteria as to whether a student should take Geometry Honors freshmen year. The inconsistencies in the eighth grade math assessments and criteria for teacher recommendations may have a significant impact on the readiness of some students in the primary sample. In order to mitigate the difference in readiness, the researcher will incorporate a brief review of algebraic concepts in the Geometry Honors Preview course.

## Data Collection Procedures

Prior to gathering data, the researcher will gain permission from the participating school district, participants and the participants' parents. Data were collected in three steps and stored in a secure location under the control of the researcher. This study used three data collection methods: field notes that included informal interviews with the summer school teacher, questionnaires, and grade-point averages and teacher comments retrieved from the student database.

1. ***Questionnaires:*** The researcher distributed questionnaires to the teacher assistants, participants, and the parents after the participants completed the Geometry Honors course. They completed the questionnaires, sealed them in folders, and delivered them to the researcher's office. The researcher utilized the questionnaires to unpack the participants' perceptions and opinions about mathematics. Furthermore, the

questionnaires provided the researcher with background information about the participants' past experiences in mathematics.

2. ***Field notes:*** The researcher will maintain a journal documenting the steps he took to create the class, the rationale behind the structure of the class and the desired outcomes. Additionally, the researcher will document his experiences making informal observations of the class and interactions with the students, their parents, teacher assistants and the summer school teacher. The researcher's journal will be stored in a secure file cabinet
3. ***Student database software:*** With permission from the headmaster, the researcher will access Peake High School's student database to retrieve the grades of the participants (primary sample) and the African American students who did not take the Geometry Honors Preview course (secondary sample). The researcher will document the students' performance at the conclusion of each of the four quarters in an Excel spreadsheet. The quarterly letter grades will be translated into numerical equivalents to calculate grade-point averages on a 4.0 scale. The researcher will analyze the grade-point averages of both samples individually and collectively in their sample groupings. Also, the researcher will utilize the student database to retrieve the teacher's comments for the students who attended the summer course. This data will be stored on the researcher's computer in a secure file.

## Method of Data Analysis

The researcher will organize, analyze and code the qualitative and quantitative data from the study in an effort to identify common themes that will address the research questions. Rossman and Wilson (1984, 1991) highlight three reasons why qualitative and quantitative data should be linked. They contend: 1) to enable confirmation or corroboration of each other via

triangulation; 2) to elaborate or develop analysis, providing richer detail; and 3) to initiate new lines of thinking through attention to surprises or paradoxes.

The relationship between qualitative and quantitative is mutually beneficial. According to Miles and Huberman, "Qualitative data can help the quantitative side of a study during analysis by validating, interpreting, clarifying, and illustrating quantitative findings, as well as through strengthening and revising theory." (Miles and Huberman, 1994, p. 41) Conversely, Miles and Huberman contend that, "Quantitative data can help with the qualitative side of a study during analysis by showing the generality of specific observations, correcting the 'holistic fallacy' (monolithic judgments about a case), and verifying or casting new light on qualitative findings." The two cohorts, African Americans who enrolled in the summer class and those who did not, will have their grade-point average documented and calculated. Additionally, the researcher will compare the final grade-point average individually and as a group for the two cohorts.

The researcher retrieved the quarterly grades from the student database system for both samples—the students who attended the Geometry Honors Preview class and those who did not. Once the letter grades were obtained, the researcher translated the letter grades into numerical values. For example a letter grade of "B" is equivalent to a "3.0". Once the letter grades were translated, the researcher calculated the grade-point average for each student individually and collectively as a cohort. The database was utilized to provide the researcher with the teacher's comments on the report card for each quarter. This information was useful to the researcher because the data was triangulated with the questionnaires completed by the participants and the researcher's field notes.

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## Data Reporting Formats

The researcher utilized tables and charts to report the quantitative data. The grade point averages were displayed in two separate tables categorizing the African American students who enrolled in the Geometry Honor Preview class and the African American students who did not. The students who attended the summer class had their freshman year report card grades along with their teacher's comments displayed in matrix form.

The researcher masked the real identity of the participants by using fictitious names for both the primary and secondary samples. The students who attended the Geometry Honors Preview course (primary sample) are in italics while the secondary sample is in normal type for all tables and graphs. Further, the primary sample known as the "African American Geometry Honors Preview" was coded "AAGHP". The secondary sample, identified as the "African American Non-Geometry Honors Preview" was coded "AANGHP". Miles and Huberman describe coding as "Tags or labels for assigning meaning to the descriptive or inferential information compiled during a study" (Miles and Huberman, 1994, p.56).

## Chapter Summary

The study will be discussed in reference to the following research questions:

1) Will African American students who took the summer course complete Geometry Honors during the school year?
2) How do students believe the Geometry Honors Preview course helped them prepare for an honors level course in mathematics?
3) What factors in the summer school preview course seemed particularly influential in student success in the Geometry Honors course?
4) Will African American students who enrolled in the Geometry Honors Preview class outperform the African American students who did not attend?

The researcher will employ qualitative and quantitative research methods and data analysis in an effort to determine the extent to which the Geometry Honors Preview class positively impacted African American achievement in Geometry Honors. The participant's questionnaires coupled with the researcher's field notes provided the researcher with enough data to measure the participants' preparedness for the rigors of the honor level.

The second question was addressed through careful analysis of the student's report card. Because 60 to 70 percent of African American students withdraw from Geometry Honors during the second quarter, successful completion of the course by all African American students who attended the Geometry Honors Preview course during the summer is pertinent data.

The researcher uncovered the students' perceptions of the strengths and weaknesses of the Geometry Honors Preview course to address the third question. The researcher accomplished this by reviewing field notes and analyzing the feedback from the questionnaires and interviews completed by the participants. The observations documented by the researcher in his reflective journal was instrumental in validating any assumptions made by the researcher during the data collection process.

The fourth question was answered by the researcher through careful analysis of the grade-point averages of each cohort (AAGHP and AANGHP). Although the "AAGHP" did not outperform the "AANGHP" all four quarters, they did have a higher grade-point average cumulatively for the year.

Chapter Three has outlined: the Research Design, Research Questions, Research Methodology, Sample Description, Data Collection Procedures, Method of Data Analysis and Data Reporting Formats; Chapter Four will reveal the findings utilizing tables and charts as described in Chapter Three.

# Chapter 4

## Analysis of Data and Findings

### Introduction

The purpose of this chapter is to present the data compiled in the study. Chapter Four commences with an introduction to the research project followed by a description of the Geometry Honors Preview course and its participants. Quantitative data comparing the performance of African American students in the ninth grade who enrolled in the Geometry Honors Preview course and those African American students who did not enroll in the summer course are compared and contrasted. The quantitative data are further dissected into performance comparisons of both cohorts on the state test as well as the PSAT (practice scholastic aptitude test).

After the presentation of quantitative data, qualitative data gathered from questionnaires completed by the teacher assistants will follow. Subsequent qualitative data include classroom observations conducted by the researcher and information gleaned from two conferences between the researcher and the teacher. Next, questionnaires completed by the student/participants and their parents provide greater insight into their attitudes and behaviors regarding mathematics and the Geometry Honors Preview course. The qualitative data conclude with teacher comments gathered from the ninth grade report cards of the five participants. The data reveal their quarterly grades in Geometry Honors along with comments written by their respective teachers.

Following the quantitative data, themes are identified by the researcher from the student/participant and parent questionnaires. These themes illuminate strategies and practices

incorporated by students, parents, and teachers that are imperative for academic success. Further, the themes help to address the research questions at the conclusion of Chapter 4.

## The Research Project

For several years, African American students at Peake High School have underperformed in honors and advanced level mathematics courses. Between 60 to 70 percent of African American freshmen enrolled in Geometry Honors withdrew from Geometry Honors into a lower level mathematics course by the end of the second quarter. As the freshman class matriculated, the remaining numbers of African American students in honors eventually withdrew. By senior year (2005/2006), there were practically no African American students enrolled in Calculus.

The researcher had numerous anecdotal explanations as to why African American students were withdrawing from Geometry Honors. The researcher believed that: 1) African American students did not learn the theorems and postulates needed to successfully write geometry proofs; 2) African American students spent less time studying and preparing for quizzes and tests; 3) African American students lacked confidence in their mathematical ability; and lastly 4) African American students did not know how to properly prepare for quizzes and tests in Geometry Honors because it was a different way of thinking mathematically to solve a problem.

Before designing a Geometry Honors summer enrichment course, the researcher believed it was imperative to meet with the African American students who had withdrawn from Geometry Honors. The researcher informally met with four African American students who had withdrawn from Geometry Honors to work on geometry proofs that were assigned during the first quarter. The researcher observed students who had above average skills in Algebra, but lacked knowledge of the theorems and postulates needed to complete geometry proofs. During

the informal conversations, the researcher learned that the students rarely met with their teacher (if at all), and did not complete their homework assignments consistently.

After meeting with the students who withdrew from Geometry Honors, the researcher created a questionnaire for the four African American students who were successful in Geometry Honors. Each of the four students who completed the questionnaire was earning at least a "B" in Geometry Honors. The researcher believed the themes derived from these questionnaires would be instrumental in creating the Geometry Honors Preview course for the summer. The questionnaires, which consisted of ten questions, are on the following pages with the student responses. The names of the students on the questionnaires are fictitious.

# Successful African American Students in Geometry Honors Questionnaire

NICK

1. **Where did you attend elementary school?** *Lake Elementary*

2. **Did you enjoy your experiences at your elementary school?** *Yeah, elementary school was nice*

3. **What math class did you take in the eighth grade? What was your grade?** *Algebra; A*

4. **Did you find your eighth grade math teacher helpful? Challenging? Why or why not?** *Yes; Yes; Mr. Dawkins made math interesting because he applied it to real life. He challenged us by giving us hard tests and asking questions that went beyond the expectations.*

5. **Have you always excelled in mathematics? If yes, what do you attribute to your success?** *Yes; I'm not really sure, but I like Math*

6. **On average, how much time do you spend on math other than the support you receive from your math teacher? Do you listen to music or watch television?** *30 minutes to an hour*

7. **Do you receive any additional support in math other than the support you receive from your math teacher?** *My parents give me extra math problems after my homework is complete. Sometimes the problems are relevant to the homework I am doing, but other times it is random.*

8. **If you had to give advice to an incoming freshman about how to succeed in Geometry Honors, what would you say?** *Pay attention to the theorems, take lots of notes, and work with other students*

9. **How would you describe the level of parental involvement in your education?** *My parents are very involved. They ask how school is going. They look over my homework and proofread my papers.*

10. **Where will you be ten years from now?** *I will be in graduate school studying for a Ph.D in eng*

# Successful African American Students in Geometry Honors Questionnaire

## AARON

1. **Where did you attend elementary school?** *Randolph Elementary*

2. **Did you enjoy your experiences at your elementary school?** *Yeah, small school….tight family environment*

3. **What math class did you take in the eighth grade? What was your grade?** *Algebra; A*

4. **Did you find your eighth grade math teacher helpful? Challenging?** *Why or why not? Yes; Yes; The teacher took time to explain concepts. Also, the teacher gave challenging problems in class and on quizzes and tests.*

5. **Have you always excelled in mathematics? If yes, what do you attribute to your success?** *Yes; I enjoy math and consider it a strength*

6. **On average, how much time do you spend on math other than the support you receive from your math teacher? Do you listen to music or watch television?** *30 minutes to an hour. I do work in the room at my desk. I prefer to study without music because I need a quiet environment to focus.*

7. **Do you receive any additional support in math other than the support you receive from your math teacher?** *I don't receive any additional help outside of class*

8. **If you had to give advice to an incoming freshman about how to succeed in Geometry Honors, what would you say?** *Try your best*

9. **How would you describe the level of parental involvement in your education?** *My parents are very involved. They check in with me and my teachers.*

10. **Where will you be ten years from now?** *I will be attending college.*

# Successful African American Students in Geometry Honors Questionnaire

## EARL

1. **Where did you attend elementary school?** *Lake Elementary*

2. **Did you enjoy your experiences at your elementary school?** *Yeah, the teachers were great and friendly. The teachers were knowledgeable and easily accessible for extra help. I really felt like the teachers cared.*

3. **What math class did you take in the eighth grade? What was your grade?** *Algebra; A*

4. **Did you find your eighth grade math teacher helpful? Challenging? Why or why not?** *Yes; Yes; The teacher offered help after school. Extra homework problems and harder questions on quizzes and tests.*

5. **Have you always excelled in mathematics?** *If yes, what do you attribute to your success? Yes; Spend more time studying for math than other subjects.*

6. **On average, how much time do you spend on math other than the support you receive from your math teacher? Do you listen to music or watch television?** *I spend 45 minutes per night studying in a room with music at times.*

7. **Do you receive any additional support in math other than the support you receive from your math teacher?** *I did not receive help from anyone.*

8. **If you had to give advice to an incoming freshman about how to succeed in Geometry Honors, what would you say?** *Pay attention and study hard.*

9. **How would you describe the level of parental involvement in your education?** *My parents were very involved. They ask about my grades and communicate with my teachers when issues arise.*

10. **Where will you be ten years from now?** *I will be doing something in the field of automotive technology.*

# Successful African American Students in Geometry Honors Questionnaire

## KARA

1. **Where did you attend elementary school?** *Peterson Elementary*

2. **Did you enjoy your experiences at your elementary school?** *Yes*

3. **What math class did you take in the eighth grade? What was your grade?** *Algebra; A*

4. **Did you find your eighth grade math teacher helpful? Challenging? Why or why not?** *Yes; Not really; My teacher was helpful, but I was not comfortable asking for help. My teacher seemed impatient so I learned by consulting with fellow teammates in the gifted and talented program. I challenged myself by helping other students understand math.*

5. **Have you always excelled in mathematics?** *If yes, what do you attribute to your success? Yes; I catch on to math quickly. When I don't understand something, I know how to advocate for myself.*

6. **On average, how much time do you spend on math other than the support you receive from your math teacher? Do you listen to music or watch television?** *15-30 minutes for homework. Approximately 1 hour for quizzes. I prepare by using flashcards and make-up tests. I meet with the teacher after I identify difficult problems on homework. I also turn the television off when I am studying for a quiz or test. I usually leave it on when I am doing work that does not require me to think a lot.*

7. **Do you receive any additional support in math other than the support you receive from your math teacher?** *My brother and sister help me with study strategies.*

8. **If you had to give advice to an incoming freshman about how to succeed in Geometry Honors, what would you say?** *Don't expect Geometry to be easy if you decide not to take AP. Don't give up. Don't expect every test grade to be good. Homework and effort counts.*

9. **How would you describe the level of parental involvement in your education?** *My mom checks in with me each day. She pushes me to try and do my best.*

10. **Where will you be ten years from now?** *Probably in school. I would like to teach.*

The researcher observed the following themes:

- All of the students stated that they had a good experience in their respective elementary schools
- They all received "A's" in Algebra.
- All of the students found their eighth grade math teachers helpful. Although Kara did not feel challenged by her teacher, she found independent methods to challenge herself.
- All of the students stated that they have always excelled in mathematics, which may indicate a high level of confidence.
- On average, the students spent 30 minutes to 1 hour each day studying Geometry.
- Two of the students received additional help in Geometry from family members, while the other two students did not receive any additional help outside of class.
- Their advice to future freshmen was to work hard. Nick's comments were very insightful because his grades in Geometry were higher than the other three students. Nick suggested that students should, "Pay attention to the theorems, take lots of notes, and work with other students."
- All of their parents were involved and invested in their child's education
- All of the students were interested in attending college.

**The Course**

The Geometry Honors Preview course was one of several mathematics courses offered at Peake's summer school program. Students who enrolled in the Geometry Honors Preview course attended class at Peake High School for two hours per day Monday through Friday for three weeks. There were nine students in the first session and eight students in the second session. The same teacher and the same pair of teacher assistants taught each Geometry Honors

section. The teacher assistants were Earl and Kara, sophomores who successfully completed Geometry Honors. The researcher asked Aaron and Nick if they would consider becoming teacher assistants; however, they had already scheduled commitments for the summer. Each teacher assistant was paid $8 per hour.

Each section of Geometry Honors Preview covered the same content. The summer curriculum was designed to cover the postulates and theorems students needed to master to successfully complete the first quarter of Geometry Honors. It is important to note that the Geometry Honor Preview course used a discontinued Geometry Honors textbook formally used by the math department at Peake High School. The researcher decided to use the older textbook out of concern students may not fully participate in homework and/or classroom activities during the school year if they had already solved the problems in the current Geometry Honors textbook. Based upon the researcher's experience teaching mathematics, most students dislike or are less interested in solving problems they have solved before. Additionally, since the course was strictly for enrichment purposes, grades were not issued to students.

**The Student Participants**

The researcher mailed 188 letters to students recommended for Geometry Honors by their eighth grade math teacher. The letters invited all of the students to enroll into the Geometry Honors Preview course offered during the summer. While there were no system-wide criteria that eighth grade teachers used as a basis for their recommendations, they typically based their recommendations on how well the students performed in Algebra. Seventeen students accepted the invitation to enroll in Geometry Honors Preview. Out of the seventeen, six of the students were African American (1 female and 5 males). There were eight African American students who were invited to enroll into Geometry Honors Preview, but declined (6 females and 2 males).

The researcher compared the performances in Geometry Honors between the group of African American students who attended the Geometry Honors Preview class and the African American students who decided not to attend.

**Quantitative Data**

The quantitative data presented compares two cohorts of African American students recommended by their eighth grade teachers to enroll into Geometry Honors. The African American students who enrolled into the Geometry Honors Preview course are denoted as, "GHP" (Geometry Honors Preview). The group of African American students who did not enroll in the summer enrichment course is denoted as, "GH" (Geometry Honors).

Students from both groups have fictitious names. The cohort of African Americans who enrolled into the Geometry Honors Preview course is also in bold and italicized print. It is also important to note that although six African American students accepted the summer invitation, one of the African American males also decided to enroll into a Geometry Standard class. The quantitative and qualitative data that follow is representative of the one female and four males who participated in the summer enrichment class. Below are some interesting facts about the Geometry Honors Preview course.

- 3 of the 17 students were female (18%), 14 were male (82%)
- 6 were African-American (35%), 4 were Asian-American (24%), 7 were White (41%)

The quantitative data compares the students' letter grades and assigns a point value that was utilized to calculate grade point averages. The Table 1 explains the point value assigned to the various letter grades.

**Table 1**

**Letter Grade and Point Value Table**

| |
|---|
| A = 4, A- = 3.7, B+ = 3.3, B = 3, B- = 2.7, C+ = 2.3, C = 2, C- = 1.7, D+ = 1.3, D = 1, D- = .7, E = 0 |

Table 2 displays the quarterly and final grades of the African American students who decided not to attend the Geometry Honors Preview course.

**Table 2**

**Non Geometry Honors Preview Students' Performance in Geometry Honors**

| Description | Q1 | Pts. | Q2 | Pts. | Q3 | Pts. | Q4 | Pts. | Final Grade | Pts. |
|---|---|---|---|---|---|---|---|---|---|---|
| Linda | C+ | 2.3 | B | 3.0 | A- | 3.7 | B+ | 3.3 | B | 3.0 |
| Ira | D | 1.0 | C | 2.0 | B | 3.0 | C- | 1.7 | C | 2.0 |
| Angela | C | 2.0 | C | 2.0 | C- | 1.7 | E | 0.0 | D+ | 1.3 |
| Calvin | C | 2.0 | E | 0.0 | E | 0.0 | E | 0.0 | E | 0.0 |
| Abby | D | 1.0 | C | 2.0 | D | 1.0 | D | 1.0 | D+ | 1.3 |
| Vanessa | C+ | 2.3 | B | 3.0 | B- | 2.7 | D | 1.0 | C+ | 2.3 |
| Allison | E | 0.0 | W | - | W | - | W | - | W | - |
| Tina | B- | 2.7 | B | 3.0 | C+ | 2.3 | B- | 2.7 | B- | 2.7 |
| **Total Pts.** | | 13.3 | | 15 | | 14.4 | | 9.7 | | 12.6 |
| **GPA** | | **1.66** | | **2.14** | | **2.06** | | **1.39** | | **1.80** |

The first, second, third, and fourth quarters are denoted by "Q1", "Q2", "Q3", and "Q4" respectively (quarters consist of nine weeks). A student who withdrew from a class is denoted with a "W". The grade point average (GPA) was calculated by totaling the number of points assigned to each letter grade and dividing by the number of students. Teachers calculated the "final grade" of each student by averaging the grades from the four quarters. The second and fourth quarter grades encompassed the mid-year and the final respectively. All Geometry Honors students took the same mid-year and final; however, some teachers weighted the mid-year and final more than others did. The percentage weight for the mid-year and final ranged from 10 to 20 percent of the second and fourth quarter grade.

Table 3 displays the quarterly and final grades for the African American students who enrolled in the Geometry Honors Preview course during the summer and then enrolled in Geometry Honors during the school year.

**Table 3**

**Geometry Honor Preview Students' Performance in Geometry Honors**

| Description | Q1 | Pts. | Q2 | Pts. | Q3 | Pts. | Q4 | Pts. | Final Grade | Pts. |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Carl*** | E | 0.0 | C | 2.0 | D- | .7 | C+ | 2.3 | D+ | 1.3 |
| ***Vance*** | C+ | 2.3 | B | 3.0 | C | 2.0 | B- | 2.7 | B- | 2.7 |
| ***Brad*** | B | 3.0 | B | 3.0 | C | 2.0 | B- | 2.7 | B- | 2.7 |
| ***Mary*** | B | 3.0 | B | 3.0 | C | 2.0 | C+ | 2.3 | C+ | 2.3 |
| ***Larry*** | N/A | - | C | 2.0 | D+ | 1.3 | C- | 1.7 | C- | 1.7 |
| **Total Pts.** | | 8.3 | | 13.0 | | 8.0 | | 11.2 | | 10.7 |
| **GPA** | | **2.08** | | **2.60** | | **1.60** | | **2.24** | | **2.14** |

Table 3 indicates that Larry received an "N/A" for the first quarter. Although he enrolled in the Geometry Honors Preview course during the summer, he enrolled in Geometry Standard for the first quarter. Larry earned an "A" in Geometry Standard, so his teacher recommended he move up a level to Geometry Honors. The grades recorded for the second, third, and fourth quarters reflected his performance in Geometry Honors. If Larry had not learned the theorems and postulates for the first quarter over the summer, it would have been almost impossible for him to transition into the Geometry Honors course. It is extremely rare that a student is successful advancing from Geometry Standard to Geometry Honors after missing the first quarter of Geometry Honors.

Table 4 provides a more succinct comparison of the grade point averages of the African American Students who studied the theorems and postulates during the summer with those students who did not learn the theorems and postulates. The **African American Geometry**

**Honors Preview** students were denoted by "AAGHP". Their counterparts, "AANGHP", represents the **African American Non-Geometry Honors Preview** students.

**Table 4**

**African American Geometry Honors Preview (AAGHP) vs. African American Non-Geometry Honors Preview (AANGHP) Quarterly and Final GPAs for Geometry Honors**

| Cohort | Q1 | Q2 | Q3 | Q4 | Final |
|---|---|---|---|---|---|
| **AANGHP** | 1.66 | 2.14 | 2.06 | 1.39 | 1.80 |
| **AAGHP** | 2.08 | 2.60 | 1.60 | 2.24 | 2.14 |

The data presented in Table 4 reveal that the African American students (AAGHP) who learned the theorems and postulates over the summer outperformed the cohort of African American students (AANGHP) who did not participate in the Geometry Honors Preview Course three out of the four quarters. Additionally, the final GPA for the "AAGHP" cohort was .34 points higher than the final GPA for the "AANGHP" cohort. This translated into an average letter grade of "C" for the "AAGHP" cohort and a "C-" for the "AANGHP" cohort respectively.

In addition to the theorems and postulates, they learned: 1) how to take comprehensive notes, 2) strategies and techniques for taking assessments, 3) how to work cooperatively in a group setting, and 4) how to compile a portfolio of their work to use as an additional resource during the school year.

Carl and Larry, who were part of the "AAGHP" cohort, enrolled into an Algebra II and Trigonometry Course during their sophomore year. Algebra II and Trigonometry was a standard level mathematics class for juniors who were on track to enrolling into a Precalculus class their senior year. Sophomores who successfully completed Algebra II and Trigonometry enrolled into Precalculus their junior year and either an Introduction to Calculus or Statistics course their sernior year. It is also important to note that students who completed Precalculus in their junior year had the option of enrolling into an Advanced Placement Statistics (AP Statistics) course or

not enrolling in a mathematics course during their senior year. The graduation requirements at Peake High School required students to successfully complete at least three mathematics courses.

Table 5 displays Carl and Larry's performance in Algebra II and Trigonometry. Both of these students belong to the "AAGHP" cohort. Prior to enrolling into Algebra II and Trigonometry, Carl enrolled into an additional mathematics enrichment course entitled Algebra II Accelerated the following summer after Geometry Honors Preview. Algebra II Accelerated was a rigorous enrichment mathematics course that was created to prepare students either "Algebra II and Trigonometry Standard" (mathematics course for junior) or "Algebra II and Trigonometry Honors" (honors level mathematics course for sophomores).

Students who enrolled in Algebra II Accelerated were recommended by their freshmen math teacher. Teachers recommended students who had a strong work ethic and earned a "B+" or higher in "Geometry Standard". Additionally, teachers recommended students who had a prodigious work ethic who were not doing well in "Geometry Honors". For example, a student in "Geometry Honors" who participated in class, completed homework on a regular basis and earned quarter grades less than a "B-", would be a potential candidate. .

Student participation in Algebra II Accelerated was voluntary and was offered as part of Peake High School's summer school program. The class met two hours each day for four weeks. Students did not receive a grade for the course; however, based upon the student's mastery of the content, the teacher made a recommendation for the student to take the following courses during their sophomore year: 1) Introduction to Algebra II; 2) Algebra II and Trigonometry; 3) Algebra II and Trigonometry Honors. Although most students and their parents adhered to the course recommendations of the summer teacher, some opted to ignore the course recommendations. Sophomores who successfully completed Introduction to Algebra II would be on track to take

Precalculus their senior year. Sophomores who successfully completed "Algebra II and Trigonometry" and "Algebra II and Trigonometry Honors" would be on track to take an Introduction to Calculus class their senior year.

**Table 5**

**Algebra II and Trigonometry Standard Grades for the "AAGHP" Cohort**

| Student | Q1 | Pts. | Q2 | Pts. | Q3 | Pts. | Q4 | Pts. | Final | Pts. |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Carl*** | A- | 3.7 | B+ | 3.3 | B+ | 3.3 | B | 3.0 | B+ | 3.3 |
| ***Larry*** | B+ | 3.3 | B | 3.0 | B | 3.0 | C | 2.0 | B | 3.0 |
| **Total Pts.** | | 7.0 | | 6.3 | | 6.3 | | 5.0 | | 6.3 |
| **GPA** | | **3.50** | | **3.15** | | **3.15** | | **2.50** | | **3.15** |

Table 6 displays the "AANGHP" cohort's performance in Algebra II and Trigonometry Standard. Linda withdrew from Peake High School after the third quarter. Vanessa enrolled into Algebra II and Trigonometry Honors for the first two quarters and then decided to withdraw because the course was too difficult. After Vanessa withdrew from the course, she enrolled into Algebra II and Trigonometry Standard for the remainder of the school year. Ira was the only student in the "AANGHP" cohort to enroll into the Algebra II Accelerated course. Angela received an incomplete for the first quarter because she enrolled into Algebra II and Trigonometry at the end of the first quarter after an unsuccessful attempt in Algebra II and Trigonometry Honors. She failed the Algebra II and Trigonometry Standard class and enrolled in the course again during her junior year.

**Table 6**

**Algebra II and Trigonometry Standard Grades for the "AANGHP" Cohort**

| Student | Q1 | Pts. | Q2 | Pts. | Q3 | Pts. | Q4 | Pts. | Final | Pts. |
|---|---|---|---|---|---|---|---|---|---|---|
| **Linda** | B+ | 3.3 | C+ | 2.3 | B- | 2.7 | E | 0 | C | 2.0 |
| **Vanessa** | - | - | - | - | B+ | 3.3 | B+ | 3.3 | B+ | 3.3 |
| **Ira** | A- | 3.7 | B | 3.0 | B+ | 3.3 | B- | 2.7 | B | 3.0 |
| **Angela** | I | - | E | 0.0 | D+ | 1.3 | E | 0 | E | 0.0 |
| **Total Pts.** | | 7.0 | | 5.3 | | 10.6 | | 6.0 | | 8.3 |
| **GPA** | | **3.50** | | **1.77** | | **2.65** | | **1.50** | | **2.08** |

Table 7 shows the performance of the three remaining students in the "AAGHP" cohort who enrolled into Algebra II and Trigonometry Honors. Brad joined Carl in attending the Algebra II Accelerated course during the summer prior to enrolling into Algebra II and Trigonometry Honors.

**Table 7**

**Algebra II and Trigonometry Honors Grades for the "AAGHP" Cohort**

| Student | Q1 | Pts. | Q2 | Pts. | Q3 | Pts. | Q4 | Pts. | Final | Pts. |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Vance*** | B- | 3.7 | C | 2.0 | B+ | 3.3 | B | 3.0 | B- | 2.7 |
| ***Brad*** | C+ | 2.3 | B- | 2.7 | B- | 2.7 | C | 2.0 | C+ | 2.3 |
| ***Mary*** | A | 4.0 | A- | 3.7 | A | 4.0 | A | 4.0 | A- | 3.7 |
| **Total Pts.** | | 9.0 | | 8.4 | | 10.0 | | 9.0 | | 8.7 |
| **GPA** | | **3.00** | | **2.80** | | **3.33** | | **3.00** | | **2.90** |

Table 8 displays the performance of their counterparts, the "AANGHP" cohort. Vanessa found Algebra II and Trigonometry Honors too difficult, so she withdrew and enrolled into the standard level course after completing the second quarter. Tina was the only student from the cohort to successfully complete the Algebra II and Trigonometry Honors course. The "AAGHP" out-performed the "AANGHP" cohort each of the four quarters. The final GPA for the "AAGHP" cohort was .20 points higher than the "AANGHP" cohort.

**Table 8**

**Algebra II and Trigonometry Honors Grades for the "AANGHP" Cohort**

| Student | Q1 | Pts. | Q2 | Pts. | Q3 | Pts. | Q4 | Pts. | Final | Pts. |
|---|---|---|---|---|---|---|---|---|---|---|
| **Vanessa** | C- | 1.7 | D+ | 1.3 | W | - | - | - | - | - |
| **Tina** | B | 3.0 | B | 3.0 | C+ | 2.3 | C | 2.0 | B- | 2.7 |
| **Total Pts.** | | 4.7 | | 4.3 | | 2.3 | | 2.0 | | 2.7 |
| **GPA** | | **2.35** | | **2.15** | | **2.30** | | **2.00** | | **2.70** |

The remaining three students in the "AANGHP" cohort withdrew from the honors sequence of mathematics courses into the standard level sequence (None of the "AAGHP" students dropped a level). Table 9 represents their performance in an Introduction to Algebra II course. Although the sequence of standard level mathematics courses leads to Precalculus in a student's senior year, the opportunity still exists for a student to enroll into an Introduction to Calculus course. This is possible because Peake High School offers an original credit Precalculus class during summer school that would provide students with the opportunity to earn credit for Precalculus prior to their senior year.

**Table 9**

**Introduction to Algebra II Grades for the "AANGHP" Cohort**

| Student | Q1 | Pts. | Q2 | Pts. | Q3 | Pts. | Q4 | Pts. | Final | Pts. |
|---|---|---|---|---|---|---|---|---|---|---|
| **Calvin** | A | 4.0 | A | 4.0 | A | 4.0 | A- | 3.7 | A | 4.0 |
| **Abby** | A | 4.0 | B | 3.0 | B | 3.0 | B | 3 | B+ | 3.3 |
| **Allison** | B | 3.0 | B | 3.0 | C | 2.0 | D+ | 1.3 | C+ | 2.3 |
| **Total Pts.** | | 11.0 | | 10.0 | | 9.0 | | 8.0 | | 9.6 |
| **GPA** | | **3.67** | | **3.33** | | **3.00** | | **2.67** | | **3.20** |

Table 10 shows the academic performance for both cohorts in Precalculus Standard during their junior year. Introduction to Calculus was comprised of students who had successfully completed Precalculus Standard and Precalculus Honors. Precalculus Standard and Precalculus Honors covered the same topics; however, Precalculus Honors classes moved at a

faster pace and covered the topics in greater depth. Hence one can make the argument that a student who successfully completed Precalculus Honors is better prepared for the rigors of an Introduction to Calculus class.

**Table 10**

**Precalculus (Standard) Grades for the "AAGHP" Cohort**

| Student | Q1 | Pts. | Q2 | Pts. | Q3 | Pts. | Q4 | Pts. | Final | Pts. |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Carl*** | B | 3.0 | B- | 2.7 | B | 3.0 | C- | 1.7 | B- | 2.7 |
| ***Vance*** | A- | 3.7 | A- | 3.7 | W | - | - | - | A- | - |
| ***Brad*** | A- | 3.7 | A- | 3.7 | A- | 3.7 | B | 3.0 | A- | 3.7 |
| ***Mary*** | B+ | 3.3 | B | 3.0 | C | 2.0 | B | 3.0 | B | 3.0 |
| ***Larry*** | D+ | 1.3 | C- | 1.7 | C- | 1.7 | C | 2.0 | C- | 1.7 |
| **Total Pts.** | | 15.0 | | 14.8 | | 10.4 | | 9.7 | | 11.1 |
| **GPA** | | **3.00** | | **2.96** | | **2.60** | | **2.43** | | **2.78** |

**Precalculus (Standard) Grades for the "AANGHP" Cohort**

| Student | Q1 | Pts. | Q2 | Pts. | Q3 | Pts. | Q4 | Pts. | Final | Pts. |
|---|---|---|---|---|---|---|---|---|---|---|
| **Vanessa** | B | 3.0 | C | 2.3 | C | 2.0 | C | 2.0 | C+ | 2.3 |
| **Tina** | B+ | 3.3 | B | 3.0 | A- | 3.7 | A- | 3.7 | A- | 3.7 |
| **Ira** | C+ | 2.3 | C | 2.0 | B | 3.0 | C | 3.0 | C+ | 2.3 |
| **Total Pts.** | | 8.6 | | 7.3 | | 8.7 | | 8.7 | | 8.3 |
| **GPA** | | **2.87** | | **2.43** | | **2.90** | | **2.90** | | **2.77** |
| | | | | | | | | | | |

Vance withdrew from Precalculus Standard to participate in a China Exchange program. After he returned from China, he enrolled into the original credit Precalculus course the summer prior to his senior year. Carl enrolled into the original credit Precalculus course too. However, he enrolled the summer prior to his junior year. Carl believed that he needed to strengthen his knowledge of mathematical concepts and hone his skills to be better prepared for Precalculus Standard during his junior year. Although he earned a "B" in the original credit Precalculus course, he decided to audit the class. If he had chosen to accept the credit for the course, he could have taken the Introduction to Calculus course as a junior instead of a senior. Although

Carl and Vance attended the original credit Precalculus course at different times, they attended class four hours each day for six weeks. Vance's final grade in the course was an "A-".

Table 11 describes the status of both cohorts during their senior year.

**Table 11**

**"AAGHP" Cohort's Senior Year Status**

| Student | Senior Year |
|---|---|
| ***Carl*** | Carl enrolled into an Introduction to Calculus course. He earned a "C" for the first quarter |
| ***Vance*** | Vance enrolled into an Introduction to Calculus course. He earned a "B-" for the first quarter |
| ***Brad*** | Brad enrolled into an Introduction to Calculus course. He earned a "C" for the first quarter |
| ***Mary*** | Mary attended a summer program at Louisiana State University (LSU) after her junior year and earned an "A-". She is the only student who has received credit in Calculus |
| ***Larry*** | Larry decided to enroll into Statistics his senior year instead of an Introduction to Calculus course. He earned a "B+" in Statistics for the first quarter. |

**"AANGHP" Cohort's Senior Year Status**

| Student | Senior Year |
|---|---|
| **Linda** | Linda is no longer a student at Peake High School. |
| **Ira** | Irvin enrolled into an Introduction to Calculus course. He earned a "B-" for the first quarter. |
| **Angela** | Angela enrolled into an Algebra II and Trigonometry class for a second time during her Junior year to earn a final grade of "C". She is currently enrolled in Precalculus where she earned a "D" for the first quarter. |
| **Calvin** | Calvin entered an alternative program at the high school during his sophomore year that provided him with a smaller structured environment. He is currently enrolled into an Advanced Algebra Honors course within the program. There was no first quarter grade recorded for Calvin. |
| **Abby** | Abby enrolled into a Precalculus course. She earned a "B" for the first quarter. |
| **Vanessa** | Vanessa enrolled into a Statistics course instead of an Introduction to Calculus course her senior year. She earned an "A" for the first quarter. |
| **Allison** | Allison enrolled into a Precalculus course. She earned a "C" for the first quarter. |
| **Tina** | Tina enrolled into an Introduction to Calculus course. She earned a "B+" for the first quarter. |

Larry was the only student in the "AAGHP" cohort who did not enroll into an Introduction to Calculus course. Larry decided to try Statistics instead of Calculus because he wanted a different mathematical experience. Mary was the only student in the cohort who decided to enroll into an Introduction to Calculus class over the summer so she could create more flexibility in her schedule for the school year.

There were three sections of Introduction to Calculus with a total of 63 students. Six of those students are African American (9.5%). Table 12 summarizes each of the six student's matriculation to the Introduction to Calculus course. It is important to note a new student

included in the data. Sarah is an African American female who was not included with the "AAGHP" or the "AANGHP" cohort. She was not included because she did not attend the elementary schools in Peake; therefore, she did not receive the letter inviting students to enroll into the Geometry Honors Preview course.

**Table 12**

**African American Students' Matriculation to an Introduction to Calculus Course**

| Student | Courses *(Summer enrichment courses are underlined) |
|---|---|
| ***Brad*** | Geometry Honors Preview →Geometry Honors →Algebra II Accelerated → Algebra II & Trigonometry Honors → Precalculus Standard → Introduction to Calculus |
| ***Vance*** | Geometry Honors Preview → Geometry Honors → Algebra II and Trigonometry Honors → Precalculus Standard → Precalculus (original credit) →Introduction to Calculus |
| ***Carl*** | Geometry Honors Preview → Geometry Honors → Algebra II Accelerated → Algebra II & Trigonometry Standard →Precalculus (original credit) → Precalculus Standard → Introduction to Calculus |
| **Ira** | Geometry Honors → Algebra II Accelerated →Algebra II and Trigonometry Standard → Precalculus Standard → Introduction to Calculus |
| **Tina** | Geometry Honors→ Algebra II & Trigonmetry Honors → Precalculus Standard → Introduction to Calculus |
| **Sarah** | Geometry Standard → Algebra II & Trigonometry Honors → Precalculus Honors → Introduction to Calculus |

Table 12 reveals that 4 out of 6 African American students enrolled in an Introduction to Calculus class have taken at least one summer enrichment course in mathematics.

**Quantitative Data for Standardized Test Performance**

Students who enrolled into an Introduction to Calculus class by the time they were seniors were more likely to perform better on standardized tests than students who were not enrolled into an Introduction to Calculus class. This was true in most cases because students who matriculated towards an Introduction to Calculus course were being assessed on mathematical content they had mastered at least a year prior to taking the standardized test.

## State Test

Table 13 outlines the design of the State Test. The test question categories and the percentage of the questions that address each category are identified. Students who attended Peake High School were given the untimed statewide test in the tenth grade. The test was given over two days and students had to pass with a score of at least 220 to receive a diploma from Peake High School. If students scored below 220 on the test, they were given several opportunities to take the test again up to their senior year.

**Table 13**

**State Test Design**

| Reporting Category | Percentage | Total Number of Points |
|---|---|---|
| Number Sense & Operations | 20% | 12 |
| Patterns, Relations and Algebra | 30% | 18 |
| Geometry | 15% | 9 |
| Measurement | 15% | 9 |
| Data Analysis, Statistics, and Probability | 20% | 12 |

(Massachusetts Department of Elementary and Secondary Education, 2009)

Table 14 displays the "AAGHP" and the "AANGHP" cohort's performance on the State Test along with the math courses they were enrolled in during their sophomore year when they took the test.

**Table 14**

**"AAGHP" State Test Performance**

| Student | 10th Grade Math Course | Raw Score | Scaled Score | Performance Level |
|---|---|---|---|---|
| ***Carl*** | Algebra II & Trigonometry Standard | 32 | 240 | Proficient |
| ***Vance*** | Algebra II & Trigonometry Honors | 47 | 262 | Advanced |
| ***Brad*** | Algebra II & Trigonometry Honors | 54 | 266 | Advanced |
| ***Mary*** | Algebra II & Trigonometry Honors | 50 | 264 | Advanced |
| ***Larry*** | Algebra II & Trigonometry Standard | 38 | 248 | Proficient |
| **AVG.** | | 44.2 | 256.0 | |

**"AANGHP" State Test Performance**

| Student | 10th Grade Math Course | Raw Score | Scaled Score | Performance Level |
|---|---|---|---|---|
| **Ira** | Algebra II & Trigonometry Standard | 50 | 264 | Advanced |
| **Angela** | Algebra II & Trigonometry Standard | 49 | 262 | Advanced |
| **Calvin** | Introduction to Algebra II | 54 | 266 | Advanced |
| **Abby** | Introduction to Algebra II | 51 | 264 | Advanced |
| **Vanessa** | Algebra II & Trigonometry Standard | 37 | 248 | Proficient |
| **Allison** | Introduction to Algebra II | 49 | 262 | Advanced |
| **Tina** | Algebra II & Trigonometry Honors | 54 | 266 | Advanced |
| **AVG.** | | 49.1 | 261.7 | |

The maximum raw score was 60, which was calculated by adding the "Total Number of Points" column from Table 13. The data above suggested that the "AANGHP" cohort outperformed the "AAGHP" on the MCAS. Since both cohorts successfully completed Algebra in the eighth grade and were recommended for Geometry Honors, this may indicate that students are fairly comparable in their mathematics knowledge up to the tenth grade; or at least the content they are assessed on the MCAS.

There are four performance levels on the MCAS: 1) Failing, 2) Needs Improvement, 3) Proficient, and 4) Advanced. Table 15 displays the general performance level definitions.

**Table 15**

**General Performance Level Definitions**

| | ***Needs Improvement*** **On MCAS, a student at this level:** | ***Proficient*** **On MCAS, a student at this level:** | ***Advanced*** **On MCAS, a student at this level:** |
|---|---|---|---|
| **Conceptual Understanding and Procedural Knowledge** | ➢ Demonstrates partial understanding of the numeration system<br>➢ Performs some calculations and estimations<br>➢ Identifies examples of basic math concepts<br>➢ Reads and constructs graphs, tables, and charts | ➢ Demonstrates solid understanding of the numeration system<br>➢ Performs most calculations and estimations<br>➢ Defines concepts and generates examples and counterexamples of concepts<br>➢ Represents data and mathematical relationships in multiple forms (e.g., equations, graphs) | ➢ Connects concepts from various areas of mathematics, and uses concepts to develop generalizations<br>➢ Performs complex calculations and estimations<br>➢ Selects the best representations for a given set of data and purpose |
| **Problem Solving** | ➢ Applies learned procedures to solve routine problems | ➢ Applies learned procedures and mathematical concepts to solve a variety of problems, including multi-step problems | ➢ Generates unique strategies and procedures to solve non-routine problems |
| **Mathematical Reasoning** | ➢ Applies some reasoning methods to solve simple problems | ➢ Uses a variety of reasoning methods to solve problems<br>➢ Explains steps and procedures | ➢ Uses multiple reasoning methods to solve complex problems<br>➢ Justifies strategies and solutions |
| **Mathematical Communication** | ➢ Identifies and uses basic mathematical terms | ➢ Uses various forms of representation (e.g., text, graphs, symbols) to illustrate steps to a solution | ➢ Uses various forms of representation (e.g., text, graphs, symbols) to justify solutions and solution strategies |

(Massachusetts Department of Elementary and Secondary Education, 2010)

The threshold score determined the performance level on the state test. A threshold score is the minimum raw score (number of points) that a student must earn on a state test for his or her performance to be categorized at a particular performance level (Massachusetts Department of Elementary and Secondary Education, 2010). Based on Table 16, a student who earned a raw score of 18 to 31 would receive a *Needs Improvement* designation. A raw score of 17 or lower was considered *Failing*. According to the Department of Education for the State, "Threshold scores are adjusted slightly each year. The Department makes these adjustments so that scaled scores have the same meaning over time—in other words, so that 240 on the grade 8 Mathematics test symbolizes the same level of performance in 2008 as it did in 2007. Threshold scores need to be adjusted because the MCAS test questions that determine a student's scaled score are completely new each year." (Massachusetts Department of Elementary and Secondary Education, 2010)

**Table 16**

**10th Grade Mathematics Threshold Scores for the State Test of Spring 2008**

| **Subject Area** | **Maximum Score *** | ***Advanced* (Above Proficient): minimum score needed** | ***Proficient*: minimum score needed** | ***Needs Improvement*: minimum score needed** |
|---|---|---|---|---|
| Mathematics | 60 | 45 | 32 | 18 |

***** The maximum score is the total number of raw score points that a student could earn in the tested subject if he or she answered all of the multiple-choice questions correctly (one point per question) and received the highest possible score for every other question (four points for each open-response)

(Massachusetts Department of Elementary and Secondary Education, 2010)

**PSAT**

The PSAT is considered as a practice test for the Scholastic Aptitude Test (SAT). A majority of the students who take the PSAT are juniors. The test is comprised of 38 questions

distributed over two 25-minute sections. Table 17 displays the PSAT results from the students in each cohort who took the test along with their junior year mathematics course.

**Table 17**

**PSAT Results for the "AAGHP" Cohort**

| Student | 11th Grade Mathematics Course | PSAT Raw Score | PSAT Scaled Score |
|---|---|---|---|
| ***Carl*** | Precalculus Standard | 43 | 430 |
| ***Vance*** | Precalculus Standard | 54 | 540 |
| ***Brad*** | Precalculus Standard | 64 | 640 |
| ***Mary*** | Precalculus Honors | 53 | 530 |
| ***Larry*** | Precalculus Standard | 53 | 530 |
| **AVG.** | | **53.4** | **534** |

**PSAT Results for the "AANGHP" Cohort**

| Student | 11th Grade Mathematics Course | PSAT Raw Score | PSAT Scaled Score |
|---|---|---|---|
| **Linda** | N/A | N/A | N/A |
| **Ira** | Precalculus | 57 | 570 |
| **Angela** | Algebra II & Trigonometry Standard | 54 | 540 |
| **Calvin** | Algebra II Honors | 40 | 400 |
| **Abby** | N/A | N/A | N/A |
| **Vanessa** | Precalculus | 44 | 440 |
| **Allison** | Algebra II &Trigonometry | 45 | 450 |
| **Tina** | Precalculus | 58 | 580 |
| **AVG.** | | **49.7** | **497** |

The "AAGHP" and "AANGHP" cohorts received an average raw score of 53.4 and 49.7 respectively. According to the College Board, the average raw score for juniors who took the 2008 PSAT was 48.8 (The College Board, 2010). The "AAGHP" cohort exceeded the average by 4.6 points while the "AANGHP" cohort was only .9 points above the average. The scaled score for the PSAT indicates the comparable SAT score for the students. These scaled scores were calculated by moving the decimal point for the raw scores one place to the right. Therefore, the raw scores 53.4 and 49.7 translate into average SAT scores of 534 and 497 for the "AAGHP" and "AANGHP" respectively.

College Board data revealed the average mathematics score for the 2008 SAT was 515 (The College Board, 2010). The "AAGHP" cohort exceeded the average 2008 SAT test by 19 points while the "AANGHP" cohort scored 18 points below the average. Further, the College Board indicated the average SAT score in mathematics for African Americans was 426 (The College Board, 2010). The "AAGHP" cohort exceeded this average by 89 points while the "AANHGP" cohort exceeded the average SAT score by 71. Below, Table 18 displays the 2008 mean scores in mathematics for the SAT Reasoning Test by race/ethnicity.

**Table 18**

**Mean Scores in Mathematics by Race/Ethnicity for the 2008 SAT Reasoning Test**

| Racial/Ethnic Groups | Mathematics |
|---|---|
| American Indian | 491 |
| Asian | 581 |
| Black | 426 |
| Mexican American | 463 |
| Puerto Rican | 453 |
| Other Hispanic | 461 |
| White | 537 |
| Other | 512 |
| No Response | 492 |

(The College Board, 2010)

When comparing the average SAT scores in mathematics for white students (537) and the "AAGHP" cohort (534), the achievement gap is virtually nonexistent. However, Asian American Students continued to distance themselves from other ethnic group with a high of 581 points. Perhaps course-taking patterns are the reason why the "AAGHP" cohort is 89 points above the average for African Americans who took the SAT. According to the College Board, the average scores for students who took Precalculus and Calculus their senior year were 533 and 611 respectively (The College Board, 2008). Hence, students who successfully completed

Calculus in high school have a better chance of scoring well above the average score on the mathematics portion of the SAT.

## Qualitative Data

Questionnaires were issued to the teacher assistants, participants, and parents to gather qualitative data to assess the strengths and weaknesses of the Geometry Honors Preview course. The researcher also informally interviewed the instructor of the Geometry Honors Preview course after observing the class on multiple occasions. The questions and responses from the teacher assistants' questionnaires are presented on the following pages.

# Teacher Assistant's Questionnaire

EARL

1. **What is your name?** *Earl*

2. **How did you become a teacher assistant?** The researcher recommended the job for me

3. **Why did you want the job?** *It was a great opportunity to work and help kids my age and older in a field I excelled. It was close by at Peake High School, good hours and pay, and a great way to spend some of my summer vacation.*

4. **Please describe your experience working with the Geometry Honors Preview teacher.** *We had good chemistry and he was open to anything. During lunch breaks we did not have to talk about math all the time; we had conversations on other topics. We both understood our roles in the classroom.*

5. **Please describe your experience working with the student in the Geometry Honors Preview class.** *Me being their age, the students were comfortable with me and didn't hesitate to ask me questions. But at the same time, I tried to keep a level of authority among the class.*

6. **How did you assist the lead teacher?** *I would help students during a less for individual help, assistance with homework, correcting tests, copy papers and documents for the teacher, keep the class in line, and create a good learning environment.*

7. **Did the experience working with the lead teacher increase your knowledge of Geometry? Please explain.** *It forced me to review the material from a different perspective and teacher. Also, this made me learn the material very well in order for me to explain it to another student who has never learned it before. It's one thing to be able to understand the subject, but to be able to explain it well is another thing.*

8. **Did you experience working with the students increase your knowledge of Geometry?** *Yes, definitely, because as I said in Question #7, I was forced to know the material well enough to be able to explain to a student that either has never learned it or one who didn't do so well.*

9. **What did you perceive as the most difficult part of the summer course for the incoming freshmen? Please explain.** *Explaining the material to some students because at times you have to start at the simplest stage and help them understand other material to be able to understand the current. At times it was frustrating, but that's one of the difficult parts of being a teacher, realizing the background and knowledge of a student and adjusting to the needs.*

Cont.

10. **Do you believe the course increased the students' confidence? Please explain.** *Yes because, especially for the incoming freshmen, it made them more comfortable with the building of the high school and they left more familiar with the material that they will use at the school. Also, there was a feeling that by physically being there, they already had a jump start*

11. **Do you believe the students were comfortable asking you for help? Please explain.** *Yes, because since we were the same age, many of us had the same interests and I could explain the material in a way that I understood it relevant to a teenagers mind, not that of a college graduate.*

12. **What aspects of the course would you improve? Please explain.** *I would somehow extend the period for many because at times the class felt rushed. There is so much material to in such little and I believe some students may have left with a condensed understanding of the subject.*

13. **Would you recommend the role of teacher assistant to other students interested in teaching? Please explain.** *Yes, because it gives you a chance to experience the work of a teacher and understand both the difficulties and joys. It also gives you a chance to work one-on-one with other students and be in a learning environment with the role as a teacher. Best introduction to teaching.*

## Teacher Assistant's Questionnaire

KARA

1. **What is your name?** *Kara*

2. **How did you become a teacher assistant?** *I was interviewed by the researcher and hired*

3. **Why did you want the job?** *I love to help/teach people and jumped at the opportunity to cement what I'd already learned and help some kids out with geometry.*

4. **Please describe your experience working with the Geometry Honors Preview teacher.** *We both worked well together. He gave me direction to grade tests, or help explain things in as easier way. He appreciated how I could simplify concepts for kids my age.*

5. **Please describe your experience working with students in the Geometry Honors Preview class.** *In the preview course the students weren't too excited to be in summer school and could be hesitant to ask questions. However, they realized quickly how much of an advantage they had over other kids (not in the course) and took the class seriously.*

Cont.

6. **How did you assist the lead teacher?** *I simplified concepts like weirdly worded problems. I also shared tricks/patterns I had learned through completing a year's worth of proofs.*

7. **Did the experience working with the lead teacher increase your knowledge of Geometry? Please explain.** *Experience with the teacher allowed me to see his perspective of how to present the information. His style was formal and straight forward like my freshman year. His style, in addition to my personalized memory tactics, allowed me to gain confidence in geometry.*

8. **Did your experience working with the students increase your knowledge of Geometry?** *Everytime I teach someone somehting, the information is replanted in my memory. In order to explain an idea I had to be confident I understood it well, and had to present the information in the easiest way possible. I essentially relearned geometry by teaching it.*

9. **What did you perceive as the most difficult part of the summer course for the incoming freshmen? Please explain.** *The most difficult part of the course was probably remembering all the little tricks of proofs. It was formulaic to me, all the SAS (side angle side) and AAS (angle angle side) stuff. But the kids had to see and memorize the patterns.*

10. **Do you believe the course increased the students' confidence? Please explain.** *Yes! The kids not only were familiar with proofs but had an in depth understanding of the construction of one, the variety/patterns of different possible test questions etc. You cannot get this without at least a month of work.*

11. **Do you believe the students were comfortable asking you for help? Please explain.** *At first students were hesitant to ask questions, especially to the teacher assistants (Actually it depended on the kid, some kids preferred asking me.) But as we became more familiar with one another, they opened up.*

12. **What aspects of the course would you improve? Please explain.** *There is no real aspect of the course I would improve besides having more classes. The small size of the class was ideal for learning; I just wish more kids could have taken the course.*

13. **Would you recommend the role of teacher assistant to other students interested in teaching? Please explain.** *YES! I would definitely recommend the role of TA to other students, even if they are not in love with teaching. Helping someone understand math, for example, allows you to gain confidence not only in the subject itself, but also in your ability to learn and cement knowledge into your*

The researcher gleaned important feedback from the questionnaires completed by the teacher assistants. First, the teacher assistants believed that working with the students helped reinforce their own mathematical knowledge in Geometry. Second, they believed that the course increased the students' confidence in completing proofs and deepened their understanding of the material. Lastly, the teacher assistants thought the course was extremely beneficial and would recommend it to other students.

**Classroom Observations and Teacher Conferences**

The researcher observed the class on two different occasions for 15 minutes, followed by a conference with the teacher. The classroom format in terms of instruction could be categorized as traditional and teacher-centered; however, students spent most of the time completing geometry proofs in small groups. The teacher and teacher assistants facilitated these small groups.

Students were encouraged to write their proofs on the chalkboard and present them to the class. Surprisingly, none of the students appeared apprehensive about presenting their proofs. This was an indication that the students felt relaxed and safe in the classroom to make mistakes. The teacher indicated that he believed students felt comfortable presenting their proofs because they had completed the proofs within their groups first. If a mistake was made, it was not a mistake by one person; it was a mistake by the group. Further, the supervision and constructive feedback by the teacher and teacher assistants assured the students that their proofs were worthy of presenting.

The teacher believed that the first week of the course was the most frustrating for the students because the theorems and postulates created a new mathematical learning experience for them. None of the students had completed a proof, in particular, a geometry proof. The teacher

introduced the theorems and postulates in addition to providing sample proofs to show the integration of the statements and reasons in the two-column proofs. It was evident based on informal observations and the type of questions posed during the third week, which students in the class would struggle with the Geometry Honors content in the school year. Later in this chapter, the researcher will elaborate further on these observations and what was revealed when these students completed the Geometry Honors course.

The participants and their parents completed questionnaires about the Geometry Honors Preview course describing their experiences and perceptions. The following pages include their questionnaires and responses.

# Student/Participant Questionnaire Responses

## CARL

1. **What was your attitude towards Algebra (i.e. did you like doing the work)?** *I mean it was a good class for me, I did good in it, the work was good.*

2. **Do you believe a student's success in mathematics is a result of hard work or innate ability? Please explain**. *For some kids it seem like they already know the material, for others they have to work hard.*

3. **Do you believe that your 8th grade math teacher did a good job teaching you mathematics? Please explain**. *I believe that my teacher did do a good job. I feel that I learned a lot of math and enjoyed learning that math*

4. **Do you believe that taking Algebra in the 8th grade prepared you well for taking Geometry Honors in the 9th grade? Please explain.** *Not really, I mean standard and honors in math is a huge difference. Like for me, standard would be easy and honors was challenging*

5. **Did your family communicate with your 8th grade math teacher? If yes, how often?** *Not really, Only on parent teacher night*

6. **Who helped you prepare for math tests in the 8th grade?** *Myself*

7. **Who helped you complete homework assignments for your 8th grade math class?** *No one really. Maybe my friends if I needed help.*

8. **How often during the week did you meet with your 8th grade math teacher?** *Maybe before a test that I wasn't feeling good about or when I needed help with the homework.*

9. **How did you hear about the Geometry Honors Preview course offered during the summer?** *My mom told me about it.*

10. **Why did you decide to enroll in the Geometry Honors Preview course?** *My mom and people were telling me the class was hard.*

11. **What did you enjoy about the summer course?** *I met new people and got a preview of math.*

12. **What did you like least about the course?** *It went really fast.*

13. **Did you receive additional help with the material covered during the summer course?** *No*

14. **Did the course make you more or less confident about taking Geometry Honors during the school year? Please explain.** *A little bit more confident but not much I was confused a lot*

15. **Would you recommend the course to incoming freshmen? Please explain.** *Yes, just to get a preview of the class*

16. **Were the teacher assistants instrumental in your learning? Please explain.** *Yes, they were cool and knew what they were doing.*

17. **Was the teacher instrumental in your learning? Please explain.** *I mean the class is fast, the teacher was a cool person but okay teacher.*

18. **How would you describe your academic performance in Geometry Honors during the school year?** *It was not what I wanted it to be, but I stuck with it and passed the class after a failing start.*

19. **Did the Geometry Honors Preview course adequately prepare you for Geometry Honors? Please explain**. *Not really because the class was moving so fast, it just gave me a little preview*

20. **Did you receive additional academic support during the school year while you were taking Geometry Honors? Please explain**. *I started meeting with my teachers and got a tutor in the 4th quarter. I also went to the math center.*

21. **On average, how often did you meet with your teacher?** *Before test and quizzes, and whenever I needed help.*

22. **Did you study in a group or by yourself when preparing for assessments?** *Both*

23. **Do you believe that your success in mathematics is vital to your future goals and aspirations? Please explain.** *Yes, because you need math everyday and it is a requirement.*

## Student/Participant Questionnaire Responses

### VANCE

1. **What was your attitude towards Algebra (i.e. did you like doing the work)?** *Good. I do much better in math and science*

2. **Do you believe a student's success in mathematics is a result of hard work or innate ability? Please explain.** *My mom taught me to work hard at everything. My mom is very smart in my opinion. I get that from her.*

3. **Do you believe that your 8th grade math teacher did a good job teaching you mathematics? Please explain.** *Yes. My teacher made learning math fun.*

4. **Do you believe that taking Algebra in the 8th grade prepared you well for taking Geometry Honors in the 9th grade? Please explain.** *Yes. Using equations to get answers come easier because of the Algebra*

5. **Did your family communicate with your 8th grade math teacher? If yes, how often?** *Yes. My mom came up to the school after I got my midterm reports*

6. **Who helped you prepare for math tests in the 8th grade?** *My teacher.*

7. **Who helped you complete homework assignments for your 8th grade math class?** *No one*

8. **How often during the week did you meet with your 8th grade math teacher?** *Three times a week to prepare for tests*

9. **How did you hear about the Geometry Honors Preview course offered during the summer?** *My math teacher.*

10. **Why did you decide to enroll in the Geometry Honors Preview course?** *My mom and teacher said it would help me with the course.*

11. **What did you enjoy about the summer course?** *My friends were in the class with me.*

12. **What did you like least about the course?** *It was in the summer.*

13. **Did you receive additional help with the material covered during the summer course?** *No*

14. **Did the course make you more or less confident about taking Geometry Honors during the school year? Please explain.** *No. It prepared me for the course.*

15. **Would you recommend the course to incoming freshmen? Please explain.** *Yes, only if they are willing to work hard at it.*

16. **Were the teacher assistants instrumental in your learning? Please explain.** *Yes, they helped me when I had problems with the work.*

17. **Was the teacher instrumental in your learning? Please explain.** *Yes, he cared about the students and what he was teaching us.*

18. **How would you describe your academic performance in Geometry Honors during the school year?** *I struggled in the beginning but got help from my teacher and brought my grade up.*

19. **Did the Geometry Honors Preview course adequately prepare you for Geometry Honors? Please explain.** *Yes, it gave me an idea and samples of what the class would be like.*

20. **Did you receive additional academic support during the school year while you were taking Geometry Honors? Please explain.** *Yes, I had tutorial class and help from the teacher*

21. **On average, how often did you meet with your teacher?** *At least four days before school.*

22. **Did you study in a group or by yourself when preparing for assessments?** *By myself*

23. **Do you believe that your success in mathematics is vital to your future goals and aspirations? Please explain.** *Yes, I want to be an engineer.*

## Student/Participant Questionnaire Responses

### BRAD

1. **What was your attitude towards Algebra (i.e. did you like doing the work)?** *I thought it was simple, but I didn't like doing it.*

2. **Do you believe a student's success in mathematics is a result of hard work or innate ability? Please explain.** *I think both because some people just get math while others have to work really hard.*

3. **Do you believe that your 8th grade math teacher did a good job teaching you mathematics? Please explain.** *Yes, he did a great job*

4. **Do you believe that taking Algebra in the 8th grade prepared you well for taking Geometry Honors in the 9th grade? Please explain.** *Not that much because we had to learn a lot of new things.*

5. **Did your family communicate with your 8th grade math teacher? If yes, how often?** *Yes, but only a few times.*

6. **Who helped you prepare for math tests in the 8th grade?** *No one.*

7. **Who helped you complete homework assignments for your 8th grade math class?** *The teacher*

8. **How often during the week did you meet with your 8th grade math teacher?** *I didn't meet with the teacher.*

9. **How did you hear about the Geometry Honors Preview course offered during the summer?** *My mom told me.*

10. **Why did you decide to enroll in the Geometry Honors Preview course?** *So I could get extra help with the course.*

11. **What did you enjoy about the summer course?** *The teacher was good and I met new people.*

12. **What did you like least about the course?** *I didn't like getting homework.*

13. **Did you receive additional help with the material covered during the summer course?** *No*

14. **Did the course make you more or less confident about taking Geometry Honors during the school year? Please explain.** *It made me more confident because I felt that I had a head start.*

15. **Would you recommend the course to incoming freshmen? Please explain.** *I would because it makes your actual math class easier.*

16. **Were the teacher assistants instrumental in your learning? Please explain.** *Yes, they were always willing to help if I had problems with the work.*

17. **Was the teacher instrumental in your learning? Please explain.** *He was because he taught us a lot.*

18. **How would you describe your academic performance in Geometry Honors during the school year?** *I would say it was a good solid performance because I did well throughout the year.*

19. **Did the Geometry Honors Preview course adequately prepare you for Geometry Honors? Please explain.** *I don't think it prepared me for the second semester work*

20. **Did you receive additional academic support during the school year while you were taking Geometry Honors? Please explain.** *I got extra help from teachers.*

21. **On average, how often did you meet with your teacher?** *Not that often*

22. **Did you study in a group or by yourself when preparing for assessments?** *By myself*

23. **Do you believe that your success in mathematics is vital to your future goals and aspirations? Please explain.** *Yes, because math is involved with everything.*

# Student/Participant Questionnaire Responses

## MARY

1. **What was your attitude towards Algebra (i.e. did you like doing the work)?** *I loved Algebra! I enjoyed doing the work because I enjoyed the subject*

2. **Do you believe a student's success in mathematics is a result of hard work or innate ability? Please explain.** *A little of both. I believe that innate ability factor's into one's success, but also their work ethic in math will make or break one's success.*

3. **Do you believe that your 8th grade math teacher did a good job teaching you mathematics? Please explain.** *Yes, because she got to know me as a person so that she knew how to push me. She was very aware of my strengths and weaknesses and targeted those.*

4. **Do you believe that taking Algebra in the 8th grade prepared you well for taking Geometry Honors in the 9th grade? Please explain.** *No, because 8th grade math has lesser demands than high school honors math. I also felt like Geometry and Algebra are so different that I wasn't well prepared.*

5. **Did your family communicate with your 8th grade math teacher? If yes, how often?** *Yes, at back to school night, but not often. My father had the same 8th grade math teacher that I did.*

6. **Who helped you prepare for math tests in the 8th grade?** *I prepared myself most of the time, but sometimes I asked for help from my teacher.*

7. **Who helped you complete homework assignments for your 8th grade math class?** *I completed homework on my own, or with friends, but we weren't helping each other. We just shared the book.*

8. **How often during the week did you meet with your 8th grade math teacher?** *Every day for class, but that's about it.*

9. **How did you hear about the Geometry Honors Preview course offered during the summer?** *From my father.*

10. **Why did you decide to enroll in the Geometry Honors Preview course?** *My parents pushed me to do it.*

11. **What did you enjoy about the summer course?** *I enjoyed meeting new people, and introducing myself to Geometry.*

12. **What did you like least about the course?** *The fact that I didn't get material even though I tried. And I didn't like the style of the teacher.*

13. **Did you receive additional help with the material covered during the summer course?** *No*

14. **Did the course make you more or less confident about taking Geometry Honors during the school year? Please explain.** *More because I felt like I had grasped the material*

15. **Would you recommend the course to incoming freshmen? Please explain.** *Definitely. I think that it is well worth the confidence boost. And freshmen get introduced to how math will be used at the high school level and what Geometry is like.*

16. **Were the teacher assistants instrumental in your learning? Please explain.** *Sort of, they didn't have a role until we started working on problems on our own.*

17. **Was the teacher instrumental in your learning? Please explain.** *No. I didn't really think that his style worked with my learning style.*

18. **How would you describe your academic performance in Geometry Honors during the school year?** *I think that I did all that I could, knowing that I was not very good in Geometry. I got a tutor, went to math center and I still didn't understand, but my work ethic was great.*

19. **Did the Geometry Honors Preview course adequately prepare you for Geometry Honors? Please explain.** *No, because the course only went over proofs and there was a lot more to Geometry Honors than just proofs.*

20. **Did you receive additional academic support during the school year while you were taking Geometry Honors? Please explain.** *Yes, I had an outside tutor and I went to the freshman math center*

21. **On average, how often did you meet with your teacher?** *Two to three times per week.*

22. **Did you study in a group or by yourself when preparing for assessments?** *With a group at the math center and with my tutor.*

23. **Do you believe that your success in mathematics is vital to your future goals and aspirations? Please explain.** *Yes, because I am looking into science majors because I am very good at sciences. An math and science go hand in hand. Plus no matter what my future holds for me. I will always need math.*

# Student/Participant Questionnaire Responses

## LARRY

1. **What was your attitude towards Algebra (i.e. did you like doing the work)?** *I did not like doing the work.*

2. **Do you believe a student's success in mathematics is a result of hard work or innate ability? Please explain.** *It is a skill that you can have but it can also be learned through hard work.*

3. **Do you believe that your 8th grade math teacher did a good job teaching you mathematics? Please explain.** *Yes, I knew what I was doing but I don't remember much because the summer class taught me more that would be used in high school.*

4. **Do you believe that taking Algebra in the 8th grade prepared you well for taking Geometry Honors in the 9th grade? Please explain.** *No, I struggled with honor only because I started with Geometry Standard, then moved up to honors late. So the struggle could have been avoided if I knew that the summer class was made for honors.*

5. **Did your family communicate with your 8th grade math teacher?** *If yes, how often? No*

6. **Who helped you prepare for math tests in the 8th grade?** *Teachers, I would study in a homework club made to help after school*

7. **Who helped you complete homework assignments for your 8th grade math class?** *Teachers that ran the homework club program.*

8. **How often during the week did you meet with your 8th grade math teacher?** *Every day*

9. **How did you hear about the Geometry Honors Preview course offered during the summer?** *My mother signed me up and told me about it the day it started*

10. **Why did you decide to enroll in the Geometry Honors Preview course?** *I had no choice*

11. **What did you enjoy about the summer course?** *It actually taught me things I would use later in the math class I was in.*

12. **What did you like least about the course?** *The speed, I couldn't keep up because there were things like proofs I had no clue about.*

13. **Did you receive additional help with the material covered during the summer course?** *No*

14. **Did the course make you more or less confident about taking Geometry Honors during the school year? Please explain.** *More confident. The things I learned in Geometry Honors were things I've worked with before.*

15. **Would you recommend the course to incoming freshmen? Please explain.** *Yes, it would introduce things that would baffle you during your freshman year.*

16. **Were the teacher assistants instrumental in your learning? Please explain.** *Yes, because they would give people some extra attention because the class was so small.*

17. **Was the teacher instrumental in your learning? Please explain.** *Not really, the teacher would go over the work but not teach the instrumental things that would be needed to do it yourself.*

18. **How would you describe your academic performance in Geometry Honors during the school year?** *It could have been a lot better. It was not to my satisfaction*

19. **Did the Geometry Honors Preview course adequately prepare you for Geometry Honors? Please explain.** *It showed me what would be going on in class but because of its length it didn't have time to go in depth and show you the mechanics behind the problem solving.*

20. **Did you receive additional academic support during the school year while you were taking Geometry Honors? Please explain.** *Yes, African American Scholars Program helped me academically during the school year.*

21. **On average, how often did you meet with your teacher?** *Before most quizzes when I first moved up to honors class.*

22. **Did you study in a group or by yourself when preparing for assessments?** *In a group with other people I knew that had the same problems I was having.*

23. **Do you believe that your success in mathematics is vital to your future goals and aspirations? Please explain.** *I doubt it. I'm thinking about becoming a psychiatrist or psychologist.*

## Parent Questionnaire Responses

### CARL'S MOTHER

1. **Do you believe your child's 8th grade math teacher did an adequate job teaching your child Algebra. Please explain.** *Yes*

2. **How often did you communicate with your child's 8th grade math teacher? Why?** *Just during conferences*

3. **Did your child struggle with Algebra? Please explain.** *At first until he understood the concept.*

4. **Did your child receive additional support for math in the 8th grade? Please explain.** *Yes, he had a tutor. I felt that he would do better if he had that extra push understanding the problems.*

5. **Do you believe that a child's success in mathematics is due to hard work or innate ability? Please explain.** *Yes, a child must study hard to achieve greatness.*

6. **How did you hear about the Geometry Honors Preview course offered during the summer?** *It was on the Peake High School website.*

7. **Was your child receptive to the idea of taking the Geometry Honors Preview course over the summer? Please explain.** *Yes, because I explained how it would help him during the school year.*

8. **Do you believe the course was vital to your child's success in Geometry Honors? Please explain.** *Yes, because he did much better at math and enjoyed the work.*

9. **If you had another child recommended for Geometry Honors, would you enroll him/her into the Geometry Honors Preview course? Please explain.** *It all depends on the child's understanding.*

10. **Did your child appear more confident in his/her mathematical ability as a result of taking the Geometry Honors Preview course? Please explain.** *He feels more confident in himself.*

11. **Did you encourage your child to meet with his/her 9th grade math teacher? Please explain.** *Only if he had a concern about a question.*

12. **Did your child receive additional academic support during his/her freshman school year? Please explain.** *Yes, just to keep up with the progress of his math work and not falling behind.*

## Parent Questionnaire Responses

### VANCE'S MOTHER

1. **Do you believe your child's 8th grade math teacher did an adequate job teaching your child Algebra. Please explain.** *Yes. The teacher was very thorough, organized and knowledgeable about the subject.*

2. **How often did you communicate with your child's 8th grade math teacher? Why?** *I checked in with the teacher at the middle of each term. I taught Vance early on that he needed to advocate for himself with school and communicating any problems with his teachers.*

3. **Did your child struggle with Algebra? Please explain.** *No. Victor has always done well with math and science. He loves equations and figuring things out.*

4. **Did your child receive additional support for math in the 8th grade? Please explain.** *No. He didn't need it.*

5. **Do you believe that a child's success in mathematics is due to hard work or innate ability? Please explain.** *Both, Victor's a hard worker and is not afraid to ask for help. He's a visual learner and thinker like myself and loves to solve problems.*

6. **How did you hear about the Geometry Honors Preview course offered during the summer?** *One of his teachers.*

7. **Was your child receptive to the idea of taking the Geometry Honors Preview course over the summer? Please explain.** *No. He wanted to work.*

8. **Do you believe the course was vital to your child's success in Geometry Honors? Please explain.** *Yes. It gave him a head start for the actual class.*

9. **If you had another child recommended for Geometry Honors, would you enroll him/her into the Geometry Honors Preview course? Please explain.** *Yes, to prepare him/her for the actual course.*
10. **Did your child appear more confident in his/her mathematical ability as a result of taking the Geometry Honors Preview course? Please explain.** *Yes. He felt more comfortable taking an honors course.*

11. **Did you encourage your child to meet with his/her 9th grade math teacher? Please explain.** *Yes, to get help preparing for quizzes and tests. He struggles with test takin.*

12. **Did your child receive additional academic support during his/her freshman school year? Please explain.** *Yes. He was in tutorial for help in English and History.*

## Parent Questionnaire Responses

### BRAD'S MOTHER

1. **Do you believe your child's 8th grade math teacher did an adequate job teaching your child Algebra. Please explain.** *I still felt that Brad needed extra help*

2. **How often did you communicate with your child's 8th grade math teacher? Why?** *Open house, to meet the teacher in a group setting*

3. **Did your child struggle with Algebra? Please explain.** *I don't feel that Brad struggled, but it was not an easy class for him.*

4. **Did your child receive additional support for math in the 8th grade? Please explain.** *Sometimes his grandfather would review with him but not often. Brent felt he had things under control and did not want the help. It had to be forced on him.*

5. **Do you believe that a child's success in mathematics is due to hard work or innate ability? Please explain.** *Hard work. If Brad studies, get extra help, he will get an "A"always.*

6. **How did you hear about the Geometry Honors Preview course offered during the summer?** *Not sure how I learned about the class, but Brent didn't want to go to camp so I told him he would go to summer school. Not because his grades were bad, but to make sure he was prepared.*

7. **Was your child receptive to the idea of taking the Geometry Honors Preview course over the summer? Please explain.** *No. He felt like he did well in math and didn't need summer school. I think he saw summer school as punishment, not as an enhancer to his education.*

8. **Do you believe the course was vital to your child's success in Geometry Honors? Please explain.** *Yes, he told me himself. He didn't want to take the class, but when he started Geometry Honors he said it had really helped.*

9. **If you had another child recommended for Geometry Honors, would you enroll him/her into the Geometry Honors Preview course? Please explain.** *Yes, because Brad said it helped him.*

10. **Did your child appear more confident in his/her mathematical ability as a result of taking the Geometry Honors Preview course? Please explain.** *Yes, because he had seen work that was to come and knew how to do it.*

11. **Did you encourage your child to meet with his/her 9th grade math teacher? Please explain.** *I always encourage Brad to meet with his teachers when his grade is below an "A" because I feel that he can get an "A" with a little follow up on things he doesn't understand.*

12. **Did your child receive additional academic support during his/her freshman school year? Please explain.** *No. Not that I am aware of or remember at this point.*

# Parent Questionnaire Responses

## MARY'S FATHER

1. **Do you believe your child's 8th grade math teacher did an adequate job teaching your child Algebra. Please explain.** *Yes! She challenged Mary to do well and more than other kids*

2. **How often did you communicate with your child's 8th grade math teacher? Why?** *Rarely, Mary kept us in the loop and we could see what she was doing with her.*

3. **Did your child struggle with Algebra? Please explain.** *No! She worked hard and had a good foundation in math.*

4. **Did your child receive additional support for math in the 8th grade? Please explain.** *No! Mary had extra work but not extra support.*

5. **Do you believe that a child's success in mathematics is due to hard work or innate ability? Please explain.** *Both! Mary is smart and has talent in math, but she works her butt off to do well.*

6. **How did you hear about the Geometry Honors Preview course offered during the summer?** *I taught summer school and the researcher told me about it.*

7. **Was your child receptive to the idea of taking the Geometry Honors Preview course over the summer? Please explain.** *Not really, but she understood it would help her and she wanted to do well in the class.*

8. **Do you believe the course was vital to your child's success in Geometry Honors? Please explain.** *Yes! It gave her a foundation in Geometry and confidence in her ability to do high school work.*

9. **If you had another child recommended for Geometry Honors, would you enroll him/her into the Geometry Honors Preview course? Please explain.** *Yes! I love how it helped Mary.*

10. **Did your child appear more confident in his/her mathematical ability as a result of taking the Geometry Honors Preview course? Please explain.** *Yes! She believes and sees the results of being a good math student.*

11. **Did you encourage your child to meet with his/her 9th grade math teacher? Please explain.** *When she struggled—yes! When some concepts were difficult, she would go see her teacher her own.*

12. **Did your child receive additional academic support during his/her freshman school year? Please explain.** *Yes! She used the math center and had a tutor for the 2nd semester.*

## Parent Questionnaire Responses

### LARRY'S MOTHER

1. **Do you believe your child's 8th grade math teacher did an adequate job teaching your child Algebra. Please explain.** *Yes, I did not have any complaints from my son.*

2. **How often did you communicate with your child's 8th grade math teacher? Why?** *Not often since Larry was doing fine.*

3. **Did your child struggle with Algebra? Please explain.** *No*

4. **Did your child receive additional support for math in the 8th grade? Please explain.** *Yes, some extra time reviewing before exams*

5. **Do you believe that a child's success in mathematics is due to hard work or innate ability? Please explain.** *A bit of both, but mostly constant practice of the materials*

6. **How did you hear about the Geometry Honors Preview course offered during the summer?** *In a meeting at PHS with the coordinator of the African American Scholars Program*

7. **Was your child receptive to the idea of taking the Geometry Honors Preview course over the summer? Please explain.** *Not at first, but once he started he enjoyed it.*

8. **Do you believe the course was vital to your child's success in Geometry Honors? Please explain.** *He did standard at first then moved to Geometry Honors half-way through the class explaining the final grade of "C".*

9. **If you had another child recommended for Geometry Honors, would you enroll him/her into the Geometry Honors Preview course? Please explain.** *Yes, of course. In fact, my younger daughter missed the opportunity this summer. We were very disappointed.*

10. **Did your child appear more confident in his/her mathematical ability as a result of taking the Geometry Honors Preview course? Please explain.** *Yes, he was very confident especially in Geometry Standard. When he moved to Geometry Honors he had to work hard to catch up.*

11. **Did you encourage your child to meet with his/her 9th grade math teacher? Please explain.** *Yes, despite the fact he was doing fine in the beginning. Hopefully the coordinator of the African American Scholars Program helped him recuperate*

**12. Did your child receive additional academic support during his/her freshman school year? Please explain.** *Yes, he did. Through the African American Scholar Program*

## Ninth Grade Teacher Comments

Table 19 highlights the comments on the four report cards issued to the five student/participants during their freshman year in Geometry Honors. Their respective grades are identified in parentheses from the Geometry Honors teachers. The fourth quarter includes the final grade for Geometry Honors.

## Table 19

## Geometry Honors Teachers' Comments for Students Who Enrolled in The Geometry Honor Preview Course

| *Name* | *Comments for Quarters 1 - 4* |
|---|---|
| **Carl** | Q1: Grade (E); Tries hard/ finds subject difficult. Shows positive attitude |
| | Q2: Grade (C); Tests and quizzes have improved |
| | Q3: Grade (D-); Tries hard/finds subject difficult |
| | Q4: Grade (C+) and Final Grade (D+); A hard worker |
| | |
| **Vance** | Q1: Grade (C+): Vance has continued to work hard, with great homework and participation. Keep up the hard work, and please keep coming in for help when you need it |
| | Q2: Grade (B): Fantastic quarter. Much better exams, and good participation |
| | Q3: Grade (C): Rough quarter. Grades got back up to C's in the second half, but Vance is definitely capable of more. Please keep coming in for help! |
| | Q4: Grade (B) and Final Grade (B-): No comments |
| | |
| **Brad** | Q1: Grade (B): Brad work in math this quarter has been solid. He is a pleasure to have in class. |
| | Q2: Grade (B): Brad worked hard this quarter, as always. He is doing very well in math. |
| | Q3: Grade (C): Brad has been working hard in math |
| | Q4: Grade (C+) and Final Grade (B-): I'm proud of the hard work "Brad" did this year. He was a pleasure to have in class. |
| | |
| **Mary** | Q1: Grade (B): Mary has good math sense and an excellent work ethic. Her tests and quizzes grades are inconsistent. I would like to help her improve her test taking strategies |
| | Q2: Grade (B): Mary is a serious dedicated math student and a joy to have in class. I hope she has some fun with math too! |
| | Q3: Grade ( C ): Mary has good comprehension of the material during class and review. Her quiz/test grades this quarter: 55, 62, 78,68, 77. |
| | Q4: Grade(C) and Final Grade (C+): "Mary" was a joy to have in class. She worked hard and was an asset to her group. "Mary" struggled with her tests and quizzes. She will have to continue to work hard. Keep up the good work and have a great summer. |
| | |
| **Larry** | Q1: Grade (A): In **Geometry Standard *After 1st quarter he moved to Geometry Honor** |
| | Q2: Grade ( C ): Larry has not been in Math 1 Honor long enough to get a grade yet. |
| | Q3: Grade (D+): Larry is working hard in Math 1 Honor, and I am proud of his progress during this difficult transition. He's welcome to see me for help outside of class. |
| | Q4: Grade (D+) and Final Grade (C-): "Larry" had difficulty transitioning into Geometry Honor. He worked hard and was a pleasure to have in class |

## Themes

There were several themes identified in the Student/Participant and Parent Questionnaires that can be used to further examine the attitudes and behaviors of students and their parents towards mathematics education. The questions with their corresponding number that have the strongest themes as identified by the researcher from the Student/Participant Questionnaire are as follows:

### STUDENT/PARTICIPANT QUESTIONNAIRE THEMES

| | |
|---|---|
| ***Question #2*** | ***Do you believe a student's success in mathematics is a result of hard work of innate ability? Please explain.*** |

Some students believed it is a combination of hard work and innate ability; however, all of the students identified working hard as the key to success in mathematics.

| | |
|---|---|
| ***Question #3*** | ***Do you believe that your 8th grade teacher did a good job teaching you mathematics? Please explain.*** |

All of the students believed their 8th grade teacher did good job teaching them Algebra. Overall they appeared to have had a good experience in mathematics.

| | |
|---|---|
| ***Question #4*** | ***Do you believe that taking Algebra in the 8th grade prepared you well for taking Geometry Honors in the 9th grade? Please explain.*** |

Most students (4 out of 5) believed that Algebra did not prepare them for Geometry Honors.

| | |
|---|---|
| ***Question #5*** | ***Did your family communicate with your 8th gade math teacher? If yes, how often?*** |

Students indicated that their parents did not communicate above and beyond the normal communication with teachers in the form of parent/teacher conferences.

| | |
|---|---|
| ***Question #6*** | ***Who helped you prepare for math tests in the 8th grade?*** |

Students prepared for tests either by themselves or with a teacher.

| | |
|---|---|
| ***Question #7*** | ***Who helped you complete homework assignments for your 8th grade math class?*** |

Students completed homework either by themselves or with a teacher.

| ***Question #8*** | ***How often during the week did you meet with your 9th grade math teacher?*** |
|---|---|

Most students (4 out of 5) met with their 8th grade teacher frequently throughout the week.

| ***Question #13*** | ***Did you receive additional help with the material covered during the summer course?*** |
|---|---|

None of the students received help for the Geometry Honors Preview course outside of class.

| ***Question #14*** | ***Did the course make you more or less confident about taking Geometry Honors during the school year? Please explain.*** |
|---|---|

All of the students believed the course increased their confidence

| ***Question #15*** | ***Would you recommend the course to incoming freshmen? Please explain.*** |
|---|---|

All of the students recommended the course to other students.

| ***Question #16*** | ***Were the teacher assistants instrumental in your learning? Please explain.*** |
|---|---|

All of the students stated the teacher assistants were instrumental in their learning the material.

| ***Question #20*** | ***Did you receive additional academic support during the school year while you were taking Geometry Honors? Please explain.*** |
|---|---|

All of the students stated they received additional academic support during the school year. These sources of support included teachers, personal tutors, and resources provided by Peake High School such as tutorial classes and the African American Scholars Program.

| ***Question #21*** | ***On average, how often did you meet with your teacher?*** |
|---|---|

All of the students met with their teacher for additional support. Most of them met with their teachers prior to tests and quizzes.

| ***Question #22*** | ***Did you study in a group or by yourself when preparing for assessments?*** |
|---|---|

Two out of the five participants studied by themselves consistently. The two students were Vance and Brad. However, it is important to note that Vance stated that he met with his teacher at least four days per week before school and Brad stated that he received extra help from his teacher.

| | |
|---|---|
| ***Question #23*** | ***Do you believe that your success in mathematics is vital to your future goals. Please explain.*** |

Four out of five students believed that success in mathematics was vital to their future goals and aspirations. Larry was the only student who doubted the importance of mathematics because he wants to become a psychiatrist or psychologist.

## PARENT QUESTIONNAIRE THEMES

| | |
|---|---|
| ***Question #1*** | ***Do you believe your child's 8th grade math teacher did an adequate job teaching your child Algebra? Please explain.*** |

4 out of 5 parents believed their child's 8th grade math teacher did an adequate job teaching their child Algebra. One parent stated that she still believed her son needed extra help.

| | |
|---|---|
| ***Question #3*** | ***Did your child struggle with Algebra? Please explain.*** |

Carl's mother voiced concern in the beginning, but overall she and the rest of the parents did not believe their children struggled with Algebra.

| | |
|---|---|
| ***Question #5*** | ***Do you believe that a child's success in mathematics is due to hard work or innate ability? Please explain.*** |

Most parents believe that it is both hard work and innate ability; however, all of the parents stated that hard work is essential to success.

| | |
|---|---|
| ***Question #7*** | ***Was your child receptive to the idea of taking the Geometry Honors Preview course over the summer? Please explain.*** |

4 out of the 5 parents said their child was not receptive to taking the Geometry Honors Preview Course during the summer. Although Carl was the only student who was open to the idea, it happened as a result of his mother explaining how v the course was vital to his success in high school.

| | |
|---|---|
| ***Question #8*** | ***Do you believe the course was vital to your child's success in Geometry Honors? Please explain.*** |

All of the parents believed the course was vital to their children's success in Geometry Honors.

| | |
|---|---|
| ***Question #9*** | ***If you had another child recommended for Geometry Honors, would you enroll him/her into the Geometry Honors Preview course? Please explain.*** |

4 out of 5 parents stated they would enroll a second child into the Geometry Honors Preview course. The one dissenting parent stated that it depended on their child's mathematical understanding or competence.

| | |
|---|---|
| ***Question #10*** | ***Did your child appear more confident in his/her mathematical ability as a result of taking the Geometry Honors Preview course? Please explain*** |

All of the parents stated their children's confidence increased.

| | |
|---|---|
| ***Question #11*** | ***Did you encourage your child to meet with his/her 9th grade math teacher?*** |

All of the parents encouraged their children to meet with their 9th grade math teacher.

| | |
|---|---|
| ***Question #12*** | ***Did your child receive additional academic support during his/her freshman school year? Please explain.*** |

4 out of the 5 parents stated that their child received additional academic support during their freshman year. Brad's mother stated that she was unaware as to whether he was receiving additional academic support. However, it is important to note that Brad stated on his questionnaire that he received additional academic support.

**Research Questions**

The researcher will attempt to address the four research questions based upon the quantitative and qualitative data gathered in Chapter 4.

1) Will African American students who took the summer course complete Geometry Honors during the school year? All five of the participants who enrolled in the Geometry Honors Preview course completed Geometry Honors during the school year.
2) How do students believe the Geometry Honors Preview course helped them prepare for an honors level course in mathematics? Based upon feedback from the questionnaire, students believed the course increased their confidence because they entered the course in the ninth grade knowing what to expect (question #14). Although three out of the five students found the teacher instrumental in learning the material (question #17), all of the students found the teacher assistants instrumental in their learning (question #16)
3) What factors do the data suggest was particularly influential in student success in the Geometry Honors Preview course? It appears as though the relationships that the students had with the teacher assistants and the teacher provided the greatest influence in

their success. Apparently, the common thread for their success during the summer and the school year involved a prodigious work ethic each student possessed. Further, the students utilized strong self advocacy skills that were enhanced by significant parental involvement. All of the students accessed teachers throughout the school year for additional support.

4) Will African American students who enrolled in the Geometry Honors Preview class outperform the African American students who did not attend? According to the quantitative data collected in the form of grade point averages (Table 5), the African American Geometry Honors Preview (AAGHP) cohort had a final grade point average of 2.14, while the African American Non-Geometry Honors Preview (AANGHP) cohort earned an average grade point average of 1.80. Further, the "AAGHP" cohort outperformed the "AANGHP" cohort three out of the four quarters (Table 5).

## Conclusion

The quantitative and qualitative data presented in Chapter 4 will be utilized to interpret the findings in Chapter 5. Chapter 5 will summarize the findings as they relate to the research questions. Additionally, Chapter 5 will the discuss the findings and provide implications and recommendations for practice, policy, and future research.

# Chapter 5

## Summary, Discussion, and Implications

### Introduction

Chapter Five is divided into seven major sections that analyzes, summarizes, and discusses the findings presented in Chapter Four. The findings are discussed in relation to pertinent research literature from Chapter Two. The discussion highlights implications for practice and recommendations for future research. The following sections comprise Chapter Five.

1. **Summary of the Findings:** This section answers the research questions presented in Chapter Four.
2. **Discussion of the Findings:** This section discusses findings of the study and how they compare and contrast with the research literature outlined in Chapter Two.
3. **Limitations of the Study:** This section addresses the extent of the limitations of the study and the impact those limitations had on the validity and reliability of the findings. This section also identifies the challenges the researcher encountered in the study.
4. **Implications for Practice and Policy:** This section addresses the findings with respect to their potential impact on practice and policy in mathematical instruction. It also addresses the implication for implementing policy district-wide.
5. **Implications for Further Research:** This section addresses the findings by outlining an additional initiative aimed at closing the achievement gap in mathematics entitled, “The Calculus Project”. The Calculus Project is an extension of the research conducted for this study.

6. **Leadership Lessons:** This section discusses the researcher's reflections and the lessons learned by the researcher.
7. **Conclusion:** This section concludes the case study and presents the researcher's personal account on the experience gained from conducting the study.

## Summary of the Findings

This case study evaluated a project focused on improving African American achievement in Geometry Honors by pre-teaching ninth graders the theorems, postulates, note-taking and study strategies prior to their enrollment into the course. The findings that surfaced from the quantitative data collected from the students' report cards and qualitative data collected through the teacher questionnaires and researcher field notes suggest that the Geometry Honors Preview course adequately prepared African American students for the rigors of Geometry Honors. This section will discuss the findings as they relate to each of the research questions.

1) Will African American students who took the summer course complete Geometry Honors during the school year? All five of the participants who enrolled in the Geometry Honors Preview course completed Geometry Honors during the school year.
2) How do students believe the Geometry Honors Preview course helped them prepare for an honors level course in mathematics? Based upon responses to the questionnaire, students believed the course increased their confidence because they entered the course in the ninth grade knowing what to expect (question #14). Although three out of the five students found the teacher instrumental in learning the material (question #17), all of the students found the teacher assistants instrumental in their learning (question #16)
3) What factors do the data suggest were particularly influential in student success in the Geometry Honors Preview course? Students reported that the relationships that the

students had with the teacher assistants and the teacher provided the greatest influence in their success. On the other hand, a the common thread for their success during the summer and the school year involved a prodigious work ethic each student possessed. Further, the students utilized strong self-advocacy skills that were enhanced by significant parental involvement. All of the students accessed their respective teachers throughout the school year for additional support.

4) Did African American students who enrolled in the Geometry Honors Preview class outperform the African American students who did not attend? According to the quantitative data collected in the form of grade point averages (Table 5), the African American Geometry Honors Preview (AAGHP) cohort had a final grade point average of 2.14, while the African American Non-Geometry Honors Preview (AANGHP) cohort earned an average grade point average of 1.80. Further, the "AAGHP" cohort outperformed the "AANGHP" cohort during three out of the four academic quarters (Table 5).

**Discussion of the Findings**

There were a couple of revelations that the researcher did not expect after he reviewed his findings. When the researcher decided to compare the state MCAS test scores of both the African American Geometry Honor Preview (AAGHP) and the African American Non Geometry Honor Preview (AANGHP) cohorts, he expected the cohort that did not enroll in the summer preview course to score lower. On the contrary, the students who enrolled in the Geometry Honors Preview course had an average grade point average (GPA) that was 5.7 points lower than the students who did not complete summer enrichment course.

After analyzing the design of the state test, it became apparent as to why there was only a small discrepancy in the performance of both cohorts. Although the state test was given in the tenth grade, the students were assessed on Algebra—a course both cohorts successfully completed in the eighth grade. In short, both cohorts were tested on material they knew fairly well that was the basis for their recommendation into Geometry Honors in the first place. The Geometry content that was included on the state test only comprised 15 percent of the total problems and consisted of basic geometry concepts that were covered in both the eighth and ninth grade.

The second revelation involved the full-year Geometry Honors course and teacher recommendations. Teachers base their recommendations for the subsequent course to Geometry Honors almost solely on the students' final grade in the course. Students who earn a "B" or higher in Geometry Honors are usually recommended to Algebra II and Trigonometry Honors, the following course in the honors sequence.

Indeed, teacher recommendations pose a significant problem when schools aspire to diversify their advanced level mathematics classes. Although parents can override a teacher's recommendation, if the student does not have an attentive, proactive parent, he or she is left to the advisement of their teacher and guidance counselor.

For example, Carl earned a final grade of "D+" in Geometry Honors and was not recommended for Algebra II and Trigonometry Honors. Instead, Carl was recommended for an Introduction to Algebra II course by his Geometry Honors teacher. Carl's mother insisted that he attend the Algebra II Accelerated course during the summer so he could enroll in an Algebra II and Trigonometry standard course. After Carl successfully completed Algebra II and Trigonometry, he attended summer school and enrolled into a standard level Precalculus course

to prepare him for Precalculus in the eleventh grade. Carl completed the standard level Precalculus class and completed his senior year in an Introduction to Calculus course. If Carl's mother did not help him advocate for himself and the enrichment courses did not exist, Carl would not have had an opportunity to enroll in an Introduction to Calculus course during his senior year.

Uri Treisman, a mathematics professor who taught Calculus at the University of California Berkeley (UC Berkeley), observed that an overwhelming number of African American students who had comparable academic transcripts and standardized test score results to their white and Asian-American counterparts were failing an Introduction to Calculus class during their first year (Treisman, 1992). The mathematics workshop Uri designed pre-taught Calculus to students of color prior to their enrollment into an Introduction to Calculus class. Although Treisman's initial intervention did not yield immediate results, he refined the structure and mathematical content of the workshop, which did yield immediate results.

The ethos of the Geometry Honors Preview course was to pre-teach students all of the theorems and postulates needed to successfully complete the first quarter. Additionally, students would learn strategies for studying effectively and improve on their classroom skills such as taking notes. The effect the summer course had on these five participants was similar to the impact students experienced who were participating in Uri Treisman's mathematics workshop at the University of California, Berkeley (UC Berkeley) (Treisman, 1992).

According to comments on the participants' report cards, the Geometry Honors teachers observed that all of the students possessed a phenomenal work ethic. Geometry Honors is an extremely rigorous course for freshmen. The researcher's anecdotal observation of student failure in the course was that students who fail the first quarter usually fail the course due to the

comprehensive structure of the curriculum. However, Carl was an exception to this observation. Carl earned an "E" for the first quarter despite meeting with his teacher several times during the week, receiving additional support in the math and tutorial centers, and enrolling into the Geometry Honors Preview course. Although Geometry Honors was clearly an obstacle for Carl he successfully completed the course.

There were several findings gleaned from questionnaires completed by the students and their parents. The findings from the student questionnaires consist of the following:

- All of the students and their parents identified working hard as the key to success in mathematics. This finding is significant because it addresses an important attitude and behavior African American students and their parents must possess if they are to thrive in advanced mathematics courses. This finding also underscores the importance of parents providing their children with the same message educators give about working hard and the need for a strong work ethic.
- All of the students and their parents believed their eighth grade teacher did a good job teaching them Algebra. Additionally, four out of five students met with their eighth grade teacher frequently during the week. This finding supports the research of Ron Ferguson and the belief that there is a direct link between a student's success and a positive relationship between his or her teacher (Ferguson, 1991). It also highlights the importance of teacher quality because the students perceived their eighth grade teachers as knowledgeable. If parents believe their child's teacher is competent and is doing a great job teaching, it strengthens the partnership between the school and the student's home.

- Students indicated that their parents did not communicate beyond the normal communication with teachers in the form of parent/teacher conferences. One can assume that the parents did not contact their child's teacher outside the scope of parent/teacher conferences because their child was successful in Algebra. However, this finding does not imply that their parents were not involved. In fact, their parents were actively involved with their education providing moral and additional academic support in the form of tutoring when needed.
- All of the students stated that they would not have attended the Geometry Honor Preview course had it not been for their parents insisting them to attend. Dedicating two hours of time during the summer to study geometry for three weeks is not appealing to most teenagers. This finding validates the importance of parental involvement in a child's education.
- All of the students stated they would recommend other freshmen to enroll in the course and four out of the five parents stated that if they had another child, they would enroll their second child too. One parent stated that enrolling her second child depended on the child's understanding of mathematics upon entering the ninth grade.
- All of the students believed that completing the course improved their confidence. Additionally, their parents also believed that the Geometry Honors Preview course increased their confidence too. The research of Claude Steele regarding the impact of the stereotype threat to African American achievement suggests the importance of student confidence as well as competence (Steele & Aronson, 1995). This finding indicates that the Geometry Honor Preview course made students feel more confident because they had learned the theorems and postulates prior to enrolling into Geometry Honors.

- All of the students stated that the teacher assistants were instrumental in their learning. There is extensive research suggesting the importance of learning with peers. In fact, Uri Treisman utilized cooperative learning strategies when he created the mathematics workshop at the University of California Berkeley to help African American students succeed in Calculus. This finding is significant because utilizing role models will be vital when additional summer enrichment courses are created.

These findings suggest that additional summer enrichment courses should be developed to extend into the elementary schools. More importantly, continued support in the form of tutoring should take place throughout the school year.

**Limitations of the Study**

There were several limitations to the study. Possibly, the most significant limitation was the small sample size. On average, approximately 190 students enroll in Geometry Honors. Out of the 190 students, approximately 16 of the students identify themselves as African American. This class had 188 students enrolled in Geometry Honors with 13 out of the 188 students identifying themselves as African American. The students who comprised my sample size of five were part of the 13 African American students enrolled in Geometry Honors. Even if all 13 African American students participated in the study, one could argue that the sample size was still too small.

Although the five participants were the primary focus of the study, the African American students who did not attend the Geometry Honors Preview course during the summer and their parents did not complete a questionnaire. Comparing the responses of the questionnaires completed by both groups may have contributed additional findings, since the cohort of African

American students who attended the Geometry Honors Preview class earned higher grades than African American students who did not attend.

It is also possible that some information was left uncovered because personal interviews with the participants and their parents did not occur. Personal interviews would have given the researcher the opportunity to probe deeper into the responses of the participants. According to Merriam, "Probing can come in the form of asking for more details, for clarification, for examples." (Merriam, 1998, p. 80).

The researcher interviewed, hired, and compensated the teacher assistants for their work in the Geometry Honors Preview class. Hence, the opinions shared by the two teacher assistants on their questionnaires could be biased in favor of the researcher. Although the researcher assured the teacher assistants their opinions would be kept confidential and would not affect the term of their current or future employment, the possibility exists that they may make comments to please the researcher.

Finally, all of the students had different eighth grade math teachers who assessed, evaluated, and graded them differently on the same content. Additionally, the eight teachers who recommended the 13 African American students for Geometry Honors based their recommendations on the students' performance in their class, personal expectations and their experience teaching mathematics. This is extremely problematic because a first year teacher will undoubtedly have a different set of criteria than a veteran teacher of 20 years. Indeed, the absence of common assessments and opportunities for the eighth grade teachers to collaborate has been documented in the Peake School District by the elementary schools' math coordinator.

## Implications for Practice and Policy

Peake High School, like virtually every diverse high school in the United States, has struggled to close the achievement gap by including students of color in advanced level mathematics classes. Major contributors to the achievement gap at Peake High School are the curriculum and the sequencing of the courses. For example, eighth graders who exhibited mastery in Algebra were recommended for Geometry Honors in the ninth grade. However, most of the students who withdrew from Geometry Honors for academic reasons, withdrew from the course because they had not learned the theorems and postulates that were vital to completing the Geometry proofs. When these students were given facts about a problem and were required to prove a geometry statement on a quiz or test, they usually failed or barely passed. Metaphorically speaking, a mathematician proving a geometry statement is like a lawyer prosecuting a defendant or defending a client. If the lawyer does not know the state and federal laws, he cannot win a case. Similarly, the adept mathematician has to know the theorems and postulates that exist to effectively write a proof.

While some of the topics in Geometry Honors required students to set up and solve basic algebraic equations to prove geometry theorems and postulates, the two column proofs that saturate the curriculum for the first 18 weeks require little if any algebra skills. This paradox was evident when the five students were asked in the questionnaire as to whether they believed the Algebra class adequately prepared them for Geometry Honors. Four out of the five students stated they did not believe the eighth grade Algebra course prepared them for Geometry Honors in the ninth grade. Vance, the one student who believed Algebra prepared him for Geometry Honors, stated that the Algebra helped him solve the equations not the geometry proofs.

Creating the Geometry Honors Preview course was significant to narrowing the achievement gap in mathematics at Peake High School because it helped students maintain their standing in the sequence of honors level courses. Prior to the implementation of this enrichment summer course, students who excelled at Algebra, but did not perform well in Geometry Honors, were demoted to the standard level sequence of courses. Once students fell into the standard level sequence, there were very little opportunities for ascending back into the honors level sequence. For African Americans, it meant that 60 to 70 percent of them would withdraw from the honors sequence by the second quarter of their freshman year. The long-term effect of this practice along with the normal attrition that occurs within a graduating class, resulted in virtually no representation of African Americans in Calculus.

The Geometry Honors Preview course coupled with Algebra II Accelerated, a separate mathematics enrichment course offered to students the summer after freshman year, has provided students with a pathway to Calculus in the twelfth grade. Because of this study, Peake High School is now operating a series of enrichment mathematics courses that run parallel to the honors level curriculum during the summer. This parallel curriculum has provided a safety net for students who have proven themselves successful in Algebra, but unsuccessful in Geometry Honors.

Students who take the Geometry Honors Preview course over the summer rarely drop Geometry Honors during the school year. In fact, all of the students in this study successfully completed the Geometry Honors course. Students who are recommended for Geometry Honors, but withdraw from the course have an opportunity to enroll into the Algebra II Accelerated course during the summer. This intensive course provides students with an accelerated overview of Algebra II. Students who successfully complete the course either move into Algebra II and

Trigonometry Honors or Algebra II and Trigonometry Standard. Both of these courses will allow these sophomores the opportunity to enroll into Calculus senior year.

This study suggests that administrators and teachers carefully analyze the sequencing of their mathematics courses, while simultaneously reviewing demographic and ethnicity data related to course enrollment as graduating classes matriculate. Once demographic and ethnic disparities emerge, administrators and teachers must identify the problem and change the policy and/or practice that cause(s) the inequity that denies all students an opportunity to learn. In the case of Peake High School, it was evident that the sequencing of the mathematics courses contributed to the achievement gap in mathematics.

The researcher concludes that the Geometry Honors Preview course is an effective intervention to prohibit the excessive number of African American students who withdraw from Geometry Honors due to poor academic performance. Since the inception of the summer enrichment course during the summer of 2006, 11 African American students have enrolled in the course (including the five students in the study). Out of the eleven students, only one student withdrew from Geometry Honors and enrolled into a Geometry Standard course. The one student who withdrew from Geometry Honors decided to withdraw from the class despite earning a "C-" for the first quarter. When the student was questioned about dropping Geometry Honors by the researcher, the student informed the researcher that he did not want to put in the additional time required to improve his performance in the class.

The student's statement was very telling because, it reemphasized the fact that changing the attitudes and behaviors of African American students is just as important as providing them with an educational opportunity that will ensure their success in a course that has marginalized them historically. Administrators, teachers, and guidance counselors have to do a better job

communicating and preparing students for rigorous coursework during the summer and school year. Until schools do a better job establishing high expectations for all students, while stressing the importance of hard work, the achievement gap in mathematics will continue to exist.

In an effort to address future African American students who may consider dropping Geometry Honors prematurely, the researcher teaches the Geometry Honors Preview course during the summer and emails the names of the students who enrolled into the Geometry Honors Preview course to their ninth grade math teachers and guidance counselors. Additionally, the researcher requested that no African American student is withdrawn from Geometry Honors until he and the parent are notified.

The questionnaires revealed that several students received academic assistance from their teachers and additional academic resources provided by Peake High School. It is imperative that schools provide students with additional opportunities to learn mathematics that will give them more time on task. More importantly, educational leaders need to provide academic support in mathematics throughout the school year that is free of charge. This important measure will help level the socioeconomic playing field because students who are poor do not have the money to pay for tutors. Principals may also address this need by creating a school day schedule that helps teachers increase the amount of time they are available to work with students.

It is unlikely that the Peake Public School system will modify the sequence of their mathematics courses to address the manner in which the Geometry Honors course displaces students of color out of the honors level. Therefore, the alternative is for the eighth grade math teachers to introduce some of the geometry theorems and postulates to them towards the end of the school year. If the teachers engaged in this practice, it will help students adapt to a new way of thinking mathematically.

Additionally, other common practice strategies include the elimination of course leveling in the elementary schools. Although most of the eighth graders are enrolled in Algebra, there are some Algebra sections within the same elementary school that offer more problems that are challenging and a more robust curriculum. The lower level Algebra class is usually comprised of students who do not excel in mathematics and students who are in special education because their learning disability hinders their academic success. This practice poses many problems when students arrive at the high school. When guidance counselors, department heads, and administrators review a student's elementary school transcript, a "B" in a lower level Algebra class has a different meaning than a "B" in a higher level Algebra class.

Course leveling also gives students and their parents a false sense of their mathematical knowledge. There were several students at Peake High School enrolled in Algebra during their sophomore year. All of the students completed Algebra in the eighth grade—some students even earned a "B". However, when they enrolled into Algebra II, the work was too difficult, so their tenth grade mathematics teachers suggested to their parents and guidance counselors the students withdraw from Algebra II and enroll into an Algebra course.

Occasionally parents have expressed their confusion with the course recommendation process when their child advanced to the high school. Some parents have wondered why their child earned the same grade as another student, but was not recommended for Geometry Honors. The fact that nothing appears on the transcript that indicates the level of rigor for the Algebra class makes the process more ambiguous. Since the course recommendation process is not a reliable method of placing a student in the appropriate course, guidance counselors and teachers at the high school should provide elementary school teachers and guidance counselors with constructive feedback when a student is placed into an inappropriate course. Additionally, all of

the guidance counselors and eighth grade mathematics teachers should create a course recommendation process that is consistent in all of the elementary schools. When there are no guiding criteria for teacher recommendations, students are placed according to assumptions that vary from teacher to teacher. In fact, the school system is obligated to establish a uniform and rigorous K-8 mathematics curriculum to prepare students for mathematics at the secondary level.

Perhaps one strategy for fostering a mathematical culture within the student population is to enlist the assistance of peer tutors who act as teacher assistants. The study suggested that all of the students found the teacher assistants helpful and effective. However, it is important to note that the relationship between the students and the teacher assistants was mutually beneficial. Both teacher assistants believed that teaching the students solidified their knowledge base of Geometry. As Kara stated in her questionnaire, "Helping someone understand math, for example, allows you to gain confidence not only in the subject itself, but also in your ability to learn and cement knowledge into your mind."

Indeed, nurturing a mathematical culture in a school cannot happen without establishing partnerships with parents. This means that schools must look to create and consistently utilize mediums of communicating with parents and the community at large. A student's success in mathematics will ultimately determine what professions will be at that teenager's disposal post-secondary. Parents may not be aware of the far-reaching implications of their child not working up to his or her potential in mathematics. Given the fact that we are living in a technological era where so many functions of our daily lives revolve around technology, students with only a high school diploma will quickly find their talents obsolete.

The findings of this study have served as a catalyst for an initiative called the Calculus Project, which is now in its second year in the Peake Public School System. The goal of the

Calculus Project is to increase the number of African American and Hispanic students who take Calculus their senior year in high school. The superintendent of Peake Public School asked the researcher to oversee the Calculus Project and provided the researcher with a budget of $25,000. The researcher mailed 35 letters to the parents of African American seventh graders inviting them to attend an orientation meeting so they could hear more about the project. Fifteen parents attended the meeting and each one of them enrolled their child into the program.

During the summer of 2009, the 15 African American eighth graders learned Algebra in an Algebra Preview course designed and taught by the researcher. The class met from 9:00 a.m. to 1:00 p.m. each day for three weeks at Peake High School. These students watched the movie *Stand and Deliver* and answered questions related to the movie. They also went on field trips to the Federal Reserve Board and the Massachusetts Institute of Technology Museum of Science (MIT Museum) to learn about the impact mathematics has had in their lives. Each field trip included a lecture from an African American affiliated with MIT who talked about their personal/professional life, education, and how mathematics played a major role in their success.

Once the school year began, the 15 students had access to free tutoring at the high school from 3:00 to 5:00 p.m. Monday through Thursday. The tutoring center was staffed each day by one of three mathematics teachers who had agreed to supervise and facilitate tutoring in the tutorial center in exchange for the hourly workshop rate of $30 per hour. An additional responsibility of the mathematics teachers was to post the students' hours in the tutoring center online and communicate regularly with the elementary school teachers and the students' parents about their progress. The mathematics teacher was assisted each day by two to three upperclassmen that excelled in mathematics at the honors and advanced level. The peer tutors

were issued community service hours that could be used toward earning elective credit instead of monetary compensation for their services.

The first cohort of the Calculus Project is showing great promise. In fact, 73 percent of the students earned an "A-" or higher in Algebra after completing the first quarter. Next year, 20 African American students in the freshman class of 2014 will be recommended to enroll into Geometry Honors. Eleven out of the 20 students participate in the Calculus Project. Furthermore, two out of the three students who are enrolling into Geometry/Algebra II Advanced (the most advanced level of mathematics offered to freshman) are students in the Calculus Project.

The researcher believes the model of pre-teaching should be extended into elementary schools as early as the third grade, where some educators have suggested the achievement gap originates. If elementary schools increase the amount of time African American and Hispanic students spend on mathematics in the early grades, their chances of enrolling into advanced and honors mathematics courses will be greater in high school.

Indeed, school districts with profiles similar to Peake High School would narrow the achievement gap that exists within their districts if they implemented policies that supported pre-teaching during the summer. Pre-teaching core mathematical concepts to students during the summer will allow students to focus on one academic subject, hence allowing them additional time to hone their skills without detracting time from other academically challenging courses. Districts could pay an hourly rate to experienced teachers that includes preparation time and provide them with student teachers from local colleges and universities who need to earn practicum hours teaching.

Additionally, school districts can undertake a "grow-your-own" teacher initiative to inspire students to pursue a career in teaching mathematics. For example, seniors who excel in mathematics can work as teacher assistants during the summer. In return, students could receive compensation, community service credit, and a college recommendation letter from the superintendent or the principal.

This model may not be ideal in a school setting with a high transient population because students who transfer to multiple school districts develop significant gaps in their education. Moreover, it would be extremely difficult to implement the pre-teaching model in a school environment where a significant portion of the student population is in the custody of or involved with state agencies, and parental support is extremely low. In fact, the responses from the students who completed the questionnaire indicate that it was their parents' insistence to attend the summer enrichment class that influenced their participation.

## Implications for Further Research

The researcher suggests that further research should involve a larger sample that encompasses communities in urban, suburban, and rural areas. Research in these demographical areas should take place in large and small schools. Performance data gathered may be analyzed and controlled for race to explore socioeconomic trends that may exist. Some educators contend that the achievement gap has more to do with socioeconomic factors than race. Focusing additional research with a larger sample may underscore this belief.

The pre-teaching model described in this study requires students to dedicate a significant amount of time in the summer. Additional research could investigate the impact of financial incentives for students to attend summer enrichment courses in mathematics. Compensating students for learning math during the summer may provide a greater opportunity for students

who work to provide supplemental income to their families. Further, students may discover a passion for mathematics that will fuel their aspirations to explore careers that involve science and mathematics.

English language learners (ELL) and special education students (SPED) have often been overlooked when the achievement gap is discussed because most of the emphasis has centered around race and socioeconomics. Future research could explore the impact of pre-teaching mathematical concepts to ELL and SPED students. ELL and SPED students could potentially make significant strides in mathematics when given additional time to hone their skills—time that often eludes them during the regular school year.

## Leadership Lessons

While conducting the research for this study, I gained greater insight to my personal educational experiences. Some of my teachers did not maintain high expectations for me as I matriculated through a school system that utilized rigid academic tracks. These academic tracks were implemented as early as elementary school. The academic tracks were so stringent that I attended traditionally academic classes with the same group of students from the ninth to the twelfth grade.

Reading Claude Steele's research about the stereotype threat (Steele & Aronson, 1995) helped me to understand why I felt a great deal of pressure, which led to test anxiety, when I took the scholastic aptitude test and college entrance exams. Quite often, I had to prove myself to a white teacher in high school who questioned my placement in her college preparatory class. My parents frequently stressed the importance for me to excel in mathematics because they believed most of the high paying careers would involve science and technology. I allowed my

parents expectations to exacerbate the stress I was feeling because I did not want to let them down. I always wanted to make them proud of me.

I felt a deep connection to Uri Treisman's research (Treisman, 1992) because I studied in isolation for the first two years I attended college at the University of South Carolina. I studied in isolation because I lacked confidence in my own intellectual capacity. This was due in part because I did not believe my high school did an adequate job preparing me for the rigors of college. I did not want my peers to think I did not belong in the same class with them. Studying in isolation provided me with the perfect cover. I never studied in groups when I attended high school, so the concept was quite foreign to me.

I learned a great deal about my leadership skills during the planning, implementation, and assessment of the Geometry Honors Preview course. Although there are various types of educational leadership, this endeavor to improve African American achievement in Geometry Honors is best described as instructional leadership. As an educational leader, I felt it was my responsibility to address the disproportionate number of African American students who did not successfully complete Geometry Honors.

I learned how to quantify the problem this study sought to remedy by identifying the technical and adaptive challenges that existed (Heifetz, 1994). For example, the technical challenge I faced was trying to create a summer enrichment course that would successfully prepare African American students for the rigors of Geometry Honors. Evidence suggested that the placement of the Geometry Honors course in the sequence of honors level courses resulted in sorting African American students significantly more than any other group.

I realized the adaptive challenge, which still exists, was to encourage teachers to reflect on their teaching practices concerning differentiating instruction and varying assessments.

Further, teachers need to reflect on the practice of making course recommendations for students the subsequent year. Are the course recommendations based upon stereotypes and assumptions about the students or are they based on sufficient evidence that the student has mastered the material?

I came to see that the adaptive challenge extends to the students and parents as well. Students need to recognize that much of their success rests with how hard they are willing to work and that they may have to sacrifice some of their personal time to improve their academic performance. This could mean self-advocating for oneself by scheduling a time to meet with the teacher or enrolling into a summer enrichment course in mathematics.

Parents need to be visible in the school and in constant communication with their children's teachers. Parental support and encouragement was vital to a child's success, as this study had uncovered by the questionnaires completed by the students and their parents. I learned that leadership must happen on all fronts. It was not sufficient to lead only teachers and students, but the parents as well. However, in order to lead parents, it may require the educational leader to go to the community and not solely rely on bringing the community to the school. I was fortunate because the parents who agreed to enroll their children were very proactive and involved in their children's education. Indeed, if the attitudes and behaviors of teachers, students, and parents do not improve, the achievement gap will never close.

Often leaders are quick to demolish educational structures that do not produce the desired results. I learned from this study that eliminating or modifying an entire structure—whether it involves curriculum or organizational management—may not be the most efficient and/or effective manner by which to improve an organization. Sometimes it is better to leave the structure in place and add another component to enhance its effectiveness. The Geometry

Honors Preview course has served as the missing component to allow African American students to maintain their standing in the honors sequence of courses.

I learned that it is important to be "quick", but do not "hurry" when it comes to taking action as a leader. At times leaders have "knee-jerk" reactions to a problem that can be very damaging or embarrassing, and without communicating the benefits of the initiative to all stakeholders, implement a response with a "ready-fire-aim" approach. The fact that so many African American students were not achieving in Geometry Honors in comparison to their white and Asian counterparts was embarrassing to Peake High School. When I initiated this endeavor, I immediately galvanized the students, teachers, parents, and administration into action. I frequently communicated the benefits of implementing the Geometry Honors Preview course to the students, parents, teachers, and administrators in each encounter; therefore, enlisting their support for the course. I know that when all or most of the stakeholders are not supporting an endeavor, it decreases the likelihood of its success.

According to Starratt, "Educational leaders must be morally responsible, not only in preventing and alleviating harm but also in a proactive sense of who the leader is, what the leader is responsible as, whom the leader is responsible to, and what the leader is responsible for." (Starratt, 2004, pg. 49). It is important for educational leaders to understand the culture of the school and community in which he or she serves. I was well aware that identifying the development of the Geometry Honors Preview course to specifically address the disproportionate number of African Americans withdrawing from Geometry Honors would create a distraction. In fact, I invited all students recommended for Geometry Honors to attend the enrichment course, with additional solicitations made to African American students encouraging their participation. Although the development of the course was initiated to address the achievement

gap, I wanted all students to benefit even though it could have had the reverse effect and made the gap wider if only white and Asian students enrolled.

One of the reasons the achievement gap continues to exist is that some educational leaders are not willing to be courageous and ethical. The achievement gap exists in different school settings for various reasons. Educational leaders have to be courageous because attempting to close the achievement gap may require him or her to go against the culture of the school and the community. I believed it was my moral responsibility as an educational leader to take action in the best interest of all children.

Educational leaders who recognize inequities in a school or school system, but do not act immediately to provide students with an equal opportunity to learn are unethical. There are no winners in our society when a child does not reach his or her full potential. Children do not have important options available to them in their future post-secondary if they are inadequately prepared academically. Regardless of race, religion, gender, sexual orientation, or socio-economic status, all students must be held to a high standard and provided with the academic skills necessary for success.

## Conclusion

The black-white achievement gap that exists in mathematics at Peake High School and throughout the country can be significantly narrowed and even closed. In order to achieve this goal, policymakers, educational leaders, school boards, teachers, and citizens must support their pro-educational equality rhetoric with deeds. Indeed, the achievement gap is a multi-faceted problem that requires all stakeholders to work together collaboratively; however, there is a culture throughout the country that educational reform can be cultivated with minimum financial investment. While the *No Child Left Behind Act of 2001* (NCLB) was created to address the

achievement gap by identifying and penalizing underperforming schools and students who failed to improve over time, one of the major complaints about the law was that it was underfunded by Congress (National Education Association, 2010).

Currently our educational system is in shambles due to a lack of adequate funding. School districts are closing schools, firing teachers, cutting extra-curricular activities, closing libraries, and eliminating visual and performing arts programs throughout the country. For most districts, in order to avoid making substantial cuts, they have to convince residents to invest money into the schools by agreeing to pay higher property taxes. Given the anti-tax/anti-government rhetoric espoused by the Tea Party movement, I suspect that it will be extremely difficult for schools to obtain adequate funding in states or communities that have a reputation for being fiscally conservative.

One of the attractive characteristics of the Geometry Honors Preview course was that it was virtually inexpensive. Students, who could pay for the course, either paid the tuition of $230.00 in full or made monthly payments during the school year that would fit within their family's budget. Students who received "free lunch" and "reduced lunch" paid 50 percent and 25 percent of the tuition cost respectively (these students also had the option of paying installments). If some students still could not afford the tuition, the Summer School Director would provide a scholarship for students who could prove financial hardship.

In conclusion, offering summer enrichment classes in various levels of mathematics is vital to closing the achievement gap because they offer something that students need to reach the same level of aptitude as their higher achieving peers…..TIME. A robust curriculum, highly skilled teachers, differentiated instruction, alternative assessments, and the latest in educational technology is ineffective unless there is time for implementation.

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