The Impact of Curriculum Change on the Mathematics Achievement of Georgia Public School Students

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ABSTRACT

The purpose of this study was to examine the effects of the Mathematics Quality Core Curriculum (QCC) and the Mathematics Georgia Performance Standards (GPS) on high school student achievement as measured by the SAT and ACT. The State of Georgia redesigned the mathematics curriculum in order to show higher achievement in mathematics by increasing the rigor. One would assume overall SAT and ACT math scores should increase. The National Council of Teachers of Mathematics (NCTM) (2013) stated improvement will take commitment and patience that may not come for a number of years. This study explored the effectiveness of mathematics curriculum reform. The findings of the study have the potential to inform future revisions of the Mathematics Georgia Standards of Excellence (MGSE) or other Georgia Curricula.

The study used an ex post facto design with quantitative methods. Quantitative data were calculated for each research question to determine significant differences between the QCC and GPS curriculum models. SAT and ACT mean scores were evaluated using a series of paired *t* tests providing a comparison between each model. Descriptive statistics were assessed to look at increases and decreases in the mean scores to identify minor and major differences. Overall, it was found that the changes in curriculum made no difference in the mathematics achievement of students in Georgia. However, a comparison of schools in Georgia suggested small schools experienced small increases in mathematics achievement while large Title I schools experienced slight decreases in mathematics achievement.

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DEDICATION

I dedicate this dissertation to my late father, Joe Don Griffith. I can still hear his question he would frequently ask; “you still working on that paper?” I would love to hear that question one more time from him so that I could finally so…no dad, I am done. I know that he would be proud.

Chapter I

INTRODUCTION

Mathematics educators have been involved in controversial debates over the mathematics curriculum for many decades. Curriculum issues center around what is important for students to learn and how the written curricula should be taught (Reys, 2001). Reys suggested in order to give all students opportunities for high academic achievement in mathematics, our curricular must improve.

Taking cues from other states, the State of Georgia has also been in debates over curriculum issues, especially the mathematics curriculum. Doug Cumming, with *The Atlanta Constitution*, suggested the Quality Core Curriculum (QCC) has too many topics and not enough depth (Cumming, 1998). According to Mark Musick, president of the Southern Regional Education Board, in 1996 Georgia students scored near the bottom of the United States in mathematics on the National Assessment of Educational Progress (NAEP) test (NAEP, 1996). In 1996, results of the NAEP revealed eighth graders in Georgia scored 34th out of 45 states in mathematics with a mean score of 262.47, which was well below the national mean of 270.51. The 1996 NAEP mathematics data also indicated Georgia's fourth grade students had a mean score of 215.46, which was well below the national mean of 222.34. The Georgia fourth grade students were ranked 35th out of 45 states. In 1996, a sampling process was used to select schools within the United States that participated in the NAEP. Legislation was initiated in 2001 requiring state participation on the NAEP in mathematics and English. Schools receiving Title I funding are required to test grades 4 and 8 every 2 years (NAEP, 2001). In 2008, State School Superintendent Kathy Cox released a statement regarding state assessments versus national tests. Mathematics scores for Georgia students were not acceptable. The percentage of Georgia public school students passing the state assessments were high compared to low scores on national tests such as the math portion of the Scholastic Achievement Test (SAT) and the National Assessment of Educational Progress (NAEP). Cox explained a major concern with the mathematics curriculum as being part of the problem.

The low SAT scores in Georgia were the main reason for changing the 22-year-old Quality Core Curriculum (QCC) and developing a new model (Peterson & Eaton, 2008). A panel of 15 leaders in education were chosen to form the new curriculum. The panel wanted to model the rigor, leanness, and coherence Japan's curriculum offered. Peterson and Eaton (2008) also stated Japanese students consistently have high scores in international comparisons, usually scoring near the top. The new curriculum was called the Georgia Performance Standards (GPS). The first cohort group of students in Georgia who have been taught using the GPS mathematics curriculum graduated in 2012. For the school year 2015-2016, the Georgia State Board of Education renamed the Math GPS, the Mathematics Georgia Standards of Excellence (MGSE) (GaDOE, 2015).

American College Testing (ACT) is a standardized test that determines college readiness of high school graduates in the United States. The test was initially administered in 1959 as a challenger to the SAT. The ACT test incorporates more subjects such as English, natural sciences, social sciences and mathematics (Marklein, 2007). Several changes have been instituted since the inception of the tests. For example, in 1989, a reading section was introduced thereby replacing the social studies section. Further the natural sciences section was reconstituted to incorporate more problem solving questions. In order to enhance the competitiveness of the ACT, in 2005, a writing test was introduced. Computer testing was also introduced in order to further increase the competitiveness of the test.

According to Marklein (2007), there has been an increase in the number of ACT takers over the years as virtually all 4-year universities and colleges accept this test. According to the makers of this test, ACT seeks to assess the overall high school students' educational development and the ability to successfully complete college education. Specifically, the subsets are designed to capture a learner's skills in algebra, humanities, English and social science and ultimately establish their suitability and success level of post high school education (Marklein, 2007).

Colleges often use the ACT and SAT to determine college readiness of student applicants. College applicants come with different experiences where educational setting, grading, funding, and curricula are diverse for each student (Pope, 2012). Both the ACT and SAT help colleges supplement the records obtained from high schools by streamlining and recording the class rank, grades, as well as course work, in a national perspective.

Statement of the Problem

Education reform is a popular topic and the State of Georgia has been working since 2003 on raising the standards in public schools (Cox, 2005). The problem addressed in the current study is whether the new Georgia Mathematics Curriculum is having a positive impact on SAT and ACT mathematics scores. The evidence suggests curriculum plays a role in SAT scores (Peterson & Eaton, 2008); however, there are no published investigations examining the Georgia Performance Standards and their effect on math SAT scores. Quan (1992) suggested Chinese students are at a more advanced level due to curriculum reforms.

Theoretical Framework

Japan ranked fourth on the Third International Mathematics and Science Survey which was given in 38 nations (Galley, 2004). The 2011 report of survey results showed Japan still ranked in the top five for mathematics scores with the United States scoring well below their average scores for fourth and eighth graders. Georgia's attempt at a new mathematics curriculum was formed after the Japanese model was found to contribute to high rankings in mathematics. The model would blend subjects such as algebra, geometry, trigonometry, and statistics into an integrated approach for mathematics learning. Following this model, Georgia students have found themselves completing the equivalent of Algebra 1 by the end of eighth grade (Galley, 2004). Schmidt, McKnight, and Raizen (1997) found differences found between the Japanese and the U.S. mathematics curricula and pedagogical practices. The U.S. mathematics curriculum was shaped by different agencies and organizations such as the National Council of Teachers of Mathematics, state board of educators, and local school boards. This resulted in a plethora of topics without enough time to cover them and also topics being repeated across different grade levels. In Japan, strict guidelines resulted in fewer topics, which allowed for greater depth (Schmidt et al., 1999). There were also organizational differences. In eighth grade, 99% of Japanese eighth graders were given only one choice for their mathematics course. In the U.S., students were being taught a wide range of courses depending on their abilities.

Schmidt et al. (1999) also stated the U.S. curricular materials tend to present a large number of topics with the same content being taught at another level with only a small increase in difficulty. Japanese math textbooks tend to cover less topics with greater depth and increase the difficulty as the student advances in grade level. One of the main discrepancies between the U.S. and the Japanese curriculum was how class time was used. In the U.S. teachers spent more time on homework questions and working on homework which depleted the time allowed for instruction of new concepts and working on more complex problems requiring higher level thinking. The Japanese teachers placed a greater emphasis on thinking and engaging students in challenging problems. Japanese students worked on challenging problems longer than U.S. students (Schmidt et al., 1999).

Georgia educators tasked with the job of writing a new mathematics curriculum for Georgia relied on the Japanese model (Galley, 2004). On May 12, 2005, the Georgia State Board of Education adopted and approved a new integrated curriculum for high school mathematics, grades 9-12, which was named the Georgia Performance Standards (GPS). The GPS require all students to take higher level courses than the previous Quality Core Curriculum (QCC) had required (Zehr, 2005). In July, 2010, Georgia adopted the Common Core Georgia Performance Standards (CCGPS) and implemented them in classrooms in 2012 ("Georgia Educators Begin," 2012). The shift to this new curriculum has not been a radical change because the standards in the GPS were already aligned with the Common Core standards. The current study explores the relationship between mean SAT scores for students who participated in the QCC mathematics curriculum and those who participated in the GPS mathematics curriculum.

According to Pope (2012), there has been an increase in the number of ACT takers over the years as virtually all 4-year universities and colleges accept this test. According to the makers of this test, ACT seeks to assess the overall high school students' educational development and the ability to successfully complete college education (Pope, 2012). Specifically, the subsets are designed to capture a learner's skills in algebra, humanities, English and social science and ultimately establish their suitability and success level to post high school education.

Colleges often use the ACT and SAT, as there exist substantial differences in grading funding and curricula amongst different students. The ACT and SAT as an entrance exam gives the college an idea of a students' college readiness without having to determine their specific school setting characteristics (Pope, 2012). Both the ACT and SAT help colleges supplement the records obtained from the high schools by streamlining and recording the class rank, grades, as well as course work, in a national perspective.

Purpose of the Study

The purpose of this study was to examine the effects of the Mathematics Quality Core Curriculum (QCC) and the Mathematics Georgia Performance Standards (GPS) on high school student achievement as measured by the SAT and ACT. The State of Georgia redesigned the mathematics curriculum in order to increase achievement scores in mathematics; therefore based on curriculum rigor one would assume overall SAT and ACT math scores should increase (NCTM, 2013). The last group of students who have studied under the GPS for mathematics graduated in 2015. These students were taught purely under the GPS curriculum. The first class graduated in 2016 who studied under the CCGPS ("Georgia Educators Begin," 2012). For the purpose of this study, SAT and ACT scores of seniors in the 2007-2008 school year taught with the QCC and seniors in the 2011-2012 who were taught with the GPS were examined.

This study explored the effectiveness of mathematics curriculum reform. The findings of the study have the potential to inform future revisions of the CCGPS or other Georgia Curricular.

Overview of Methodology

Seniors in the classes of 2008 and 2012 in the State of Georgia who took the SAT made up the population for this study. The senior class of 2008 graduated under the QCC and the senior class of 2012 graduated under the GPS. Since the data is archival, the decision was made to use the entire population instead of a sample. SAT scores were used to determine relationships between scores of seniors in the class of 2008 and seniors in the class of 2012.

The State of Georgia is comprised of diverse socioeconomic levels as well as diverse ethnic groups. There were 62,287 seniors who took the SAT with the class of 2008 in the State of Georgia (The College Board, 2008a). There were 73,187 seniors who took the SAT with the class of 2012 in the State of Georgia (The College Board, 2012a).

The study examined 357 high schools in Georgia. This was an ideal opportunity to gather first-hand information in order to form comprehensive data interpretation. In addition, the up-to-date data is confidential due to the ethical considerations of the participants.

Research Questions

The research objective was to determine if the Georgia Performance Standards have any effect on the Math SAT and ACT scores for Georgia students. Research questions are as follows:

RQ1: Is there a significant difference in the mathematics achievement, as measured by the SAT and ACT, of high school seniors participating in the Quality Core Curriculum and those participating in the Georgia Performance Standards?

RQ2: Is there a significant difference in the mathematics achievement, as measured by the SAT and ACT, of high school seniors participating in the Quality Core Curriculum and those participating in the Georgia Performance Standards in large Georgia high schools and small Georgia high schools?

RQ3: Is there a significant difference in the mathematics achievement, as measured by the SAT and ACT, of high school seniors participating in the Quality Core Curriculum and those participating in the Quality Core Curriculum in Georgia Title I schools Georgia Non-Title I Georgia schools?

Limitations

The researcher was aware of a series of limitations that may have impeded effective collection of the necessary data. First, a major limitation of this study was due to using the entire population. Using the population for the State of Georgia did not allow for studies of individual students. The study was limited in information regarding student backgrounds and grades that could have added to this study. SAT and ACT scores were used to measure learning of mathematics. Other instruments could possibly better measure the learning of mathematics such as using the NAEP to determine if there was improvement in scores due to the curriculum change. Another limitation to this study was that the fidelity of curriculum implementation in the schools was not examined. There may have been a variety of implementation models among schools and within classrooms in the same school. Factors such as instructional strategies, the availability of mathematics coaches in the schools, and how the leaders evaluated the expectations were not considered in this study. It is also unlikely to access the data on high school performance for the entire respondents. Lack of such critical information is likely to impede interpretation of the data and analysis of the research questions.

The issue of access to the respondents is virtually impossible. The respondents were willing to participate in this study, but due to prior engagements and busy schedules it was impossible to hold interviews.

Definition of Terms

The American College Test (ACT). A test used as an entrance exam into college based on curriculum with an achievement score ("Preparing for the ACT test," 2017).

Data-Driven Decision Making. School and student decisions based on information gathered through standardized assessments and observations (Bernhardt, 2004).

Georgia Performance Standards (GPS). Performance standards which signify what a student is expected to do and what concepts he or she are expected to master (GDOE, 2013).

Integrated Curriculum. Integrated curriculum is a curriculum designed to bring together elements from different subjects and express their relationships to bring about a more concrete understanding of their uses (Reza, 2008).

No Child Left Behind Act of 2001 (NCLB). The NCLB was brought into federal law for kindergarten through high school students for all schools in America. The act's main objective is to decrease achievement gaps amongst different types of students and to improve all students' achievement as a whole (NCLB, 2001).

Quality Core Curriculum (QCC). A set of content objectives by grade level for grades K-8 and a set of objectives for grades 9-12 in Georgia public schools implemented in Georgia schools in 1985 due to the Quality Basic Education Act (Georgia Department of Education, n.d.).

Scholastic Achievement Test (SAT). A standardized test including sections; writing, mathematics, and verbal. The test is aligned with current high school curricula and is designed to identify skills required to be successful in college (The College Board, 2008c).

School Size. In Philadelphia, a study on progress and challenges of small high schools defined small schools as those having a maximum enrollment of between 400 and 700 students (Hartmann et al., 2009). In Texas, a study describing achievement differences between large and small schools defined small schools to have maximum enrollments of 900 students (Stewart, 2009). There is not a consensus on what is a small school vs. large school. For the purpose of this study, a small school is defined as a school with a maximum enrollment of 900.

Title I High School. A Title I high school is a high school that received federal funds due to having at least 40% of their student population come from low-income families (U.S. Department of Education, 2014).

Chapter II

REVIEW OF LITERATURE

Introduction

The review of literature covers the history of Georgia curriculum with a focus on mathematics. This is covered in a historical overview of QCC and GPS. National curriculum trends are discussed with information regarding SAT and NAEP. The socio economic status of schools is included in the discussion along with school size. Each of these areas of discussion frames the context of this study. The State of Georgia has gone through several curriculum changes over the past 30 years. Grant (2014), of Mercer University, claimed history mainly shows education as a local function for local school boards and over time more of the responsibility has been assumed by the state.

Historical Overview of Mathematics Curriculum

Mathematics curriculum design has been an emphasis in the United States for many years. In 1957, the Soviet Union's Sputnik left an impact on American education (Garrett, 2008). Due to this space flight, billions of dollars were spent to enhance the mathematics and science education in America (Cavanagh, 2007). Sputnik brought fear to America, and as a result American schools were faced with increasing the emphasis in mathematics and science in order to remain competitive globally. Science curriculum changed to include laboratory time and project-based learning. Mathematics introduced set theory and problem-based activities with engineering concepts. Computers were now being implemented in most schools.

During the 1960s and 1970s, the United States began attempts to reform mathematics curriculum, but not without criticism (Kilpatrick, 2009). The 60s and 70s is referred to as the new math era. In 1968, mathematics educator Wilfred H. Cockcroft suggested students in the future will be introduced to more abstract math than students in the 1960s due to the introduction of technology in the work force (Schoenfeld, 2007). Cockcroft also believed the mathematical way of thinking must be considered vital in the modern technological society that was developing. Because of technological changes and the need for a new approach to mathematics curriculum, mathematics research in the United States mainly consisted of problem solving from the mid-1970s through the late 1980s (Schoenfeld, 2007).

Quality Core Curriculum

In 1985, Georgia proposed legislation to reform education with the Quality Basic Education Act (QBE Act) under the leadership of Governor Joe Frank Harris. The QBE Act is legislation that allows for equality in funding of schools across the State of Georgia. Within the QBE Act, the Quality Core Curriculum (QCC) was established. This curriculum set guidelines at each grade level for schools so certain material would be implemented into classrooms across the state.

In 1998, in the State of Georgia, author Doug Cumming stated, the Quality Core Curriculum (QCC) has too many topics and not enough depth. Cumming's article placed the blame squarely on the president of Southern Regional Education Board, Mark Musick. That article reported that in 1996 Georgia students scored near the bottom of the United States in both math and science, according to the National Assessment of Educational Progress Test. Results of the National Assessment of Educational Progress test (NAEP) disclosed eighth graders in the 34th percentile out of 42 states in mathematics with a mean score of 262.47, which was well below the national mean of 270.51 (NAEP, 1996). The NAEP results for Georgia's fourth graders revealed a mean score of 215.46, which ranked fourth graders 35th out of 45 states in mathematics. This score is well below the national mean of 222.34.

Cumming (1998) also stated experts have blamed the curriculum as the reason students across the United States were not performing in mathematics and science. Students were behind when compared internationally. The Fordham Foundation, a company out of Washington, is considered knowledgeable with education and gave the Georgia Quality Core Curriculum grades in mathematics and science. Mathematics received a B and science received a D.

Due to the growing concerns the curriculum was not producing results as hoped, the state requested a study of the curriculum. Grant (2014) reported in 2002, the organization Phi Delta Kappa International was charged with the task of auditing the Quality Core Curriculum. The findings were that the curriculum could not be covered in twelve years and the guidelines did not meet national standards. A new curriculum was tasked to a group of expert educators and teachers from across the state.

Georgia Performance Standards

The development of the Georgia Performance Standards took place under the direction of then State School Superintendent Kathy Cox and Governor Sonny Perdue (Cox, 2003). Kathy Cox announced an education package called the STARS Education Plan in February 2003. Cox's article in the *Atlanta Journal – Constitution* also stated that the STARS Education Plan was primarily based on the premise that local school systems have freedom in the selection and use of resources and instructional programs; however, the state was responsible for setting the accountability goals.

Expert educators and teachers worked together beginning in 2003 and developed the GPS adopted in 2004 (Cox, 2005). Due to the Quality Basic Education Act of 1985, it was important to develop standards specific to what the expectations were of students for each subject and grade level. Not only was it important to develop these standards, but it was also important to make sure teachers understood how to use them. Kathy Cox stated, “Since 2003, we have been rewriting and implementing our new curriculum, the Georgia Performance Standards, and working with our teachers on how to use it” (2006, p. A11). In 2007, The Georgia Council of Supervisors of Mathematics (GCSM) released an open letter to Superintendent Kathy Cox (GCSM, 2007). The GCSM gave accolades to Superintendent Cox for creating an implementation plan they stated was successful. Their focus was on the component of support for K-12 teachers and guidance transitioning from QCC to GPS. Vertical teams were created to develop exemplary learning tasks. These master teachers designed tasks for students that included rigor and depth to prepare students for post-secondary options.

The Georgia Performance Standards (GPS) were developed and implemented beginning in 2005 (Peterson & Eaton, 2008). The GPS standards were developed to be more rigorous and were also aligned to national and international standards. The GCSM (2007) have agreed the curriculum is aligned to the national and international mathematics education recommendations from organizations such as the National Council of Teachers of Mathematics. International curriculum and methods of teaching were consulted by the Georgia GPS design team. The team decided to model the design based on Japan's curriculum. The characteristics used were rigor, leanness, and coherence. According to Schumer (1999), teachers in Japan, unlike Germany and the United States, wanted their students to develop mathematical critical thinking and understanding instead of concentrating on technical skills. In the elementary years, the expectation is that students develop their technical skills at home while at school the teachers are developing the students' critical thinking skills. Approximately 2% of Japanese high school students attend special schools and only about 6% enroll in elite or private schools. All other students are taught in Japanese public schools.

In developing the standards, integration of topics from different mathematics courses were in the design (Schoen & Hirsch, 2003). The course names, Mathematics I, Mathematics II, Mathematics III, and Mathematics IV, each included topics from algebra, geometry, discrete mathematics, statistics, and probability. The Conference Board of the Mathematics Sciences (CBMS) called for a redesign of mathematics curriculum. They challenged the curriculum designs which at that time were year-long courses of algebra, geometry, and pre-calculus topics. The board reported in order to improve mathematical learning, development of an integrated curriculum was necessary. Not only was the created curriculum integrated, it also allowed for all students in the State of Georgia to complete mathematics courses equivalent to the level of Algebra 2 (Zehr, 2005).

Learning tasks for Georgia Performance Standards

The learning tasks for the GPS are designed to develop more critical thinking and teachers are expected to use these tasks in the classroom (GCSM, 2007). Peterson and Eaton (2008) described what a typical day should look like with the new mathematics curriculum. With the more rigorous curriculum, the teacher would present the learning task to the students, and encourage them to explore mathematical thinking and develop constructive plans for solving the problems. Communicating mathematical ideas is very important in a global competitive market (Peterson & Eaton, 2008). Being able to work through these tasks and explain their mathematical thinking, better prepares students for solving problems.

Mathematics Coaches

For the implementation of the GPS as a whole to be successful, mathematic coach positions were established in many schools across the state of Georgia (Obara, Samuel & Sloan, 2009). Obara et al. studied the role of mathematics coaches and how they connected to performance standards. The authors stated the employment of a mathematics coach is a crucial piece in the implementation of the GPS and the success of students with the new standards. Teachers were unpacking standards, attending formal trainings, participating in collaborative sessions, and being observed by the coaches to provide appropriate feedback for improvement. Traditional practices were not a part of the new GPS. Teachers were being encouraged to apply more innovative techniques and were given professional development opportunities in their own school setting. These meetings with teachers affected them in positive ways.

Common Core Standards

Simultaneously, while Georgia was developing the GPS, a movement toward school accountability progressed in the United States where states implemented tests measuring student achievement (Common Core Standards, 2014). In 2009, the National Governors Association joined 48 states in the efforts to form common standards for mathematics and English. A memorandum was signed in April of the same year and a drafting committee was selected (Zimba, 2014). Zimba was a member of this committee and the first document, "College and Career Readiness Standards," was submitted in September of 2009 for review and feedback. The request for review was sent to all the states and the public. This preliminary committee did not develop standards for grade levels; instead, they developed a list of mathematical concepts and skills they believed were essential for college and career readiness.

After the "College and Career Readiness Standards" document was created, the committee that developed the list was dissolved (Zimba, 2014). Dissolvent of this committee led to the Council of Chief State School Officers and the National Governors Association assembling a 73 member math committee to develop the Common Core State Standards. Three groups were given specific roles on this committee. Two groups working to create the standards, which totaled 51 people, two committees to give feedback that consisted of 22 people, and a committee of 29 people to validate the standards.

The public draft of Common Core Standards was released on March 10, 2010 (Zimba, 2014). Common Core State Standards for Mathematics (CCSSM) are different from prior state standards in several ways. The most vital difference is the emphasis of arithmetic in elementary grades. Arithmetic plays a crucial role in future learning of algebra. Developers of the standards focused on this concept when writing. Additionally, the CCSSM build knowledge for applying mathematics to solve real world problems. These standards align with countries who have higher mathematics achievement scores.

In addition, the push for states to adopt the Common Core Curriculum has also been in the forefront (Achieve, 2010). The Common Core Curriculum was designed with students in grades K-12 in mind to provide a shared direction for U.S. schools to implement mathematics concepts (Monroe & Young, 2014). The expectation was students would be focusing on the key concepts that would prepare all for college and careers. States were not on the same page with these key concepts; thus, the National Council of Teachers of mathematics (NCTM) began publishing documents that set standards so students would learn mathematics concepts in a more lasting way than in the past.

The NCTM was playing a major role in the development of new standards for U.S. states to adopt, not only by developing the standards but also by providing resources to help states implement the standards (Achieve, 2010). *Curriculum Focal Points for Prekindergarten through Grade 8 Mathematics: A Quest for Coherence,* was one of these documents created. It was published by the NCTM to add to their existing principals and standards. This document has been a resource for states since its release in 2006. Whereas, the *Focal Points* gave states a resource to help guide them on what students should learn year to year and how each strand connects with others across the grade levels, the Common Core was setting standards for the practices of mathematics and the content (Monroe & Young, 2014).

In July, 2010, Georgia was one of the 46 states that adopted Common Core and incorporated the standards with the Georgia Performance Standards (GPS) ("Georgia Educators Begin," 2012). The GPS already closely resembled the Common Core Standards so teachers did not have to deal with extreme changes in the curriculum. In

July, 2012, under the leadership of State School Superintendent Dr. John Barge, mathematics teachers across the state began training on the new Common Core Georgia Performance Standards (CCGPS). Georgia students starting school in 2012 were introduced to the CCGPS in mathematics and English language arts. Science, social studies, and CTAE courses also implemented literacy standards as part of the CCGPS.

The curriculum is based on three facets: fluency, conceptual understanding and problem solving (GaDOE, 2013). Indeed, the tutors pursue these three facets with extensive intensity to ensure learning of the subject is manageable. The mathematics curriculum in Georgia primarily focuses on students' engagement in an effort to develop the understanding of the taught concepts. The mathematics tutors are expected to instill in the learners the use of different representations such as verbal, concrete, symbolic and graphical mechanisms to enhance understanding (NCTM, 2000).

The curriculum is further designed to encourage fluent computation as well as estimation when solving the mathematics problems. Further, the curriculum offers the learners an ideal opportunity to extensively conduct investigations, come up with solutions and report the results. To enhance quality, the CCGP mathematics courses are designed to encourage learners to apply the learnt skills and concepts instead of merely following the laid down procedures (Woods, 2015). This is achieved through formulation of authentic problems that enhance understanding of the mathematics concepts. Learners are expected to develop the mannerisms of independent mathematics thinkers that allow them to solve mathematics problems while explaining their logic and thinking (Woods, 2015). Learners have an opportunity to criticize the thinking exhibited by other mathematics thinkers. The mathematics practice standards ideally define and illustrate the logical connections that depict mathematics as a manageable subject and are thus critical to the mathematics structure (Reston, 2004).

In CCGPS mathematics, the content is laid out in such a way that the clusters of standards are grouped into different unit sizes. The clusters are taught at different grade levels as they equally contribute to learning progression. Such progressive learning is based on the notion that grade level content extends from previous learning and is equally an overture to future lessons (Woods, 2015). The entire CCGPS mathematics curriculum is formulated to ensure a high school graduate is career and college ready upon graduation. Woods (2015) asserted the CCGPS coordinate algebra course is a representation of the college discrete algebra study due to its statistics applications. In addition, learners are introduced to coordinate geometrics that lead to quantitative reasoning in order to solve the mathematics problems. The CCGPS analytic geometry course is an embodiment of discrete geometry study achieved through algebraic operations intertwined in statistics applications as well as probability. The CCGPS culminating course is the advanced algebra that essentially prepares learners to identify the fourth course options that will help in advancing future career pursuits (Woods, 2015). In this course, learners not only solve problems but also explain their reasoning in coming up with the solutions. Lastly, the CCGPS pre-calculus curriculum introduces and prepares learners for college level courses (Woods, 2015).

The Georgia Department of Education has specific standards a learner must demonstrate. Learners who complete CCGPS mathematics in grades 6-8 have the requisite content mastery to enable them to pursue successfully the coordinate algebra course (Woods, 2015). The learner may study analytic geometry or accelerated coordinate algebra course depending on the interests and career pursuits of the individual. Usually, the structure and rigor of accelerated mathematics course is extensively challenging (Woods, 2015). A student who wishes to pursue this course must depict higher-level mathematical skills as well as an urge to pursue advanced placement in mathematics.

The state of Georgia has integrated such topics as algebra, probability, geometry and statistics in every academic year of high school (GaDOE, 2013). The first year is primarily dedicated to mastery of algebra through such activities as ving linear equations, graphing exponential functions as well as finding arithmetic sequences, amongst other tasks. Other topics in the first year include statistics, transformation and geometric algebra. As indicated, the Georgian mathematics curriculum lacks a seamless flow of content. Indeed, there is minimal logical flow as evidenced by the sudden shift from algebra to statistics then to geometry. It is virtually impossible for a mathematics teacher to derive new content from the recently concluded topic. Thus, the axiomatic approach, which is a critical methodology that enhances understanding of the mathematical concepts, is not incorporated.

Challenges of New Curriculum

Since the implementation of the integrated math curriculum, many controversies continue to mar the teaching of the subject. Mathematical study should be geared towards assisting a learner to think logically. Both inductive and deductive thinking is a core objective of mathematics study even teachers should seek to instill in his or her students. It is important the mathematics teachers develop in their students that mathematics study is not merely master of specific objectives or even identifying ways in which the concepts can benefit the learner in future (Woods, 2015). Rather, a learner should seek to grow and develop his logical part of the brain in a way that no other subject can achieve. A mathematics learner should always endeavor to prove any conclusion is an ultimate logical consequence of an already established conclusion (Woods, 2015). Since it is virtually impossible to accept certain axioms, a learner should logically deduce the highlighted conclusions.

Integration of the mathematics curriculum implies there lacks a seamless and logical flow of the mathematical concepts being taught (Barge, 2014). Common Core persistently provides direction on the type of curriculum to be incorporated in the U.S. The integrated approach attracts massive international appeal that necessitates different nations to adopt the system in order not to be left out.

The Common Core State Standards have faced several misconceptions in regard to the content, implementation, intent and development. Parents, educators and other stakeholders have diverse views on the importance of the CCSS. Every state has its own unique educational standards the policy makers seek to uphold (Georgia Department of Education, 2015). A common misconception about the adoption of the common standards is the assumption the other existing standards will be done away with. The best policymakers in the country develop standards, and incorporate high international standards, with the ultimate aim of improving educational standards (Georgia Department of Education, 2015). Even with the introduction of the CCSS, every state is expected to maintain high standards that will adequately prepare high school graduates for not only college life but also their chosen careers. The standards are essentially meant to remediate the learners' postsecondary work and to ensure they are well prepared for the job market and college life (Georgia Department of Education, 2015).

The CCSS have international appeal and were developed from close interaction with the best performing countries. Largely, prior to the development of the CCSS, extensive benchmarking was undertaken with the sole intention of ensuring the standards are recognized globally. The international standards were incorporated during the development process to give the CCSS the ideal international appeal.

The developers of the CCSS put in extensive thought and expertise to ensure the standards address both content and skills. Notably, the mathematics standards form a formidable foundation in virtually all foundation elements such as decimals, whole numbers, fractions, addition, division and multiplication. These basic concepts form a key basis through which a learner is able to learn, internalize and apply other demanding and complex mathematics procedures and concepts (Georgia Department of Education, 2015). Essentially, the high school curriculum requires learners apply the mathematical concepts learnt to solve world challenges (Georgia Department of Education, 2015). There are concerns the mathematics standards hardly prepare learners for algebra. However, the CCSS clearly stipulates in grades k-7 learners are introduced to the perquisites for algebra. Learners are thus expected to master this content in order to be adequately prepared to handle Algebra while in eighth grade. Indeed, it is at eighth grade learners are introduced to rigorous algebra, where the most pertinent concepts are taught (Georgia Department of Education, 2015).

A lot of research is incorporated prior to enactment of the standards. In mathematics particularly, a large body of evidence based on surveys and scholarly research is undertaken to ensure learners are equipped with the necessary skills and competencies (Barge, 2014). In addition, prior to enactment of the curriculum, the standards derive their conclusions from the Trends in International Mathematics and Science Study (TIMSS) (Barge, 2014). This has helped in streamlining the mathematics curriculum to ensure it is coherent and focused on improving student achievement. Lastly, the Common Core sets out clearly the expectations as well as the goals teachers should endeavor to impart to learners. This reaffirms the assertion the Common Core is not a curriculum, but an effort to incorporate real-world and consistent goals in learning (Barge, 2014).

These standards encompass the attitudes, habits and mannerisms of mathematical thinkers. Studies revealed these standards are an integral part of the CCGPS mathematics structure as they primarily define the manner in which students learn and incorporate in the real world the knowledge acquired in the learning process (Barge, 2014). The mathematical practice standards primarily highlight the expertise the Georgian mathematics tutors should develop and inculcate in their learners. Some of the key practices the mathematics educators should instill in the learners is the ability to make sense of mathematics problems, as well as development of perseverance in finding solutions (NCTM, 2000). According to NCTM (2000), learners should also develop both quantitative and abstract reasoning capabilities. It is equally important learners use the available tools strategically while attending to problems with precision. The standards for mathematical practice equally seek to inculcate in learners the ability to develop viable arguments while equally analyzing the reasoning and arguments brought about by others. Tutors of mathematics are also expected to ensure learners identify and express repeated reasoning regularity and the structures brought about in the mathematical concepts taught (NCTM, 2000).

The National Council of Teachers of Mathematics (NCTM) believes the implementation of the CCSSM created an opportunity for advancement in mathematics education for students all across the United States (NCTM, 2013). The NCTM is in full support of the CCSSM and is committed to helping with this implementation process of understanding and interpretation. The NCTM acknowledges and believes all stakeholders must accept improvements made by these standards can only be documented in time. It may take several years to see their impact on learning, which suggests long-term sustainable and commitment to the CCSSM. In the *Atlanta Journal and Constitution* (2013) Pam Williams, the 2011 Georgia Teacher of the Year, stated stakeholders have expected results way too soon and she asked for patience for teachers as they struggle through this shift in teaching and on-going effective professional development. Georgia continues to feel the pains of growing as it moves through the implementation of CCGPS. Williams also stated as long as Georgia continues to move in the right direction with the support needed with the implementation of CCGPS, its teachers will foster growth within their students.

The Georgia standards of learning are constantly reviewed to ensure they replicate high standards and they are a representation of the fast-paced and constantly changing global environment. In mathematics, careful thought is placed on the development of the curriculum to ensure an appropriate balance in skills acquisition and problem solving is seamlessly integrated (Woods, 2015). The standards seek to explicitly highlight the expectations of the instructors in achieving the set educational goals. Real world applications and appropriate concept development are some of the key parameters the Georgian mathematics curriculum seeks to incorporate.

The greatest challenge with the mathematics curriculum in Georgia lies in the inability to seamlessly and logically flow from one topic to the other (Woods, 2015). Such a scenario poses major difficulties for college prep courses, as learners are likely to be stuck as they pursue higher levels of education. Woods review of other states revealed it is only in Georgia where the integrated curriculum has been adopted. Such a scenario limits the competitiveness of learners as they are expected at the same level of competency in the SAT and ACT prior to joining the institutions of higher learning. It is beneficial for the mathematics curriculum to be laid out logically. A logical flow from one topic to another will enhance the understanding of the taught concepts thereby making the graduates competitive (Woods, 2015).

Revisions to the CCGPS in English language arts and mathematics were approved by the State Board of Education on January 15, 2015 (GaDOE, 2015). The State Board of Education voted to change the name of the Common Core Georgia Performance Standards (CCGPS) to the Georgia Standards of Excellence (GSE) on February 19, 2015. Implementation of the CCPGS in mathematics and English language arts ended with the 2014-2015 school year. Beginning in the 2015-2016 school year, standards codes and updated resources for the courses were implemented by schools. A listing of the changes with the English language arts and mathematics standards were posted along with these resources in the Spring of 2015. Other content areas will reflect the Georgia Standards of Excellence (GSE) as the revisions are completed.

The curriculum and instruction leaders in Georgia are keen on integrating research-based practices in the teaching of Mathematics. The state-adopted standards seek to incorporate differentiated and innovative practices that will lead to realization of set educational goals (Woods, 2015).

National Trends in Curriculum Design

Science, Technology, Engineering and Mathematics

According to Garrett (2008), students in America have not reached expected growth in these areas as hoped for after Sputnik. Craig Barrett, chairman of a huge technology corporation, met with federal officials and corporate executives at the National Summit on American Competitiveness (Cavanagh, 2007). He called for an emphasis on mathematics and science education. Due to the unease with the global economy, attendees believed in seizing the moment just as history had shown with Sputnik. Attendees advocated for decisions to be made on an improved curriculum for science, technology, engineering, and math (STEM).

Reactions from Americans after Sputnik, resulted in responses such as the No Child Left Behind Act (Garrett, 2008). Standards for student achievement were revised through this act, establishing graduation requirements that increased the number of mathematics and science courses that must be completed. During the late 50s and 60s, students were being encouraged to study in a STEM related field. According to Watson and Watson (2013), in the late 50s and 60s the STEM acronym was not a buzz word like it is in today's time. The acronym was coined by Judith A. Ramaley, a member of the National Science Foundation in 2001. The integration of these core subjects, science, technology, engineering, and mathematics is the brand name STEM.

Ramaley's theory of STEM required learning be placed in context that involved students solving real-world problems by being creative and innovative (Watson & Watson, 2013). American students were performing low on standardized exams in areas of mathematics and science. Universities were seeing a decline in the enrollment of students in STEM fields and Ramaley's idea of STEM seemed to provide an answer to these issues.

In more recent years, public education has faced difficulties with funding; thus resulting in organizations and companies investing their money into STEM education (Emeagwali, 2015). Corporate America believes quality is also important with STEM education. Schools can implement STEM but if it isn't high-quality then it will not have as much of an impact on society. Emeagwali also stated, high-quality STEM education develops highly skilled knowledgeable workers and is the guide to the nation's economic growth and leading edge competitiveness. Moreover, Sam Huston, president of the North Carolina Science, Mathematics, and Technology Education Center (NCSMTEC) stated in the 21^{st} century, STEM is a trend growing due to the job markets (Groves, 2014).

Not only are college related degrees needed for STEM fields, there are also jobs related to STEM fields that do not require advanced degrees (Groves, 2014). The STEM linked disciplines were created by studies completed by organizations such as the National Science and Technology Council, the National Academies of Science and Engineering, the Institute of Medicine, and the National Science Board (Watson & Watson, 2013). The concept associated with these studies was to integrate the subjects together by incorporating projects that require learning from several courses such as building a greenhouse by using mathematics, biology, and physics.

Science, Technology, Engineering and Mathematics vs. Science, Technology, Engineering, Art and Mathematics

Advocates for other disciplines have joined the discussions regarding integration of subjects. Many educators are pushing for the acronym to be changed from STEM to STEAM (O'Hanley, 2015). The beginning of this concept has been traced back to Socrates where he claimed beauty is connected to goodness (Watson & Watson, 2013). Beauty in STEM comes from the characteristics of creating, inventing, innovating, engineering, and controlling. Organizations such as The American Association for the Advancement of Science have included language in the definition of engineering associated with creativity and logic (Watson & Watson, 2013). STEM would now implement art with the other disciplines causing the acronym to change from STEM to STEAM. Education Closet founder, Susan Riley, believes not including art leaves the STEM concept with missing main components critical to the future (O'Hanley, 2015). The Rhode Island School of Design has sponsored efforts for this transition since 2008 (Watson & Watson, 2013). President of the Rhode Island School of Design, John Maeda, has participated in conferences developing the understanding of how art together with design, guide innovation ("Rhode Island," 2013). Maeda insisted the visual reminder when adding the A in STEM will reassure the addition of art and design throughout many disciplines in elementary and secondary education.

Furthermore, the holistic approach to curriculum is to teach the whole child. The Blue Man Group and Blue School's co-founder, Matt Goldman, stated at Blue School, they believe including creativity with innovation is as important as working collaboratively with self and social learning ("Rhode Island," 2013). Using real life experiences and collaboration involves creativity and enhances learning. Incorporating creativity into the learning process as we do collaboration in all subjects is linked to inquiry curriculum. Creativity and inquiry together are means to steer and combine the skills of scientists and artists.

O'Hanley identified art as being creative and a subject that can be connected to many other disciplines (2015). Engineering is taught in art through design using imagination. When creating landscape designs, art is being taught with plant science. When creating art from clay, science associated with the hardening and softening of the clay is discussed. Technology is connected to art with the use of sketchbook apps and creating display images using graphics. Math is connected to art especially with the use of geometry; measurements, scale drawings, and symmetry are just a few examples. O'Hanley stated art is "the glue that holds the bridge together" (2015, p. 11).

Science, Technology, Engineering and Mathematics vs. Science, Technology, Reading, Engineering, Art and Mathematics

Dialogue regarding transitioning from STEM to STEAM to STREAM has appeared in written articles. An article in the *Palm Beach Daily News* stated educators who advocate for reading/research have extended the discussions to include R in the acronym (Connelly, 2013). At a conference with the Center for Creative Education in West Palm Beach, Florida, students presented projects that included thinking (art), and reading for a STREAM labeled project. In Sterling, Colorado, Christy Fitzpatrick (2014), an Extension STEM specialist, discussed the concept of STREAM. She stated advocates are using different meanings for the R. Some stated reading should be added while others have claimed writing should be the meaning. Likewise, Blessed Sacrament, a Catholic school, has implemented projects around the STREAM concept; however, they have claimed the R represents religion for their purposes (Groves, 2014).

Algebra for All

Not only has there been the movement toward Common Core and the STEM initiatives, there has also been the "algebra for all" movement (Eddy et al., 2015). Eddy et al. stated with the heightened attention on school mathematics over the last couple of decades has also come the push for all students to complete the first-year algebra course in either eighth or ninth grade. During the last several years of the 20^{th} century, increases were occurring for increased graduation requirements as a trend to prepare more students for college. They claimed this resulted in a trend of growth in students taking algebra. However, this decreased the emphasis on students preparing for vocational related fields.

On the other hand, educators such as Bagwell (2000) stated algebra for all may hurt many students placing them at risk for failure and not giving them the content they really need. Eddy et al. (2015) specified algebra for all is not productive if there is not consistency in what is being taught. Watered down content has been found in some variations of the course and the key concepts may not have been rigorous enough to meet the requirements of a course to prepare for postsecondary courses.

The mathematics curriculum adopted in Georgia about 5 years ago has abandoned the need for learners to logically derive the mathematics conclusions. The curriculum has integrated such topics as algebra, probability, geometry and statistics in every academic year of high school. The first year is primarily dedicated to mastery of algebra through such activities as solving linear equations, graphing exponential functions as well finding arithmetic sequences, amongst other tasks (Barge, 2014). Other topics in the freshman year include statistics, transformation as well as geometric algebra. As indicated, the Georgian mathematics curriculum lacks a seamless flow of the content. Indeed, there is minimal logical flow as evidenced by the sudden shift from algebra to statistics then to geometry (Barge, 2014). It is virtually impossible for a mathematics teacher to derive new content from the recently concluded topic. Thus, the axiomatic approach, which is a critical methodology that enhances understanding of the mathematical concepts, is not incorporated.

Eddy et al. (2015) concluded instruction and the use of assessment frameworks should be designed in a way so algebra is unified for the success of all students. The six key ideas included variables, patterns, modeling, functions, technology, and multiple representations. According to Eddy et al. (2015), these areas created a common language so stakeholders can communicate when writing curriculum and creating assessment frameworks for high-stakes testing.

Graduation Requirements

The Georgia education department has put in place stringent requirements that every learner must fulfill prior to promotion to the next grade. According to Barge (2014), the education department is mandated to thoroughly prepare high school graduates regardless of whether the individual wishes to pursue college education or enter the job market thereafter. In 2007, the Board of Education in Georgia implemented a rigorous graduation regiment that led to abolition of the tiered-diploma options (Barge, 2014). The mathematics requirements were synchronized thereby mandating each graduate to pursue such competitive mathematics courses as International Baccalaureate, Advanced Placement as well as the dual enrollment courses. The Georgia Board of

Education further encourages students to exhibit their strengths by being actively involved in the selection of the mathematics courses that are in line with the learners' interests.

The adoption of the 2010 Common Core Standards in mathematics and other critical subjects were a clear testament of preparation of the Georgian students to enter the competitive global workforce. The Common Core Standards are extensively competitive as prior to their development rigorous studies and research is undertaken (Barge, 2014). In addition, the internationally benchmarked and rigorous standards are aligned with the existing college and workplace prospects to ensure Georgian graduates are extensively competitive. According to Reston (2004), the standards are not static, rather they are a continuous work, as immediately novel evidence emerges the changes are instituted into the curriculum. The standards are a clear representation of what learners are required to study and replicate in their final exam. The CCGPS were initially instituted in 2012-2013 in Georgia's K-9 and were fully implemented in the 2015-2016 academic year (Barge, 2014).

The GPS and CCGPS are guiding parameters in the determination of the mathematical achievements graduates must achieve. The major barrier that hinders academic performance in mathematics is the apparent lack of understanding of mathematics procedures (Woods, 2015). There is need for curriculum developers and assessors to develop modalities that will help learners and tutors develop a connection between mathematical content and practice during instruction (Reston, 2004).

The graduation rule enforced in 2007 is aligned with GPS and CCGPS for mathematics. These two standards have significant resemblances especially concerning efficacy. Notably, the two standards ensure the mathematics courses offer learners an opportunity to advance their coursework or even benefit from the academic support classes. In addition, based on the academic strengths of the learner, an individual can pursue special interest courses.

The inclusion of these standards in mathematics testing has also led to an increased enrollment rate of learners with disabilities. This category of learners has higher chances of perusing post high school education or even being employed (Radunzal & Noble, 2003). The mathematics curriculum instituted in 2007 therefore ensures the state curriculum standards are achieved and learners who complete high school thrive in the existing knowledge based and highly skilled economy.

Prior to graduation, the department of education has mandated a student shall obtain four credits in Mathematics in the following CCGPS units; coordinate algebra, analytical geometry, advanced algebra as well as any other dual enrollment course unit (Barge, 2014). Successful completion of these four mathematics core units is critical prior to any admission in the Georgian university system. Students with any disability that may impede mathematics achievement have the choice of following an alternative course sequence that will guarantee the achievement of the set graduation requirements of 160-4-4-48 (Woods, 2015). The department of education proposes such students can receive mathematics instructions for 2 years after signing up for a single advanced mathematics course. A student with a disability may also complete CCGPS advanced algebra, thereby receiving special treatment.

Scholastic Aptitude Test (SAT)

Achievement tests such as the Scholastic Aptitude Test (SAT) for college readiness also includes mathematics skills (Campbell & Courant, 1992). In March 2005, the SAT was redesigned to align the material more with curricula high schools were implementing and to emphasize the skills needed to be successful in college (The College Board, 2008c). Changes took place in the verbal and mathematics sections and the test to measure basic writing skills was added. For mathematics, changes allowed for content from courses more advanced than a first-year algebra course such as a second-year algebra course. Quantitative comparison items were removed from the test and are no longer included as test items.

The score from the SAT achievement test predicts a student's success academically in college (The College Board, 2008b). Because of what this test measures, validity of this test must be substantiated. A pilot version was administered to 1,572 at 13 colleges and universities in 2006 to first year freshmen to validate the new writing section and the changes to the verbal and mathematics sections. In 2007, these students first year college GPAs (FYGPA) were used along with the 2006 high school GPAs. The study concluded the best way to predict students FYGPA is by using both the high school GPA and the SAT score to approve, deny, or place students in college.

SAT average scores showed an increase in the mathematics and verbal sections in 2003 (Hoover, n.d). At the same time, there was a record breaking increase in the number of students who took the SAT. The average math score was higher than it had been in more than 35 years. It increased 3 points from 516 to 519. The average SAT score increase was linked to the fact students were taking more advanced math classes than in previous years.

There has been criticism of the SAT (Sackett et al., 2012). The College Board hired researchers to look into the continuing criticism the SAT is a disadvantage to minority and low-income students along with being a poor predictor of how a student will perform in college. The researchers looked at students GPAs in high school and their first year in college, test scores, and socioeconomic status. The researchers claimed the poverty and parents' education does not show a correlation between students' SAT scores and their grades as a first year freshman.

Currently, the SAT is set for new changes. In March 2016, students will take the revised SAT (Nuwer, 2015). The revised SAT will include more graphics than text. Graphics will be found in the math section as well as the reading and language portions. Accrued evidence is showing literacy from tables, charts, and graphs is a much needed skill for success in life, college, and careers. The last changes to the SAT occurred in 2005 when the College Board introduced a mandatory essay and changed the scale from 1600 to 2400 ("A New SAT," 2014). Students will find the scale going back to 1600 and the essay will be optional.

American College Test (ACT)

The American College Test (ACT) is a test used as an entrance exam into college that is based on curriculum with an achievement score (www.actstudent.org, 2016). The foundation of the ACT was laid by E. F. Lindquist in 1958 (Lindquist, 1958). He stated the exam would be used to determine a students' use of their intelligence rather than only measure a students' knowledge (Lindquist, 1958). Lindquist also suggested the design of the exam would allow for other ways to analyze the results rather than only be used for college admissions. Research regarding ACT and its correlation with students' college readiness (as measured by ACT scores), shows the best way to predict college success is by looking at the specific courses taken in that subject area (ACT Inc., 2004). Research shows there is even a larger effect associated with courses taken for ACT mathematics scores. Students taking courses higher than Algebra 2 and Geometry are more likely to score 5.5 points higher on this portion of the ACT than students only taking Algebra 1, Algebra 2, and Geometry.

The ACT is comprised of sections containing content in reading, English, mathematics, science and an optional writing section. Each section is timed and the test taker must use pacing strategies while taking the test. The student's knowledge of that subject area is measured with a composite score.

The English test contains 75 multiple choice questions with a time limit of 45 minutes (www.actstudent.org, 2016). This section measures a student's knowledge of the conventions of English and measures rhetorical skills. Specific examples for measurement include punctuation, organization, grammar, structure of sentences, strategy and style. The multiple-choice questions are based on essays or passages that cover a wide range of topics. The students receive a total score based on all 75 questions. The students also receive individual scores for Usage/Mechanics and Rhetorical Skills. There are 40 questions related to Usage/Mechanics and 35 questions related to Rhetorical Skills. The Usage/Mechanics sub score is broken down into three areas. Punctuation makes up 10 to 15% of the Usage/Mechanics section, grammar and usage make up 15 to 20% of the section, and sentence structure makes up 20 to 25%. The Rhetorical Skills sub score is divided into three areas. Strategy makes up 15 to 20% of the rhetorical sub score, organization makes up 10 to 15%, and style makes up 15 to 20%.

The mathematics test contains 60 multiple choice questions with a time limit of 60 minutes (www.actstudent.org, 2016). The ACT mathematics section assesses content a student would learn in courses taken up until the beginning of twelfth grade. Questions in the mathematics section on the ACT are designed to cover content areas that would determine successful performance in entry-level college courses in mathematics. Test takers receive a score based on all 60 questions and they receive scores in three separate areas. A subscore is given in Pre-Algebra/Elementary Algebra, Intermediate Algebra/Coordinate Geometry, and in Plane Geometry/Trigonometry. These sections comprise the entire 60 question test. The Pre-Algebra/Elementary Algebra subscore is derived from the questions pertaining to pre-algebra and elementary algebra. The pre-algebra questions are 20 to 25% of the subscore while the questions associated with elementary algebra makes up 15 to 20%. The Intermediate Algebra/Coordinate Geometry subscore is made up of 15 to 20% of the questions pertaining to intermediate algebra and 15 to 20% coordinate geometry. The third subscore Plane Geometry/Trigonometry has 20 to 25% of the questions covering plane geometry and 5 to 10% of the questions containing trigonometry concepts.

The science portion of the ACT contains 40 questions with a time limit of 35 minutes (www.actstudent.org, 2016). The science portion measures the evaluation, analysis, reasoning, interpretation, and problem-solving skills students learn in the natural science courses taken in high school. The ACT science portion contains questions that cover the content areas of biology, physics, chemistry, astronomy, geology, and meteorology. The science portion contains scientific information conveyed in one of three formats: data representation, research summaries, or conflicting viewpoints. The test taker will receive a total science score along with three subscores. The Data Representation subscore makes up 30 to 40% of the science questions, the Research Summaries subscore makes up 45 to 55% of the science questions, and the Conflicting Viewpoints makes up 15 to 20% of the science questions.

The writing portion of the ACT is a measure that shows a student's skill in composing an essay (www.actstudent.org, 2016). Students have 40 minutes to complete the essay portion of the ACT. The ACT provides a writing prompt and the expectation is for the writer to compose a meaningful response that addresses the perspectives and issue the prompt presents.

SAT and ACT Scores and College Success

Documented studies revealed success in SAT and ACT do not necessarily translate to college success (Radunzal & Nobel, 2003). These standardized test scores hardly predict a learner's academic success or even the grade point average. In about 33 institutions reviewed, the test scores do not correlate with the graduation rates or even the eventual grade a learner gets. Radunzal & Noble (2003) opined the tests are not an indicator of human intelligence but help the admissions panel to truncate individuals to be admitted in specific institutions. Students who persistently record strong grades in high school have the capability of succeeding in college even when they post poor SAT or ACT scores (Pope, 2012). The administrators of SAT and ACT asserted the results from multiple surveys indicated the tests are an accurate predictor of a student's college preparedness as well as the success level of the learner. However, the College Board maintained neither these standardized scores nor high school performance should be used in exclusivity to determine college admission (Radunzal & Noble, 2003). The tests often lock out individuals who would perform exemplary well in college such as the minority students, low-income learners, students with learning disabilities as well as first generation college students.

Statistics from the 2015 SAT and ACT scores revealed majority of students are not well prepared for college (Pope, 2012). Although the number of students taking the exams is on the rise, a worrying trend revealed the majority of high school graduates can hardly keep up with the academic rigor of high school. According to Marklein (2007), ACT has recorded an increased volume in enrollment as compared to SAT. The worrying trend in the drop in performance was revealed in the 2015 results whereby the average composite score stood at 1490. In critical reading, the scores dropped to 495, in mathematics 511 and 484 in writing. In 2014, the graduates posted 497 in critical reading, 513 in mathematics and 487 in writing out of a possible 800 point in each subject (Marklein, 2007). There has been a prolonged stagnation in the college readiness test for the past 5 years whereby minimal improvement has been recorded. Redesigning of the SAT is considered as a welcome move that will help shift this trend as the new test is designed to reflect the current high school curriculum as well as the critical aspects the learners need to know prior to joining college (Pope, 2012).

National Assessment of Educational Progress

The National Assessment of Educational Progress (NAEP) is an assessment that measures American students' knowledge in mathematics, English, science, social studies, art, technology, and engineering (NAEP, 2015). Currently, the test is a paper and pencil test but a computer-based assessment is planned to be available beginning in 2017 for basic subjects such as mathematics, writing, and reading with additional subjects being added in 2018. The NAEP allows schools to see progress among students using a measure consistent among states.

Students in grades 4, 8 and 12 are randomly selected to complete the NAEP. The sample is used to compare populations of students and their achievement for specific subjects, school environment, and instructional experiences (NAEP, 2015). Most states test around 2,500 students from approximately 100 public schools for each grade level. A stratified random sampling is used to choose the schools in the state who will administer the assessment. A national sample is also chosen for private schools and the results are used to compare these schools separately.

The NAEP is used nationally to represent how students perform in mathematics based on what they know and can do (Munik, McMillian, & Lewis, 2014). Students with low socioeconomic status have shown to perform low on the NAEP in mathematics. Munik et al. (2014) studied student performance on the NAEP and looked at socioeconomic status. Economic status was determined using subsidized lunch status. They concluded students receiving free lunch scored about 21 points lower than students who paid full price for lunch. Students who received lunch at a reduced rate scored about 10.5 points higher than the students who received free lunch and about 10 points lower than the students who paid full price for lunch. These results reinforce the concept that economic status predicts test scores.

School Size

According to Weiss, Carolan, and Baker-Smith (2010), small high schools are being formed in an attempt to involve more students in school and increase academic achievement. Districts are building separate schools and developing concepts such as schools within schools to create smaller atmospheres as a restructuring of the secondary school. Their study found moderately sized schools appeared to provide the greatest advantage for the students. Their findings pointed to school sizes of approximately 600 students showing the greatest success which was aligned to the general literature in their study.

In Philadelphia, high school reform took place between 2003 and 2008 by creating small high schools (Hartmann et al., 2009). School districts across America have formed high schools with a maximum number of students between 400 and 700. These schools are considered small sized schools. Their studies found students and parents wanted small high schools and smaller schools had favorable outcomes for increased student engagement and achievement. Philadelphia reorganized their high schools into 31 smaller settings. Research from 1998-2000 showed small high schools have an increase in graduation rates, climate, student gratification, teacher approval, and student attendance. Their findings showed promise in addressing high school dropout rates and students' readiness for post-secondary options. The study also showed the school climate was improved along with increased positive relationships between students and teachers. Suspension rates were lower in small high schools and students and teachers felt safer in the small high school setting.

Studies regarding school size have also taken place in other states such as California (Gardner, Ritblatt, & Beatty, 2000). Gardner, Ritblatt and Beatty defined schools with enrollments between 200 and 600 to be a small high school and enrollments over 2,000 being a large high school. Schools were randomly selected for the study with 67 selected large high schools and 60 small high schools. Data were collected using the 1995-1996 school year. The researchers looked at SAT scores, absenteeism, dropout rate and parental involvement. The researchers indicated greater student achievement in the large high schools on SAT total verbal and math scores. On the other hand, the small high schools exhibited better attendance, higher graduation rates, and more parental involvement.

Similarly, a study examining mathematics and science achievement in Canada, stated large schools were outperforming small schools in mathematics and science (Lytton & Pyryt, 1998). The study primarily examined the gaps in mathematics and science achievement among economically disadvantaged students within a school compared to students who were not economically disadvantaged within the same school. The small schools did not show a narrower gap than the large schools.

School Size and Achievement

The school size is integral in determining the academic achievement of a learner. While some education experts assert bigger is better, recent statistics revealed learners perform better in relatively smaller institutions. In a study conducted in Georgia, the education stakeholders revealed it is difficult to ascertain the impact of school size on academic achievement since other factors come into play (Stevenson, 2006). However, the existing research revealed the school size plays a significant role in determining the overall results. Essentially, the large district size is often detrimental to the educational achievement of learners due to the great equity effects exhibited. Many districts are creating relatively smaller institutions as an ideal strategy meant to improve the overall academic performance of the learners. Studies have revealed small schools have the potential of significantly raising the student achievement of learners from minority communities as well as those in the low-income bracket. This positive trend in student achievement is mainly attributed to reduced incidences of violence as well as disruptive behavior evident in large schools (Fowler, 1995). In addition, in a small school there is a significantly higher sense of identity as result of reduced instances of isolation and anonymity amongst the learners. The ability of the school to function cost effectively elevates educational achievement and overall teacher satisfaction, which ultimately result in better performance (Fowler, 1995). Studies have revealed mathematics teachers in small schools are extensively responsible for the overall social and academic achievement of the learners. Indeed, the level of student persistence and attendance in a small school is relatively higher in a small school as compared to a large school. The socioeconomic status of a school determines the learners' achievement.

A study conducted by Howley, Strange and Bickel (2000) revealed academic achievement in poor schools is greatly hampered by the size. In impoverished schools, the large number of learners exerts massive pressure on the school's resources thereby resulting in reduced academic achievement (Stevenson, 2006). Stevenson suggested such findings do not entirely mean students can only succeed in small schools. However, incorporating a comprehensive plan in the education sector coupled with small schools can help improve on the education achievement of learners. The large school size tends to form and strengthen the negative relationship that exists between student achievement and school poverty. Significant improvement in mathematics performance can be achieved in relatively smaller middle and elementary schools in Georgia (Stevenson, 2006). The smaller schools offer learners an opportunity to be directly involved in learning activities that enhance academic achievement. The number of people competing for various positions and activities during the learning process is low, thereby ensuring each learner gets an opportunity to participate. Larger schools often lead to marginalization as the learners are often denied an opportunity to participate in the different activities available since large schools often pass across as impersonal and bureaucratic (Stevenson, 2006).

Several elementary schools in Georgia that have low enrollment revealed mathematics test scores are relatively high even when the socioeconomic factors of the learners are different (Stevenson, 2006). Statistics obtained from third graders from smaller institutions revealed their achievement in mathematics is relatively higher than that of their counterparts from larger institutions. The results from the high schools are not conclusive as different studies give varying outcomes.

Some studies revealed high schools with low enrollment record higher academic achievement on high school proficiency tests as compared to the results posted by learners from large institutions (Bickel & Howley, 2000). Bickel & Howley's study analyzed data from the National Assessment of Educational Progress (NAEP) and revealed mathematics assessment was relatively lower in institutions with high number of students. It also emerged medium-sized institutions record significantly higher achievement as compared to learners from the small or larger institutions. The authors analyzed longitudinal data sourced from a nationwide sample of learners that revealed the achievement gains of learners in the eighth and twelfth grade is essentially dependent on the school size (Bickel & Howley, 2000). The moderate sized high schools, with student population of between 600 and 900 students, tend to record higher academic achievement in mathematics. In another study undertaken amongst high school learners who took the ACT, learners from small school scored relatively lower (Stevenson, 2006). These results largely give diverse results on the relationship between size and achievement. However, the overall results revealed smaller institutions are associated with better behavior outcomes and higher academic achievement owing to better and increased participation in both educational and extracurricular activities. Large schools can form a small school atmosphere that allows the learners to experience the same learning environment that enhances achievement of the set educational goals. Ultimately, the large school will achieve increased academic achievement as they are inexpensive to operate due to the massive savings achieved through consolidation.

Socioeconomic Status

Understanding poverty and its effects on education can be beneficial to schools (Marzano, 2003). Marzano stated, "For decades, educational researchers, education practitioners, and the public at large have assumed that socio-economic status is one of the best predictors of academic achievement" (p. 126). In the 1960s, studies were conducted regarding poverty effects on student achievement. In 1966, a sociologist by the name of James Coleman at John Hopkins University published a highly known piece of social science research (Ravani, 2011). Colemen's research involved 600,000 students from 4,000 schools nationwide. Ravani claimed Coleman's research is the second largest social science research ever conducted throughout the history of educational research. Coleman et al. (1966) concluded schools with high poverty were at a disadvantage and socioeconomic status was showing a negative impact on student achievement. Coleman's research came a few years after the 1964 Civil Rights Act (Ravani, 2011). This study looked at minorities and concluded the students' family economic status was the main link to lower student achievement. Barton, Coley and Educational Testing Service (2003) stated the color of a students' skin has no correlation to their ability to be successful academically. The authors confirmed academic achievement is connected to family roots with socioeconomic issues.

There are other studies finding socioeconomic status as a cause of low academic achievement. Yelgün and Karaman (2015) conducted a study to look at the conditions of families within a low socioeconomic neighborhood to determine the conditions that had the most negative effect on academic achievement. The main factor linked to academic achievement was low educational level of the parents. Other factors that negatively affected the academic achievement of students in this neighborhood included low family income, lack of comfortable study rooms, lack of an internet connection at home, and the time students had in the afternoons as determined by outside jobs or housework that was required to be completed. Diaz (2008) explored connections between student achievement and socioeconomic status. He defined socioeconomic status as being based on percentages of students who receive free and reduced meals. Diaz's study took place in Washington State with school districts with enrollment under 2,000. This particular study did not include districts with an enrollment less than 500. The study concluded there was a negative effect on economically disadvantaged students' academic achievement. McConney and Perry (2010) also reported socioeconomic status negatively impacted student success.

Studies have also linked school size and socio economic status. The Rural School and Community Trust released a study for Iowa high schools regarding student achievement in math and reading proficiencies (Johnson, 2006). In this study, Johnson stated smaller districts contain high levels of poverty as compared to larger districts. In comparing small districts with large districts whose high school enrollment was 200 or less verses high schools whose enrollments were 400 or less, student achievement was negatively impacted more in larger districts where the enrollment cutoff for high schools was 200. Johnson concluded the influence of poverty on achievement rests on the size of the district. He concluded poverty has a negative impact on scores in reading and math for both sizes; however, it has a greater negative impact in larger districts that keep their enrollment lower for their high schools. In contrast, studies have found as schools increase their enrollment, the negative impact of poverty decreases student achievement (Howley & Bickel, 2000)

Social Economic Status and Achievement

Recent studies revealed a correlation exists between the social economic status of a learner and academic achievement. The studies revealed small school sizes are ideal for learners from low socio-economic backgrounds. In addition, the negative effects of poverty and economic disadvantage are mainly exhibited in learners studying in large schools as compared to those from smaller schools. The lower mathematics achievement is largely pronounced in learners of non-white descent who are economically impoverished. In a study undertaken by the Rural School and Community Trust (2000), outcomes revealed poverty significantly impedes academic achievement in learners in large public schools. This means learners from poor backgrounds can equally perform better if they study in relatively smaller schools.

Other studies have revealed minimal changes in the academic achievement of larger schools located in affluent areas. Indeed, the more affluent a community is, the larger the school and the better the academic achievement (Bickel & Howley, 2000). Smaller schools are important in curtailing school dropout rates amongst learners from low socio-economic status backgrounds. Bickel and Howley contribute dropout rates being lower to the close monitoring that learners in smaller schools enjoy.

Summary

` The review of literature examined the State of Georgia's SAT scores and demonstrated they were not adequate which resulted in the adoption of a new curriculum. The evolution of mathematics curriculum was also reviewed. This literature revealed there is no clear evidence to support that curriculum improves student learning in mathematics. It is important to look at the curriculum implemented as well as the leaders' role for the implementation process.

The review of the literature also showed SAT and ACT scores are a valid measure of student achievement and college readiness. A description of the population along with its demographics, instrumentation, data collection procedures, and data analysis are examined in Chapter 3.

Chapter III

METHODOLOGY

The purpose of this study was to examine the effects of the Mathematics Quality Core Curriculum (QCC) and the Mathematics Georgia Performance Standards (GPS) on high school student achievement in mathematics. Student achievement was determined through an analysis of student scores on the Scholastic Achievement Tests (SAT) as well as ACT. In addition, due to the increased use of the ACT as a test for determining college readiness of high school graduates, student scores on the ACT will also be analyzed.

Participants

Utilizing the Georgia Department of Education's report card, 357 high schools in the State of Georgia were considered to be participants in the study. For the purpose of this study, the number of high schools chosen was determined by categorizing the schools into one of four groups; small high school (maximum 900 students), large high school (greater than 900 students), Title I school, or non-Title I school. Each high school had to meet the requirement for large school or small school for both the 2007-2008 school to be considered in the school size study. To be considered in the Title I study, each school had to meet the requirement for both the 2007-2008 school year and the 2011-2012 school year.

In Philadelphia, a study on progress and challenges of small high schools defined small schools as those having a maximum enrollment of between 400 and 700 students

(Hartmann et al., 2009). In Texas, a study describing achievement differences between large and small schools defined small schools to have maximum enrollments of 900 students (Stewart, 2009). There is not a consensus on what is a small school vs. large school.

For the purpose of this study, a small school is defined as a school with a maximum enrollment of 900 and a large school with an enrollment greater than 900. The population included grades 9 through 12. For the purpose of this study, schools in the study defined as Title I schools in 2007-2008 were also Title I schools in 2011-2012. Concurrently, schools that fell into the small school or large school category in the 2007-2008 school year were also in the same size category for the 2011-2012 school year. Schools not in the same category for each school term were not used in this study.

High schools were placed into categories by school size and socioeconomic status (SES). Out of the 357 high schools considered, 57 schools were excluded due to having too few students take the SAT and/or ACT, or the school did not exist in the 2007–2008 school year, leaving 300 total high schools with useable data. The population for the comparison of small schools to large schools consisted of 284 total high schools due to 16 schools being excluded because of not being the same size school for both the 2007-2008 and 2011-2012 school years. The total population for small schools was 80 and the total population for large schools was 204. The population for the comparison of Tile I schools to Non-Title I schools consisted of 258 total high schools due to 42 high schools being excluded because of not having the same Title I status for both the 2007-2008 and 2011-2012 school years.

The gender and demographic breakdowns of the SAT and ACT are represented in Table 1 and Table 2.

Table 1

SAT Senior Test Takers

QCC (2008) SAT senior test takers, 62,287 GPS (2012) SAT senior test takers, 73,187		
	2008	2012
	GENDER	
Male	45.4%	45.7%
Female	54.6%	54.3%
	ETHNICITY	
White	56%	52%
Black or African American	28%	32%
Asian, Asian American, or Pacific Islander	5%	6%
Other Hispanic, Latino, or Latin American	2%	3%
Mexican or Mexican American	1%	3%
Puerto Rican	1%	1%
American Indian or Alaskan Native	0%	0%
Other	3%	3%
No Response	.1%	2%

(The College Board, 2008a, 2012a)

Table 2

ACT Senior Test Takers

QCC (2008) ACT test takers, 33,238 GPS (2012) ACT test takers, 47,169		
	2008	2012
	GENDER	
Male	42%	43%
Female	56%	57%
	ETHNICITY	
White	50%	46%
Black or African American	33%	36%
Asian, Asian American, or Pacific Islander	3%	4%
Other Hispanic, Latino, or Latin American	3%	7%
American Indian or Alaskan Native	1%	0%
Other	10%	7%

(ACT Profile Report, 2008, 2012)

Ethical Considerations

Prior to conducting this study, a form for approval was given to the Valdosta State University Institutional Review Board (IRB) (see Appendix A). Data were gathered for the study from the Georgia Public Education Report Card and annual report cards. The Council for School Performance published these reports. The reports do not show any individually identified schools. Summaries of groups of information were reported.

Instrumentation

Data consisted of SAT and ACT mathematics scores from 2008 and 2012. The data were gathered from the Georgia Department of Education Public Education Report Card. Data were gathered and stored as electronic data in Microsoft Excel.

The SAT has been used to predict a student's college academic success since 1926 and has changed through the years (The College Board, 2008c). In 2006, the SAT added a writing section. The SAT evaluates mathematics, reading, verbal, and writing.

This study focused on the mathematics portion of the SAT and ACT tests. The SAT administered in 2008 contained a total of 54 questions (The College Board, 2008a). Forty-four questions were multiple-choice with an additional ten questions designed for students to produce a response without giving any answer choices. Total time given on the test was 70 minutes. The test was broken into two 25 minute sections and one 20 minute section. The mathematics test had four general categories; numbers and operations, algebra and functions, geometry and measurement, and data analysis, statistics, and probability. The area which contains the most questions is the algebra and functions category. Scores ranged from 200 to 800 on each section. The SAT administered in 2012 was of the same design (The College Board, 2012a).

The mathematics portion of the 2008 ACT contained a total of 60 multiple choice questions (ACT, 2008).   Test takers were given 60 minutes to complete the section. The mathematics section of the ACT in 2008 contained four sections Pre-Algebra/Elementary Algebra (24 questions), Intermediate Algebra/Analytic Geometry (18 questions), and Plane Geometry/Trigonometry (18 questions). All questions on the test were multiple choice and the questions were designed to have the test taker use reasoning skills to find solutions to practical problems. The ACT administered in 2012 was of the same design (ACT, 2012).

Design of the Study

Quantitative methods were utilized in this study. The research design used in this study is an ex post facto design. In an ex post facto design, data used has already been collected (Simon & Goes, 2013). Thus, permissions are not necessary as would be with creating new data with participants. This study was an ex post facto design based on the lack of ability to manipulate the independent variables, not being able to randomly assign groups, and cause and effect situations had already happened.

The data collection for this study was a quantitative data collection. The dependent variables were the student scores on the mathematics section portion of the Scholastic Assessment Test (SAT) and the Academic Achievement Test (ACT). The SAT measures were chosen because of the initial research which indicated the SAT scores were a reason Georgia mathematics curriculum needed to be changed (Cox, 2008). The ACT measures were included to determine if the implementation of the new mathematics standards had an effect on ACT scores. The independent variables in this study consisted of Title I school status and school size. All data were gathered from the Governor's Office of Student Achievement (GOSA, 2016).

The study was guided by these research questions:

RQ1: Is there a significant difference in the mathematics achievement, as measured by the SAT and ACT, of high school seniors participating in the Quality Core Curriculum and those participating in the Georgia Performance Standards?

RQ2: Is there a significant difference in the mathematics achievement, as measured by the SAT and ACT, of high school seniors participating in the Quality Core Curriculum and those participating in the Georgia Performance Standards in large Georgia high schools and small Georgia high schools?

RQ3: Is there a significant difference in the mathematics achievement, as measured by the SAT and ACT, of high school seniors participating in the Quality Core Curriculum and those participating in the Quality Core Curriculum in Georgia Title I schools Georgia Non-Title I schools?

Data Analysis

Data analysis was conducted to access the effect of the two sets of curriculum. For SAT and ACT mathematics scores, a series of *t* tests was conducted to compare the two means and determine (a) if there is a significant overall difference in achievement as measured by the SAT and ACT between QCC completers in 2008 and GPS completers in 2012, and (b) if there is a significant difference in achievement of small schools and large schools as measured by the SAT and ACT between QCC participants and GPS participants (McMillan & Schumacher, 2001). Cohen's effect sizes were calculated for all significant differences.

Summary

Chapter 3 was designed to provide a description of the participants, design, data analysis, ethical considerations, instrumentation, data collection, and variables used to conduct this research. Chapter 4 describes the findings of the research, and Chapter 5 is a detailed discussion of the results of the research and their implications.

Chapter IV

RESULTS

The purpose of this study was to examine the effects of the Mathematics Quality Core Curriculum (QCC) and the Mathematics Georgia Performance Standards (GPS) on high school student achievement as measured by the SAT and ACT. Does mathematics curriculum make a significant difference on the SAT and ACT mathematics scores, and do factors such as socioeconomic status and school size make a significant difference in student achievement in mathematics as measured by the SAT and ACT?

In looking at Georgia High Schools, 357 total schools were considered for the study. The data was reviewed to find some schools had too few students participate on the SAT, or the school did not exist in both the 2007–2008 school year and 2011-2012 school year. The data review revealed 57 schools did not meet the criteria stated above leaving 301 total high schools with useable student achievement data as measured by the SAT, and 73 schools did not meet the criteria as stated above leaving 284 total high schools with useable student achievement data as measured by the ACT.

Data analysis was conducted to access the effect of the two sets of curriculum. For SAT and ACT mathematics scores, a series of *t* tests was conducted to compare the two means and determine if there was a significant difference in the SAT and ACT mathematics scores.

Research Questions

RQ1: Is there a significant difference in the mathematics achievement, as measured by the SAT and ACT, of high school seniors participating in the Quality Core Curriculum and those participating in the Georgia Performance Standards?

The data review revealed 56 schools did not meet the criteria out of the 357 schools considered, leaving 301 total high schools with useable student achievement data as measured by the SAT, and 73 schools did not meet the criteria as stated above leaving 284 total high schools with useable student achievement data as measured by the ACT (see Table 3).

Table 3

Summary of Useable Data that Met Criteria for the Study

	SAT	ACT
Total Schools N = 357	301	284

The descriptive statistics indicated there was a decrease of 5.44 points in the overall mean between the QCC years 2007-2008 and GPS years 2011-2012 SAT mathematics scores from a mean of 471.62 to 466.20 (see Table 4).

Table 4

Descriptive Statistics for 2007-2008 and 2011-2012 SAT Scores

	QCC (2007-2008) SAT Math Score Avg	*GPS (2011-2012) SAT Math Score Avg*
Mean	471.64	466.20
Median	473.00	465.00
Mode	473.00	456.00
Standard Deviation	45.62	43.88

The descriptive statistics indicated there was a decrease of .11 points in the overall mean between the QCC years 2007-2008 and GPS years 2011-2012 ACT mathematics scores from a mean of 19.56 to 19.45 (see Table 5).

Table 5

Descriptive Statistics for QCC (2007-2008) and GPS (2011-2012) ACT Scores

	QCC (2007-2008) ACT Math Score Avg	*GPS (2011-2012) ACT Math Score Avg*
	19.56	*19.45*
Median	19.40	19.00
Mode	16.70	17.80
Standard Deviation	2.19	2.20

A series of paired *t* tests were conducted to determine if there were significant differences between Georgia SAT and ACT mathematics scores between QCC (2007-2008) and GPS (2011-2012).

The paired *t* test revealed a statistically significant decrease between the SAT mathematics scores (*N* = 301), QCC (2007-2008) (*M* = 471.64, *SD* = 45.62), GPS (2011-2012) (*M* = 466.20, *SD* = 43.88), *t*(300) = 1.97, p $\leq$ .05, CI.95 4.98 – 5.17 (see Table 6). Further, Cohen's effect size value (*d* = .001) suggested a low practical significance.

Table 6

Paired- t-test RQ 1 Georgia High Schools SAT Mathematics Scores QCC (2007-2008) and GPS (2011-2012)

Sample	*M*	*SD*	*difference*	*Df*	*p-value*	*T-Critical Value*
QCC Math SAT Scores	471.64	45.62	-5.44	300	0.00*	1.97
GPS Math SAT Scores	466.20	43.88				

Note: *Significant at the p < .001 level.

The paired *t* test revealed no statistically significant difference between the ACT mathematics scores (*N* = 282), QCC (2007-2008) (*M* = 19.56, *SD* = 2.19), GPS (2011-2012) (*M* = 19.45, *SD* = 2.20), *t*(282) = 1.97, p $\geq$ .05, CI.95 0.26 – 0.26 (see Table 7).

Table 7

Paired t-test RQ 1 Georgia High Schools ACT Mathematics Scores QCC (2007-2008) and GPS (2011-2012)

Sample	*M*	*SD*	*difference*	*Df*	*p-value*	*T-Critical Value*
QCC Math ACT Scores	19.56	2.19	-.11	283	0.11	1.97
GPS Math ACT Scores	19.45	2.20				

RQ2: Is there a significant difference in the mathematics achievement, as measured by the SAT and ACT, of high school seniors participating in the Quality Core Curriculum and those participating in the Georgia Performance Standards in large Georgia high schools and small Georgia high schools?

The population for the comparison of student achievement as measured by the SAT between small schools and large schools consisted of 285 total high schools due to 16 schools being excluded because of not being the same size school for both the 2007-2008 and 2011-2012 school years. The population for the comparison of student achievement as measured by the ACT between small schools and large schools consisted of 267 total high schools due to 17 schools being excluded because of not being the same size school for both the 2007-2008 and 2011-2012 school years (see Table 8).

Table 8

Summary of Useable Data That Met Criteria For the Definition of Small Schools and Large Schools for Both QCC (2007-2008) and GPS (2011-2012) School Years

	SAT	ACT
Small schools (< 900 students)	83	66
Large schools (≥ 900 students)	202	201
Total	285	267

The descriptive statistics indicated there was an increase of .06 points in the overall mean between the QCC years (2007-2008) and GPS years (2011-2012) SAT mathematics scores from a mean of 453.87 to 453.93 in small schools. There was a decrease of 8.08 points in the overall mean between the QCC years (2007-2008) and GPS (2011-2012) SAT mathematics scores from a mean of 480.81 to 472.73 (see Table 9).

Table 9

Descriptive Statistics for QCC (2007-2008) and GPS (2011-2012) SAT Scores by School Size

	2007-2008 SAT Math Score		*2011-2012 SAT Math Score*	
	Small School	*Large School*	*Small School*	*Large School*
Mean	453.87	480.81	453.93	472.73
Median	453.00	482.50	482.50	470.00
Mode	459.00	446.00	473.00	466.00
Standard Deviation	44.40	40.15	43.48	44.42

The paired *t* test revealed no statistically significant difference between the SAT mathematics scores for small schools ($N = 66$), QCC (2007-2008) ($M = 453.87$, $SD = 44.40$), GPS (2011-2012) ($M = 453.93$, $SD = 43.48$), $t(65) = 1.99$, $p \geq .05$, CI.95 6.03 – 9.69 (see Table 10).

Table 10

Paired t-test RQ 2 Georgia High Schools SAT Mathematics Scores QCC (2007-2008) and GPS (2011-2012) for Small Schools

Sample	*M*	*SD*	*difference*	*df*	*p-value*	*T-Critical Value*
2007-2008 Math SAT Scores	453.87	44.40	.06	65	0.98	1.99
2011-2012 Math SAT Scores	453.93	43.48				

Note: Small school is defined as schools with a population less than 900.

The paired *t* test revealed a statistically significant decrease between the SAT mathematics scores for large schools ($N = 202$), QCC (2007-2008) ($M = 480.81$, $SD =$

40.15), GPS (2011-2012) (M = 453.93, SD = 43.48), $t(201) = 1.97$, $p \leq .05$, CI.95 6.16 – 8.77 (see Table 11). Further, Cohen's effect size value (d = .191) suggested a low practical significance.

Table 11

Paired t-test RQ 2 Georgia High Schools SAT Mathematics Scores QCC (2007-2008) and GPS (2011-2012) for Large Schools

Sample	*M*	*SD*	*difference*	*df*	*p-value*	*T-Critical Value*
2007-2008 Math SAT Scores	480.81	40.15	-8.08	201	0.00*	1.97
2011-2012 Math SAT Scores	472.73	44.42				

Note: Large school is defined as schools with a population greater than or equal to 900.
*Significant at the $p < .001$ level.

The descriptive statistics indicated there was an increase of 2.38 points in the overall mean between the QCC years (2007-2008) and GPS (2011-2012) ACT mathematics scores from a mean of 18.54 to 20.92 in small schools. There was a decrease of 0.99 points in the overall mean between the QCC years (2007-2008) and GPS (2011-2012) ACT mathematics scores from a mean of 19.96 to 18.97 in large schools (see Table 12).

Table 12

Descriptive Statistics for 2007-2008 and 2011-2012 ACT Scores by School Size

	2007-2008 ACT Math Score		*2011-2012 ACT Math Score*	
	Small School	*Large School*	*Small School*	*Large School*
Mean	18.54	19.97	20.92	18.97
Median	18.35	19.7	20.00	18.6
Mode	17.9	19.0	19.5	18.4
Standard Deviation	1.73	2.22	2.73	1.78

The paired t test revealed a statistically significant increase between the ACT mathematics scores for small schools (N = 66), QCC (2007-2008) (M = 18.54, SD =

1.73), GPS (2011-2012) (*M* = 20.92, *SD* = 2.73), *t*(65) = 1.99, p <.05, CI.95 .672 - .425 (see Table 13). Further, Cohen's effect size value (*d* = .1.014) suggested a practical significance.

Table 13

Paired t-test RQ 2 Georgia High Schools ACT Mathematics Scores QCC (2007-2008) and GPS (2011-2012) for Small Schools

Sample	*M*	*SD*	*difference*	*df*	*p-value*	*T-Critical Value*
2007-2008 Math ACT Scores	18.54	1.73	2.38	65	0.00*	1.99
2011-2012 Math ACT Scores	20.92	2.73				

Note: Small school is defined as schools with a population less than 900.
*Significant at the $p < .001$ level.

The paired *t* test revealed a statistically significant decrease between the ACT mathematics scores for large schools (*N* = 201), QCC (2007-2008) (*M* = 19.96, *SD* = 2.22), GPS (2011-2012) (*M* = 18.97, *SD* = 1.78), *t*(200) = 1.97, p ≤ .05, CI.95 .247 - .309 (see Table 14). Further, Cohen's effect size value (*d* = .006) suggested a low practical significance.

Table 14

Paired t-test RQ 2 Georgia High Schools ACT Mathematics Scores QCC (2007-2008) and GPS (2011-2012) for Large Schools

Sample	*M*	*SD*	*difference*	*df*	*p-value*	*T-Critical Value*
2007-2008 Math ACT Scores	19.96	2.22	-0.99	200	0.00*	1.97
2011-2012 Math ACT Scores	18.97	1.78				

Note: Large school is defined as schools with a population greater than or equal to 900.
*Significant at the $p < .001$ level.

RQ3: Is there a significant difference in the mathematics achievement, as measured by the SAT and ACT, of high school seniors participating in the Quality Core

Curriculum and those participating in the Georgia Performance Standards in Title I Georgia schools and Non-Title I Georgia schools?

The population for the comparison of student achievement as measured by the SAT between Title I and Non-Title I schools consisted of 259 total high schools due to 42 schools being excluded because of not holding the same socio economic status for both the 2007-2008 and 2011-2012 school years. The population for the comparison of student achievement as measured by the ACT between Title I and Non-Title I schools consisted of 243 total high schools due to 58 schools being excluded because of not holding the same socio economic status for both the 2007-2008 and 2011-2012 school years.

Table 15

Summary of Useable Data that Met Criteria for the Definition of Title I and Non-Title I Schools for Both the QCC (2007-2008) and GPS (2011-2012) School Years

	SAT	ACT
Title I (≥ 40%)	192	176
Non-Title I (< 40%)	67	67
Total	259	243

Note: Title I schools are defined as schools with at least 40% of the total population receiving free or reduced lunch.

The descriptive statistics indicated there was a decrease of 4.64 points in the overall mean between the QCC years (2007-2008) and GPS years (2011-2012) SAT mathematics scores from a mean of 450.47 to 445.83 in Title I schools. There was a decrease of 3.73 points in the overall mean between the QCC years (2007-2008) and GPS years (2011-2012) SAT mathematics scores from a mean of 521.40 to 517.67 in Non-Title I schools (see Table 16).

Table 16

Descriptive Statistics for QCC (2007-2008) and GPS (2011-2012) SAT Scores by Socio-Economic Status (Title I and Non-Title I)

	2007-2008 SAT Math Score		*2011-2012 SAT Math Score*	
	Title I School	*Non-Title I School*	*Title I School*	*Non-Title I School*
Mean	450.47	521.40	445.83	517.67
Median	454.00	522.00	447.00	513.00
Mode	473.00	528.00	456.00	513.00
Standard Deviation	36.58	32.15	32.86	33.09

The paired *t* test revealed a statistically significant decrease between the SAT mathematics scores for Title I schools (*N* = 192), QCC (2007-2008) (*M* = 450.47, *SD* = 36.58), GPS (2011-2012) (*M* = 445.83, *SD* = 32.86), *t*(191) = 1.97, p $\leq$ .05, CI.95 4.68 – 5.21 (see Table 17). Further, Cohen's effect size value (*d* = .154) suggested a low practical significance.

Table 17

Paired t-test RQ 3 Georgia High Schools SAT Mathematics Scores QCC (2007-2008) and GPS (2011-2012) for Title I Schools

Sample	*M*	*SD*	*difference*	*Df*	*p-value*	*T-Critical Value*
2007-2008 Math SAT Scores	450.47	36.58	-4.64	191	0.00*	1.97
2011-2012 Math SAT Scores	445.83	32.86				

Note: Title I school is defined as a school with 40% or more of the students receiving free and reduced lunch.
*Significant at the *p* < .001 level.

The paired *t* test revealed a statistically significant decrease between the SAT mathematics scores for Non-Title I schools (*N* = 67), QCC (2007-2008) (*M* = 521.40, *SD* = 32.15), GPS (2011-2012) (*M* = 517.67, *SD* = 33.09), *t*(66) = 1.99, p $\leq$ .05, CI.95 7.84 –

8.07 (see Table 18). Further, Cohen's effect size value (*d* = .114) suggested a low practical significance.

Table 18

Paired t-test RQ 3 Georgia High Schools SAT Mathematics Scores QCC (2007-2008) and GPS (2011-2012) for Non-Title I Schools

Sample	*M*	*SD*	*difference*	*Df*	*p-value*	*T-Critical Value*
2007-2008 Math SAT Scores	521.40	32.15	-3.73	66	0.03*	1.99
2011-2012 Math SAT Scores	517.67	33.09				

The descriptive statistics indicated there was a decrease of .11 points in the overall mean between the QCC years (2007-2008) and GPS years (2011-2012) ACT mathematics scores from a mean of 18.45 to 18.34 in Title I schools. There was an increase of .21 points in the overall mean between the QCC years (2007-2008) and GPS years (2011-2012) ACT mathematics scores from a mean of 21.94 to 22.15 in Non-Title I schools (see Table 19).

Table 19

Descriptive Statistics for QCC (2007-2008) and GPS (2011-2012) ACT Scores by Socio-Economic Status (Title I and Non-Title I)

	2007-2008 ACT Math Score		*2011-2012 ACT Math Score*	
	Title I School	*Non-Title I School*	*Title I School*	*Non-Title I School*
Mean	18.45	21.94	18.34	22.15
Median	18.35	21.6	18.3	21.9
Mode	16.70	22.8	18.4	21.4
Standard Deviation	1.52	1.85	1.24	2.03

Note: Non-Title I school is defined as a school that does not have at least 40% of the students receiving free and reduced lunch.
*Significant at the $p < .05$ level.

The paired *t* test revealed no statistically significant difference between the ACT mathematics scores for Title I schools (*N* = 176), QCC (2007-2008) (*M* = 18.45, *SD* =

1.52), GPS (2011-2012) (*M* = 18.34, *SD* = 1.24), *t*(175) = 1.97, $p \geq .05$, CI.95 0.18 - 0.23 (see Table 20).

Table 20

Paired t-test RQ 3 Georgia High Schools ACT Mathematics Scores QCC (2007-2008) and GPS (2011-2012) for Title I Schools

Sample	*M*	*SD*	*difference*	*Df*	*p-value*	*T-Critical Value*
2007-2008 Math ACT Scores	18.45	1.52	-0.11	175	0.20	1.97
2011-2012 Math ACT Scores	18.34	1.24				

Note: Title I school is defined as a school with at least 40% of the total population receiving free or reduced lunch.

The paired *t* test revealed a statistically significant increase between the ACT mathematics scores for Non-Title I schools (*N* = 67), QCC (2007-2008) (*M* = 2194, *SD* = 1.85), GPS (2011-2012) (*M* = 22.15, *SD* = 2.03), *t*(66) = 1.99, $p \leq .05$, CI.95 0.45 – 0.50 (see Table 21). Further, Cohen's effect size value (*d* = .108) suggested a low practical significance.

Table 21

Paired t-test RQ 3 Georgia High Schools ACT Mathematics Scores QCC (2007-2008) and GPS (2011-2012) for Non-Title I Schools

Sample	*M*	*SD*	*difference*	*df*	*p-value*	*T-Critical Value*
2007-2008 Math ACT Scores	21.94	1.85	0.21	66	0.04*	1.99
2011-2012 Math ACT Scores	22.15	2.03				

Note: Non-Title I school is defined as a school that does not have at least 40% of the students receiving free and reduced lunch.
*Significant at the $p < .05$ level.

Summary of Findings

After removing schools that did not meet the criteria, the study was conducted using 301 schools for the SAT data and 284 schools for the ACT data.

Research Question 1. A paired *t* test was used to determine if there was a statistically significant difference between the mathematics SAT and ACT scores between schools in Georgia for the school years 2007-2008 implementing the Quality Core Curriculum (QCC) and schools in 2011-2012 implementing the Georgia Performance Standards (GPS). Results indicated there was a statistically significant decrease between the two school years as measure by the SAT. The effect size for this analysis (d = .002) was found below Cohen's convention for small effect (d = 0.20); however, there was no statistically significant difference between the two school years as measured by the ACT.

Research Question 2. A paired *t* test was used to determine if there was a statistically significant difference between the mathematics SAT and ACT scores between small schools and large schools in Georgia for the school years 2007-2008 implementing QCC and schools in 2011-2012 implementing the GPS. Results indicated there was no statistically significant difference between the two school years in small schools as measured by the SAT; however, there was a statistically significant increase between the two school years in small schools as measured by the ACT. The effect size for this analysis (d = 1.041) was found to exceed Cohen's convention for large effect (d = .80). There was a statistically significant decrease between the two school years in large schools as measured by the SAT. The effect size for this analysis (d = .191) was found below Cohen's convention for small effect (d = .20). There was a statistically significant decrease between the two school years in large schools as measured by the ACT. The effect size for this analysis (d = .006) was found below Cohen's convention for small effect (d = .20).

Research Question 3. A paired *t* test was used to determine if there was a statistically significant difference between the mathematics SAT and ACT scores between Title I schools and Non-Title I schools in Georgia for the school years 2007-2008 implementing QCC and schools in 2011-2012 implementing the GPS. Results indicated there was a statistically significant decrease between the two school years in Title I schools as measured by the SAT. The effect size for this analysis (d = .154) was found below Cohen's convention for small effect (d = .20). There was no statistically significant difference between the two school years in Title I schools as measured by the ACT. There was a statistically significant decrease between the two school years in Non-Title I schools as measured by the SAT. The effect size for this analysis (d = .114) was found below Cohen's convention for small effect (d = .20). There was a statistically significant increase between the two school years in Non-Title I schools as measured by the ACT. The effect size for this analysis (d = .108) was found below Cohen's convention for small effect (d = .20).

Chapter V

SUMMARY AND DISCUSSION

The State of Georgia developed an integrated mathematics curriculum to replace the long standing Quality Core Curriculum (QCC) Georgia had been utilizing, and introduced the new standards known as the Georgia Performance Standards (GPS) in 2005 (Peterson & Eaton, 2008). The main reason for replacing the QCC model was the low SAT scores Georgia students had been producing in mathematics. The GPS were developed after a panel of leaders in education, business, government, and industry studied curricula extensively. Their study revealed a good model to follow was Japan's curriculum due to having top international scores, and North Carolina's curriculum due to scores approaching the mathematics national average on the Scholastic Achievement Test (SAT). Respected teachers from across Georgia used these resources and the guidelines of the National Council of Teachers of Mathematics (NCTM), the College Board, the American Statistical Association and the American Diploma Project to put together the first draft of the GPS. A team of teachers and administrators were then assembled by the Georgia Department of Education. This team worked with mathematicians from universities such as Kennesaw State University, Georgia Tech, and the University of Georgia, and mathematics educators across Georgia to review the initial version and finalize the curriculum. The curriculum had its final approval in May of 2005. The state school superintendent during this time, Kathy Cox, stated, "Since 2003, we have been rewriting and implementing our new curriculum, the Georgia Performance Standards, and working with our teachers on how to use it" (2006, p. A11). The Georgia Council of Supervisors of Mathematics (GCSM) released an open letter to Superintendent Cox giving her accolades for the development and implementation of a plan they supported and called it successful (GCSM, 2007).

The QCC provided courses in high school that were subject based. Algebra, geometry, algebra II, trigonometry, and statistics were concepts taught within a specific course. Under the GPS, these concepts were integrated within courses named Math I, Math II, and Math III (Georgia Department of Education, n.d.). Learning tasks were created to incorporate integrated concepts that required problem solving skills and higher order thinking related to specific standards. Integrated standards based curriculum is what the state developed and implemented.

The state adopted integrated standards based mathematics curriculum has not been without criticism (Senk & Thompson, 2003). Many have felt changes in curriculum should not be in place without research that proves it will improve student achievement. This bold change in curriculum from QCC to GPS created debates among parents and stakeholders in Georgia and educators (Dodd & Perry, 2010).

As with any new products and implementations, evaluation of the effects must be encouraged. According to Robbins and Alvy (2003), it is essential all educational leaders study the effects any changes to school programs may have on student achievement. A review of the changes will allow stakeholders involved to discuss and make any needed revisions based on the study. The purpose of this study was to examine the effects of the Mathematics Quality Core Curriculum (QCC) and the Mathematics Georgia Performance Standards (GPS) on high school student achievement as measured by the SAT and ACT.

In addition, the study determined if there were differences in mathematics scores for large schools and small schools as well as for Title I and Non-Title I schools. The study answered three research questions:

RQ1: Is there a significant difference in the mathematics achievement, as measured by the SAT and ACT, of high school seniors participating in the Quality Core Curriculum and those participating in the Georgia Performance Standards?

RQ2: Is there a significant difference in the mathematics achievement, as measured by the SAT and ACT, of high school seniors participating in the Quality Core Curriculum in large Georgia high schools and those participating in the Georgia Performance Standards in small Georgia high schools?

RQ3: Is there a significant difference in the mathematics achievement, as measured by the SAT and ACT, of high school seniors participating in the Quality Core Curriculum in Georgia Title I schools and those participating in the Georgia Performance Standards in Georgia Non-Title I schools?

Overview of the Study

The Georgia Performance Standards began Fall of 2005 with sixth grade students across the state. The seniors in the class of 2008 were in the ninth grade and taught under the QCCs through high school. The 2008 SAT and ACT data represented these students under the QCC model. The seniors in the class of 2012 were in the sixth grade when the GPS was first implemented and these students were taught completely under the GPS model. The SAT and ACT data for this study were archival data. The SAT scores were gathered from the 2008 and 2012 College-Bound Seniors State Profile Report and the ACT scores were gathered from the 2008 and 2012 ACT High School Profile Report.

here were a total of 357 high schools in the State of Georgia considered for this study that had a SAT mean score or an ACT mean score on the 2008 reports listed above. The high schools chosen for Research Question 1 showed reported mean scores for both the 2007-2008 and 2011-2012 school years. There were 56 high schools that did not have reported mean scores on the SAT for both school years, and 73 high schools that did not have reported mean scores on the ACT for both school years, leaving 301 high schools with useable data for student achievement data as measured by the SAT and 284 total high schools with useable student achievement data as measured by the ACT. High schools for Research Question 2 were determined by categorizing the schools into small high schools (maximum of 900 students) and large high school (greater than 900 students). To remain in the study for Research Question 2, the schools had to stay within the same size school category for both the 2007-2008 and 2011-2012 school years. Research Question 2 included 285 total high schools that were either small schools or large schools consistently for both the 2007-2008 and 2011-2012 school years. For Research Question 3, schools were categorized into Title I schools (40% or more students free and reduced lunch), and Non-Title I schools and must have maintained the same socioeconomic status for both the 2007-2008 and 2011-2012 school years. Research Question 3 included 259 high schools that held the same socioeconomic status for both school years.

The study, using an ex post facto design, utilized quantitative methods. Quantitative data were calculated for each research question to determine significant differences between the QCC and GPS curriculum models. SAT and ACT mean scores were evaluated using a series of paired *t* tests providing a comparison between each model. Descriptive statistics were assessed to look at increases and decreases in the mean scores to identify minor and major differences.

Summary of Findings

Research Question 1: Is there a significant difference in the mathematics achievement, as measured by the SAT and ACT, of high school seniors participating in the Quality Core Curriculum and those participating in the Georgia Performance Standards?

The first research question was designed to determine if high schools in the state of Georgia were showing improvements in mathematics as measured by the Scholastic Achievement Test (SAT) and American College Testing (ACT). The data was examined to determine if there was a statistically significant difference in the mathematics achievement, as measured by the SAT and the ACT, of high school seniors participating in the Quality Core Curriculum (QCC) and those participating in the Georgia Performance Standards (GPS).

Descriptive statistics measured a decrease in the SAT scores. The mean score for students in Georgia following the QCC (2007-2008) was 471.64. Subsequently, the mean score for students in Georgia following the GPS (2011-2012) was 466.20. This was a 5.44 decrease in the mean score for Georgia students.

A paired *t* test was calculated using the mathematics SAT and mathematics ACT scores from the school years associated with the QCC (2007-2008) curriculum and the GPS (2011-2012) curriculum. The findings for Research Question 1 revealed there was a statistically significant decrease between the QCC and GPS as measured by the SAT (N = 301), QCC (2007-2008) (M = 471.64, SD = 45.62), GPS (2011-2012) (M = 466.20, SD = 43.88), $t(300) = 1.97$, $p \leq .05$, CI.95 4.98 – 5.17. Further, Cohen's effect size value (d =

.001) suggested a low practical significance. On the other hand, there was not a statistically significant difference between the QCC and GPS as measured by the ACT (N = 282), QCC (2007-2008) (M = 19.56, SD = 2.19), GPS (2011-2012) (M = 19.45, SD = 2.20), $t(282) = 1.97$, $p \geq .05$, CI.95 0.26 – 0.26.

Research Question 2: Is there a significant difference in the mathematics achievement, as measured by the SAT and ACT, of high school seniors participating in the Quality Core Curriculum and those participating in the Georgia Performance Standards in large Georgia high schools and small Georgia high schools?

Research Question 2 examined whether there was a significant difference in the mathematics achievement, as measured by the SAT of high school seniors participating in the Quality Core Curriculum in small Georgia high schools and those participating in the Georgia Performance Standards in large Georgia high schools.

Descriptive statistics indicated a decrease of 8.08 in the mathematics SAT scores in large schools. The mean score for students under the QCC model was 480.81 with the mean score for students under the GPS model being 472.73.

A paired t test was calculated using the mathematics SAT from the school years associated with QCC (2007-2008) curriculum and the GPS (2011-2012) curriculum. There was no statistically significant difference between QCC and GPS students as measured by the SAT in small schools (N = 66), QCC (2007-2008) (M = 453.87, SD = 44.40), GPS (2011-2012) (M = 453.93, SD = 43.48), $t(65) = 1.99$, $p \geq .05$, CI.95 6.03 – 9.69. There was a statistically significant decrease between mean SAT scores for students following the QCC and students following the GPS in large schools (N = 202), QCC (2007-2008) (M = 480.81, SD = 40.15), GPS (2011-2012) (M = 453.93, SD =

43.48), $t(201) = 1.97$, $p \leq .05$, CI.95 6.16 – 8.77. Further, Cohen's effect size value (d = .191) suggested a low practical significance.

Research Question 2 also examined whether there was a significant difference in the mathematics achievement, as measured by the ACT of high school seniors participating in the Quality Core Curriculum in small Georgia high schools and those participating in the Georgia Performance Standards in large Georgia high schools.

The descriptive statistics indicated there was an increase of 2.38 points in the overall mean between the QCC years (2007-2008) and GPS (2011-2012) ACT mathematics scores from a mean of 18.54 to 20.92 in small schools. There was a decrease of 0.99 points in the overall mean between the QCC years (2007-2008) and GPS (2011-2012) ACT mathematics scores from a mean of 19.96 to 18.97 in large schools.

A paired *t* test was calculated using the mathematics ACT scores from the school years associated with QCC (2007-2008) curriculum and the GPS (2011-2012) curriculum. There was a statistically significant increase between the scores of students following the QCC mathematics plan as compared to the scores of students following the GPS mathematics plan in small schools (N = 66), QCC (2007-2008) (M = 18.54, SD = 1.73), GPS (2011-2012) (M = 20.92, SD = 2.73), $t(65) = 1.99$, $p < .05$, CI.95 .672 - .425 and in large schools (N = 201), QCC (2007-2008) (M= 19.96, SD= 2.22), GPS (2011-2012) (M = 18.97, SD = 1.78), $t(200) = 1.97$, $p \leq .05$, CI.95 .247 - .309. Further, Cohen's effect size value (d = .1.014) suggested a practical significance. There was a statistically significant decrease in large schools (N = 201), QCC (2007-2008) (M = 19.96, SD = 2.22), GPS (2011-2012) (M = 18.97, SD = 1.78), $t(200) = 1.97$, $p \leq .05$, CI.95 .247 - .309. Further, Cohen's effect size value (d = .006) suggested a small significance.

Research Question 3: Is there a significant difference in the mathematics achievement, as measured by the SAT and ACT, of high school seniors participating in the Quality Core Curriculum and those participating in the Georgia Performance Standards in Georgia Title I schools and Georgia Non-Title I schools?

Research Question 3 examined whether there was a significant difference in the mathematics achievement, as measured by the SAT, of high school seniors participating in the Quality Core Curriculum in Georgia Title I schools and those participating in the Georgia Performance Standards in Georgia Non-Title I schools.

The descriptive statistics indicated there was a decrease of 4.64 points in the overall mean between the QCC years (2007-2008) and GPS years (2011-2012) SAT mathematics scores from a mean of 450.47 to 445.83 in Title I schools. There was a decrease of 3.73 points in the overall mean between the QCC years (2007-2008) and GPS years (2011-2012) SAT mathematics scores from a mean of 521.40 to 517.67 in Non-Title I schools.

A paired *t* test was calculated using the mathematics SAT scores from the school years associated with QCC (2007-2008) curriculum and the GPS (2011-2012) curriculum. There was a statistically significant decrease in SAT mean scores between the school years associated with the QCC and the school years associated with the GPS in Title I schools (N = 192), QCC (2007-2008) (M = 450.47, SD = 36.58), GPS (2011-2012) (M = 445.83, SD = 32.86), $t(191) = 1.97$, $p \leq .05$, CI.95 4.68 – 5.21. Further, Cohen's effect size value (d = .154) suggested a low practical significance. There was also a statistically significant decrease in SAT mean scores between the school years associated with the QCC and the school years associated with the GPS in Non-Title I schools (*N* = 67), QCC (2007-2008) (*M* = 521.40, *SD* = 32.15), GPS (2011-2012) (*M* = 517.67, *SD* = 33.09), *t*(66) = 1.99, p ≤ .05, CI.95 7.84 – 8.07. Further, Cohen's effect size value (*d* = .114) suggested a low practical significance.

Research Question 3 also examined whether there was a significant difference in the mathematics achievement, as measured by the ACT, of high school seniors participating in the Quality Core Curriculum in Georgia Title I schools and those participating in the Georgia Performance Standards in Georgia Non-Title I schools.

The descriptive statistics indicated there was a decrease of .11 points in the overall mean between the QCC years (2007-2008) and GPS years (2011-2012) ACT mathematics scores from a mean of 18.45 to 18.34 in Title I schools. There was an increase of .21 points in the overall mean between the QCC years (2007-2008) and GPS years (2011-2012) ACT mathematics scores from a mean of 21.94 to 22.15 in Non-Title I schools.

A paired *t* test was calculated using the mathematics ACT scores from the school years associated with QCC (2007-2008) curriculum and the GPS (2011-2012) curriculum. There was no statistically significant difference in ACT mean scores between the school years associated with the QCC and the school years associated with the GPS in Title I schools (*N* = 176), QCC (2007-2008) (*M* = 18.45, *SD* = 1.52), GPS (2011-2012) (*M* = 18.34, *SD* = 1.24), *t*(175) = 1.97, p ≥ .05, CI.95 0.18 - 0.23. However, there was a statistically significant decrease in the QCC and GPS in Non-Title I schools (*N* = 67), QCC (2007-2008) (*M* = 2194, *SD* = 1.85), GPS (2011-2012) (*M* = 22.15, *SD* = 2.03), *t*(66) = 1.99, p ≤ .05, CI.95 0.45 – 0.50. Further, Cohen's effect size value (*d* =

.108) suggested a low practical significance. Table 22 summarizes the results for the three research questions.

Table 22

Summary of p-values and Cohen's Effect Size for Research Questions

Question Category	SAT p-values	SAT Cohen's d	ACT p-values	ACT Cohen's d
Overall (RQ 1)	0.00**	0.001	0.11	
Small Schools (RQ2)	0.98		0.00**	1.041
Large Schools (RQ2)	0.00**	0.191	0.00**	0.006
Title I (RQ3)	0.00**	0.154	0.20	
Non-Title I (RQ3)	0.04*	0.114	0.04*	0.108

Note: *Significant at the $p < .05$ level, **Significant at the $p < .001$ level

Discussion

The research questions in this study were designed to measure the effect of mathematics curriculum design on student achievement in the state of Georgia. The three research questions in this study examined differences between SAT and ACT mean scores of Georgia high school seniors who were taught under the QCC model and the SAT and ACT mean scores of Georgia high school seniors who were taught under the GPS model. The results showed no practical statistical differences. These findings were supported by Mallanda (2011) who investigated how the new GPS curriculum effected student achievement as measured by the Preliminary SAT/National Merit Scholarship Qualifying Test (PSAT/NMSQT). Her findings indicated there was not an increase in mathematics scores on the PSAT/NMSQT with the implementation of the integrated GPS curriculum and student achievement remained the same regardless of the traditional curriculum known as QCC or an integrated curriculum known as GPS. It is possible the measure used in Mallanda's study and the measure used in this study was not sensitive enough with mathematics classrooms.

The results of this study showed no statistically significant difference in students' mathematics scores in Georgia on the ACT. The data indicated students' mathematics scores on the ACT had little change regardless of the curriculum change. However, although with low practical significance, the study did show a statistically significant difference in students' mathematics scores in Georgia on the SAT but not in the direction state educators had planned. One might suggest the integrated curriculum hindered the students' mathematics learning. In the state of Montana, the Systematic Initiative for Montana Mathematics indicated traditional curricula made no difference on PSAT scores and concluded integrated curriculum did not improve college entrance exam scores, but the mathematics curriculum is not hindering the learning of the students (Lott et al., 2003). Schoen and Hirsch (2003) suggested there was not a significant difference in SAT or ACT for students who studied under the Core Plus Mathematics Project instead of a traditional curriculum.

There were statistically significant differences on the ACT in small schools but not on the ACT in large. There were statistically significant differences on the ACT and SAT in large schools. One might suggest the curriculum did play a role in the student achievement. In this study, small schools (schools with less than 900 students) did show academic gains on the ACT and large schools (schools with greater than or equal to 900 students) did not show academic gains on the ACT or SAT. Carolan and Baker-Smith's (2009) study contradicted small schools' results, but it is in alignment with the findings in this study with large schools. They found mid-size schools (schools with approximately 600 students) showed overall greater success as compared to schools of other sizes. However, in a study conducted in Georgia, the education stakeholders revealed it is difficult to ascertain the impact of school size on academic achievement since other factors come into play (Stevenson, 2006).

There was not a statistically significant difference on the ACT in Title I schools but there was a statistically significant difference on the SAT in Title I schools. For Non-Title I schools, there was a statistically significant difference on the SAT and the ACT. With a p-value of 0.03 for the SAT and a p-value of 0.04 for the ACT. One may suggest the curriculum did play a small role in the student achievement for Non-Title I schools. Here again, the outcome was a decrease in the scores, but it can be suggested the impact was not as severe on the Title I schools as in the Non-Title I schools and the practical significance was low. Barton, Coley and Educational Testing Services (2003) confirmed academic achievement is connected to the family roots with socioeconomic issues.

First, the integrated curriculum possibly hindered students' mathematics learning. Results revealed there was a decrease in achievement for students learning under the GPS integrated curriculum. It shall be noted, it can take up to 7 years for a new curriculum to be implemented (St. John, Fuller, Houghton, Tambe, & Evans, 2004). However, with changes in state leadership there may not always be that much time allotted before a new set of standards is introduced. Educational leaders will need to explore the best practices for successful curriculum integration. Possible strategies such as following the frameworks and having someone whose primary role was the implementation of the curriculum could have impacted the success or lack of success in student outcomes. In order for the implementation of the GPS to be successful, mathematics coach positions were established in many schools across the state (Obara et al., 2009). Obara et al. studied the role of mathematics coaches and how they connected to performance standards. Obara et al. stated the employment of a mathematics coach is a crucial piece in the implementation of the GPS and the success of students with the new standards. The State Department of Education encouraged teachers to unpack standards, attend formal trainings, participate in collaborative sessions, and be observed by the coaches to provide appropriate feedback for improvement. It is unknown if all schools in the study followed this recommendation and delivery of practices. Moreover, the follow-up from the coaches' observations must be honest and appropriate in order to make sure strategies are effective. Coaches who are not giving appropriate feedback could be damaging the student outcomes. Even more importantly, this feedback should be given in a timely manner.

Limitations

There were some limitations to this study. First, a major limitation of this study was due to using the entire population. Using the population for the State of Georgia did not allow for studies of individual students, teachers, or classrooms. The data gathered for this study only included the entire schools' mean averages. The study was limited in information regarding student backgrounds and grades that could have added to this study. SAT and ACT scores were used to measure learning of mathematics. There was limited access to other data on high school mathematics performance for the entire student population. Lack of such data impeded the ability to perform a more in depth study. This limited the measurement of the learning of mathematics. Other instruments could better measure the learning of mathematics such as using the NAEP to determine if there was improvement in scores due to the curriculum change. Another limitation to this study was the fidelity of curriculum implementation in the schools was not examined.

There may have been a variety of implementation models among schools and within classrooms in the same school. Also, there was a limited amount of research focusing on the integrated Georgia Performance Standards. For this particular study, the literature reviewed was primarily focused on general integrated curriculum.

Implications for Practice

Although research of this study showed very little change in student achievement within some areas as measured by SAT and ACT scores, it may not be due to curriculum. It may be a result of the fidelity of implementation of the curriculum. Some examples of the elements of implementation may be instructional practices, instructional models, or leader evaluation of the classroom within the schools. In a similar study conducted by Mallanda, evaluating the relationship between tenth grade students completing the Quality Core Curriculum (QCC) and the new Georgia Performance Standards (GPS) in a school district with 15 high schools as measured by the Preliminary SAT/National Merit Scholarship Qualifying Test (PSAT/NMSQT), the researcher concluded there was a lack of systemic changes needed in mathematics classrooms and negatively impacted student academic achievement in mathematics.

This study indicated small schools were less likely to be negatively impacted by curriculum changes. Smaller schools might mean smaller class sizes where students could get more individualized instruction. In small schools, individual counseling might be more readily available to help students pick the appropriate college entrance exam and more academically inclined students could be taking the ACT along with the SAT to be more competitive in the scoring process.

Educators and policy makers in the state of Georgia believed an integrated approach to mathematics was a means of getting to the goal of higher SAT scores (Peterson & Eaton, 2008). Thus, adopting a new curriculum. The role of instructional coaches became very important during this process (Obara et al., 2009). However, not all schools may have funded mathematics coaches. It could be lack of a consistent position in all schools across the state may have been a disadvantage overall especially in Title I schools who, according to this study, are at greater risk.

This study indicated large Title I schools were the most negatively affected. Title I schools with a large population could need more support. According to Obara et al. (2009), mathematics coaches do play a very supportive role, however, their study indicated the coaches' knowledge of mathematics may not be enough. The study implied math coaches or other instructional support specialists, should be trained in matters of discipline, as well as language or reading difficulties. With the new curriculum, teaching reading and managing behaviors was a common request for help from struggling mathematics teachers. Title I schools may want to consider the hiring of additional types of instructional specialists to help support these management and reading needs of mathematics teachers. It is possible the creation of the budget for Title I schools could play a vital role in improving student. Leaders should look at reallocating funds for more coaches or the possibility of cross training using literacy coaches with mathematics teachers.

Leaders of instructional programs and how they monitor classrooms could have an impact on student achievement. According to Marzano (2003), instructional leaders have a duty to protect and monitor instructional time. Leaders may want to delegate managerial tasks and make curriculum and instruction a priority in the school. A culture must be created that focuses on teaching and learning. Instructional models, time management, and what is being taught (curriculum) all may play roles in student achievement. It is important our leaders spend time in all classrooms giving appropriate feedback daily.

Leaders need to be more comfortable giving feedback and be involved in the training process of newly implemented curriculum and instructional models (Schlechty, 2005). In order to create change in the classroom, leaders' feedback is essential. Many teachers are reluctant to change, therefore, leaders may want to support the theory of transformational leadership (Hallinger, 2003). It is not always the work of one person who leads change, but the work of a group. Leaders may want to develop leadership groups to support teacher led initiatives in order to sustain change and improve student achievement.

Recommendations for Further Research

In the current study, it is clear the curriculum change did not have an overall impact to increase student achievement in mathematics. Since the GPS, the state of Georgia has modified the curriculum to now offer the mathematics Georgia Standards of Excellence (GSE) (GaDOE, 2015). The mathematics GSE allows schools to choose between more traditional courses named Algebra I and Geometry or the more integrated courses named Coordinate Algebra and Analytic Geometry. Because of the changes in the curriculum since the class of 2012, a longitudinal study of the GPS is only possible with schools who are offering the Coordinate Algebra and Analytic Geometry sequence. Past research showed it takes between 5 and 7 years to determine implementation of curriculum outcomes (St. John et al., 2004). Further study is recommended to determine student achievement under the GSE. This could include a study of schools in the state of Georgia who chose to change back to the traditional Algebra I and Geometry course sequence to determine differences between schools teaching the integrated curriculum and schools teaching the traditional curriculum. In other words, research on how schools perform in Georgia using schools under the integrated mathematics curriculum as compared to those who changed back to the traditional model of mathematics curriculum. The SAT and ACT measurements for this study may not have been sensitive to the mathematics classrooms. Other types of measurements may need to be used in a further study of the GSE.

The recommendation is to provide additional research to better understand curricula effects on student achievement. More specifically, research into the various demographics including special education, early intervention plan, gifted, English speakers of other language, military, non-military, ethnicity, and gender. Also, the level of education of the faculty along with staff development as related to mathematics GPS and the use of mathematics coaches. For example, were teachers expected to follow the frameworks as provided by the state of Georgia?

The state of Georgia evaluates schools using the College and Career Readiness Performance Index (CCRPI) (GaDOE, 2017). Due to this accountability measure, the Georgia Milestones End of Course (EOC) assessments are used to measure student achievement and student growth. Types of measurements could influence instructional priorities. The EOC measures may not align with SAT or ACT and further research may be needed using a different measurement for student achievement in mathematics.

This study did not address the implementation expectations of each school as they rolled out the new curriculum and created lessons and activities. Further research may examine the links between implementation expectations and student achievement as it is related to the new Georgia Performance Standards. Although this curriculum is not the current curriculum, further studies can be completed based on the implementation process and administrative requirements and how closely they are aligned to the state expectations.

Conclusions

The current study's primary implication is the change in curriculum did not impact student achievement. There was a slight decrease in student achievement as measured by the SAT and no difference in student achievement as measured by the ACT. These findings had very low practical significance. When looking at school size, there was a decrease in student achievement of large schools as measured by both the SAT and ACT. Whereas, in small schools there was a decrease in student achievement as measured by the ACT, there was not a difference in student achievement as measured by the SAT. Lastly, Title I schools revealed a decrease in student achievement in schools covering the GPS as measured by the ACT, but no difference in student achievement as measured by the SAT. However, in Non-Title I schools there were a decrease in student achievement as measured by both the SAT and ACT. The results of this study can provide insight to curriculum leaders as the state moves forward with new curriculum. The new GSE does allow school's choice between an integrated curriculum and a more traditional curriculum for mathematics. One might ask, does school choice of the model of curriculum make a difference in overall student achievement?

REFERENCES

Achieve, I. (2010). *Comparing the common core state standards in mathematics and NCTM's "Curriculum Focal Points".* Achieving the Common Core. Achieve, Inc.

ACT, Inc. (2004). *Crisis at the Core.* Iowa City, IA: Author.

ACT, Inc. (2008). *ACT High School Profile Report.* Iowa City, IA: Author.

ACT, Inc. (2012). *ACT High School Profile Report.* Iowa City, IA: Author.

Bagwell, S. (2000). No! Not algebra. *Mathematics Education Dialogues*, 3(2), 9.

Barge, J. (2014). Mathematics graduation requirement guidance for students entering ninth grade in 2013-2014 and thereafter. *Georgia Department of Education, 2-24.*

Barton, P. E., Coley, R. J., & Educational Testing Service, P. C. (2009). *Parsing the achievement gap II. Policy Information Report*. Educational Testing Service.

Bernhardt, V.L. (2004). *Using Data to Improve Students Learning in Middle Schools*. Larchmont, NY: Eye on Education, Inc.

Bickel, R., & Howley, C. (2000). The influence of scale on student performance: a multi-level extension of the Matthew Principle. *Education Policy Analysis Archives*, *8* (22).

Bloom, H. S., et al. (2011). Transforming the high school experience: How New York city's new small schools are boosting student achievement and graduation rates. *Society for Research on Educational Effectiveness*: *ERIC*. Web. 13 Sept. 2014.

Branscome, E. (2012). The impact of education reform on music education: Paradigm paradigm shifts in music education curriculum, advocacy, and philosopy from Sputnik to Race to the Top. *Arts Education Policy Review, 113*(3), 112-118.

Campbell, S., & Courant, S. (1992, Oct 02). *Opinions differ on suitability, fairness of* *standardized tests standardized tests are: A. needed B. unfair C. disputed*. Hartford Courant. Retrieved from http://search.proquest.com/docview/255390916?accountid=14800

Cavanagh, S. (2007). Lessons drawn from Sputnik 50 years later. *Education Digest, 73*(4), 31-34.

Coleman, J. S., Campbell, E. Q., Hobson, C. J., McPartland, F., Mood, A. M., Ceinfeld, F. D., et al. (1966). *Equality of Educational Opportunity*. Washington, DC: U.S. Government Printing Office.

Cox, K. (2003, February 23). Other opinion: Flexible approach what schools need. *The Atlanta Journal – Constitution,* p. E9.

Cox, K. (2005). *What Georgia educators need to know about Georgia's testing program*. Atlanta, Georgia: Georgia Department of Education.

Cumming, D. (1998). Study gives Ga. Curriculum mixed grades math awarded a B and science a D in Fordham Foundation's evaluation of state's required course work. *The Atlanta Journal-Constitution.* Retrieved September 18, 2011 from http://search.proquest.com/atlantajournalconstitution/docprintview/413750981

Dodd, D. A. & Perry, J. (2010, May 20). New Curriculum: math anxiety for students and Teachers. *The Atlanta Journal-Constitution.* Retrieved from http://www.ajc.com/news/new-curriculum-math-anxiety-532073.html

Donnelly, S. (2013, Mar 06). From STEM to STREAM; three classes of students to showcase expanded education project. *Palm Beach Daily News*. Retrieved from http://search.proquest.com/docview/1314870030?accountid=14800

Eddy, C. M., Quebec Fuentes, S., Ward, E. K., Parker, Y. A. Cooper, S., Jaspter, W. A., & Wilkerson, T. L. (2015). Unifying the algebra for all movement. *Journal of Advanced Academics, 26*(1), 59. doi: 10.11771932202X14562393.

Emeagwali, N.S. (2015). Investing in STEM education: The key to economic vitality. *Techniques: Connecting Education & Careers [serial online]*, *90*(3), 24-26.

Fitzpatrick, C. (2013, Jul 09). STEM at the center: STEM, STEAM and STREAM. *Journal – Advocate.* Retrieved from http://search.proquest.com/docview/1398870508?accountid=14800

Fowler, W. J. (1995). School size and student outcomes. *Advances in Educational Productivity*, 5, 3-26.

Galley, M. (2004, March 17). Georgia reaches out to Japan for math-curriculum model. *Education Week, 23*(27), 13.

Gardner, P. W., Ritblatt, S. N., & Beatty, J. R. (2000). Academic achievement and parental school involvement as a function of high school size. *The High School Journal, 83*(2), 21. Retrieved from http://search.proquest.com/docview/220218827?accountid=14800

Garrett, J. L. (2008). STEM: The 21st century sputnik. *Kappa Delta Pi Record, 44*(4), 152-153. Retrieved from http://search.proquest.com/docview/232033497?accountid=14800

Georgia Council of Supervisors of Mathematics (GCSM). (2007). Retrieved September 13, 2014.

Georgia Department of Education (GaDoe). (n.d.). *Frequently asked questions Georgia Performance Standards in mathematics*. Retrieved September 13, 2014, from https://www.georgiastandards.org/standards/ GPS.

Georgia Department of Education (GaDOE). (2013). Retrieved September 13, 2014, from https://www.georgiastandards.org.

Georgia Department of Education (GaDOE). (2015a). Retrieved March 10, 2015, from http://www.gadoe.org/Curriculum-Instruction-and-Assessment/Curriculum-and-Instruction/Pages/default.aspx

Georgia Department of Education (GaDOE). (2017). Retrieved April 9, 2017, from http://www.doe.k12.ga.us.

"Georgia educators begin teaching common core Georgia performance standards this school year." (2012, July 26). *Targeted News Service*. Retrieved from http://search.proquest.com/docview/1028002839?accountid=14800.

Governor's Office of Student Achievement (GOSA). (2016). Retrieved from http://gosa.georgia.gov.

Georgia Partnership for Excellence in Education (GPEE). (2013). Retrieved May 3, 2014, from http://toolbox.gpee.org/Curriculum-and-Standards.238.0.html.

Grant, C. (2014). Education reform. *New Georgia Encyclopedia.* ERIC. Web. 25 October 2014.

Groves, I. (2014, Nov 13). Blessed sacrament STEM program wins state recognition. *McClatchy - Tribune Business News.* Retrieved from http://search.proquest.com/docview/1624152512?accountid=14800

Hallinger, P. (2003, November). Leading educational change: Reflections on the practice of Instructional and transformational leadership. *Cambridge Journal of Education, 33*(3), 71- 101.

Hartmann, T., Reumann-Moore, R., Evans, S. A., Haxton, C., Maluk, H., Neild, R. C. (2009). Going small: Progress & challenges of Philadelphia's small high schools. *Research for Action*. ERIC. Web. 13 Sept. 2014.

Hoover, E. (n.d.). SAT scores rose and ACT scores held steady in 2003. *Chronicle of Higher Education, 50*(2), A47.

Howley, C. B., & Bickel, R. (2000). *When it comes to schooling small works: School size, poverty, and student achievement.* Retrieved from ERIC database. (ED447973)

Howley, C., Strange, M., & Bickel, R. (2000). *Research about school size and school performance in impoverished communities* [ERIC Digest].Washington, DC: Office of Educational Research and Improvement.

Johnson, J. (2006). *More doesn't mean better: Larger high schools and more courses do not boost student achievement in Iowa high schools*. ERIC Document Reproduction Service No.
ED497981. Arlington, VA: Rural School and Community Trust.

Kilpatrick, J. (2009). The mathematics teacher and curriculum change. *PNA, 3*(3), 107-121.

Lindquist, E. (1958). *The nature of the problem of improving scholarship and college entrance examinations.* A speech presented at the Invitational Conference on Testing Problems, New York City.

Lott, J. W., Hirstein, J., Burke, M., Lundin, M., Allinger, G., Souhrada, T. A., …Preble, D. (2003). Curriculum and assessment in SIMMS Integrated Mathematics. In S. L. Senk and D. R. Thompson (Eds.), *Standards-oriented School Mathematics Curricula: What are They? What do Students Learn?* Mahwah, NJ: Lawrence Erlbaum Associates.

Lytton, H., & Pyryt, M. C. (1998). Predictors of achievement in basic skills: A canadian Effective schools study. *Canadian Journal of Education, 23*(3), 281-301. Retrieved from http://search.proquest.com/docview/215377411?accountid=14800

Mallanda, C. L. (2011). *The effects of changing from a traditional mathematics curriculum to an integrated mathematics curriculum on student mathematics learning in Georgia* (Doctoral dissertation). Retrieved from http://aquila.usm.edu/dissertations/485/

Marklein, M. (2007). All four-year U.S. colleges now accept ACT test*. USA Today.*

Marzano, R. J. (2003). *What Works in Schools: Translating Research Into Action.* Alexandria, VA: Association for Supervision and Curriculum Development.

Mcconney, A., & Perry, L. B. (2010). Socioeconomic status, self-efficacy, and mathematics achievement in australia: A secondary analysis. *Educational Research for Policy and Practice, 9*(2), 77-91. doi:http://dx.doi.org/10.1007/s10671-010-9083-4

McMillan, J.H. & Schumacher, S. (2001). *Research in Education.* United States: Addison Wesley Longman, Inc.

Monroe, E. E., & Young, T. (2014). Math and the Common Core. *Booklist,* 111(5S), 14-17.

Morgatto, S. F. (2008). Should all students be required to take algebra? Are any two Snowflakes alike? *Clearing House*, *81*(5), 215-218.

Munik, T., McMillian, M., & Lewis, N. (2014). Compositional effects, segregation and test scores: Evidence from the National Assessment of Educational Progress. *Review of Black Political Economy, 41*(4), 433. doi: 10.1007/s12114-014-9200-3

NAEP (National Assessment of Education Progress). (1996). *The nation's report card*. Retrieved April 2, 2014, from http://nces.ed.gov/nationsreportcard/statecomparisons.

NAEP (National Assessment of Education Progress). *The nation's report card*. Retrieved August 8, 2015, from http://nces.ed.gov/nationsreportcard/statecomparisons.

National Center for Education Statistics. (2007). *Trends in International Mathematics and Science Study (TIMSS).* Retrieved October 25, 2014, from https://nces.ed.gov/TIMSS/results07_math07.asp.

National Council of Teachers of Mathematics. (2013). *Supporting the common core state standards for mathematics*. Reston, VA: National Council of Teachers of Mathematics.

No Child Left Behind Act (NCLB). (2001). Public Law No. 107-110. Retrieved March 1, 2014, from http://www.nclb.gov.

Nuwer, R. (2015). SAT charts new territory. *Scientific American, 313*(3), 22.

Obara, Samuel, & Sloan, M. (2009). The Evolving Role of a Mathematics Coach during the Implementation of Performance Standards. *The Professional Educator,* 33.2 (2009): 1-13. *ProQuest.*Web. 10 Mar. 2015.

O'Hanley, H. (2015). The STEAM Initiative. *Arts & Activities, 157*(1), 11.

Peterson, L. I. & Eaton, A. (2008, September 1). New math coursework rigorous, more effective. *The Atlanta Journal-Constitution,* p. A14.

Pope, J. (2012). SAT scores edge down; ACT now more popular exam. *Associated Press, 1-2.*

Preparing for the ACT Test. (2017, June 24). Retrieved from http://www.act.org/content/dam/act/unsecured/documents/Preparing-for-the-ACT.pdf

Quan,W. L. (1992, June). Chinese advancements in mathematics education. *Educational Studies in Mathematics*, *12*, 287-298.

Radunzal, J. & Noble, J. (2003). *Tracking 2003 act-tested high school graduates: College readiness, enrollment, and long-term success*. Retrieved from http://www.act.org/research/researchers/reports/pdf/ACT_RR2012-2.pdf

Ravani, G. (2011, July 23). Why 'no excuses' makes no sense: Revisiting the coleman report. *The Washington Post.* Retrieved from http://www.washingtonpost.com.

Reston, V. (2004). *Elementary and Middle School Mathematics: Teaching Developmentally*. New York, NY: Pearson Education Press.

Reys, R. E. (2001). Curricular controversy in the math wars: A battle without winners. *Phi Delta Kappan, 83*(3), 255-258. Retrieved from http://library.valdosta.edu:2048/

Reza, S. A. M. (2008). Japan's national curriculum reforms: Focus on integrated curriculum approach. *Quarterly Journal of Educational Innovations*, 22, 16-22. Login?url=http://search.proquest.com/docview/218524739?accountid=14800.

Rhode Island School of Design announces "STEM to STEAM: Full circle from education To economy" expert panel at SXSWedu. (2013, Jan 22). *Business Wire.* Retrieved from http://search.proquest.com/docview/1271941607?accountid=14800

Robbins, P., & Alvy, H. (2003). *The Principal's Companion, Second Edition.* Thousand Oaks, CA: Corwin Press.

Rural School and Community Trust. (2000). *School size, poverty, and student achievement.* Retrieved from http://www.ruraledu.org/matthew.html

Sackett, P. R., Kuncel, N. R., Beatty, A. S., Rigdon, J. L., Shen, W., & Kiger, T. B. (2012).The role of socioeconomic status in SAT-Grade relationships and in college Admissions decisions. *Psychological Science* (Sage Publications Inc.), 23(9).

Schmidt, W., Jorde. D., Barrier, E., Gonzalo, I., Moster, U., et al. (1997). *Characterizing Pedagogical Flow: An Investigation of Mathematics and Science Teaching in Six Countries*. Dordrecht, the Netherlands: Kluwer.

Schmidt, W., McKnight, C., Cogan, L., Jakwerth, P., & Houang, R. (1999). *Facing the Consequences: Using TIMSS for a Closer Look at U.S. Mathematics and Science Education*. Dordrecht, the Netherlands: Kluwer.

Schmidt, W., McKnight, C., & Raizen, S. (1997). *A Splintered Vision: An Investigation of U.S. Science and mathematics education.* Dordrecht, the Netherlands: Kluwer.

Schoen, H. L., & Hirsch, C. R. (2003). The Core-Plus Mathematics Project: Perspectives and Student Achievement. In S. Senk, & D. Thompson (Eds.), *Standards-based School Mathematics Curricula: What Are They? What Do Students Learn?* (pp. 311-343). Hillsdale, NJ: Lawrence Erlbaum Associates.

Schoenfeld, A. (2007, May 2). Problem solving in the United States, 1970-2008: Research and theory, practice and politics. *ZDM Mathematics Education,* 39, 537 – 551. doi:10.1007/s11858-007-0038-z.

Schumer, G. (1999). Mathematics education in japan. *Journal of Curriculum Studies*, *31*(4), 399-427.

Senk, S. L., & Thompson, D. R. (2003). *Standards-based school mathematics curricula: What are they? What do students learn?* Mahwah, NJ: Lawrence Erlbaum Associates.

Shaffer, L. (2014). Full STEAM Ahead. *Instructor, 123*(5), 32.

Simon, M. K., & Goes, J. (2013). Ex post facto research. *Dissertation and Scholarly Research: Recipes for Success.* Seattle, WA: Dissertation Success LLC.

St. John, M., Fuller, K.A., Houghton, N. Tambe, P. & Evans, T. (2004). *Challenging the Gridlock: A study of High Schools Using Research-based curricula to improve mathematics.* Inverness Research Associates.

Stevenson, K. (2006). *School Size and Its Relationship to Student Outcomes and School Climate*.Washington DC: National Clearinghouse for Educational Facilities.

Stewart, L. (2009). "Achievement Differences Between Large And Small Schools In Texas." *Rural Educator,* 30.2, 20-28. *ERIC*. Web. 13 Sept. 2014.

The College Board. (2008a). *SAT preparation booklet 2007-2008.* Retrieved from https://sat.collegeboard.org.

The College Board. (2008b). *2008 college-bound seniors state profile report Georgia*. Retrieved from http://professionals.collegeboard.com.

The College Board. (2008c). *Validity of the SAT for predicting first-year college grade Point average* (Research Report No. 2008-5). Retrieved from https://professionals.collegeboard.com.

The College Board. (2012a). *2012 college-bound seniors state profile report Georgia*. Retrieved from http://professionals.collegeboard.com/.

The College Board. (2012b). *SAT preparation booklet 2011-2012.* Retrieved from https://sat.collegeboard.org.

U.S. Department of Education. (2014, June). Retrieved September 14, 2014 from http://www2.ed.gov/programs/titleiparta/index.html.

Watkins, W. J. (1987). *A study of curriculum enrichment and its effect on SAT verbal and math scores.*(Doctoral dissertation). Available from ProQuest Dissertation and Theses database. (UMI No. 8727446).

Watson, A. D., & Watson, G. H. (2013). Transitioning STEM to STEAM: Reformation of Engineering Education. *Journal for Quality & Participation, 36*(3).1-4.

Weiss, C. C., Carolan, B. V., and Baker-Smith, C. (2010). Big school, small School: (Re)testing assumptions about high school size, school engagement and mathematics achievement. *Journal of Youth & Adolescence,* 39.2, 163-176.

Williams, P. (2013, July 7). Stay the course. *The Atlanta Journal & Constitution.* Retrieved from http://www.myajc.com/news/opinion.

Woods, R. (2015). Georgia standards of excellence. *Georgia Department of Education*, 1-27.

Woodward, J. & Yumiko, O. (2004). Mathematics and academic diversity in Japan. *Journal of Learning Disabilities*, *37*(1), 74-82. Retrieved from http:// library.valdosta.edu:2048/login?url=http://search.proquest.com/docview/1942208 99 accountid=14800.

Yelgün, A., &Karaman, I. (2015). What are the factors reducing the academic achievement in aprimary school located in a neighborhood with a low socioeconomic status? *EgitimVeBilim, 40*(179). Retrieved from http://search.proquest.com/docview/1682152264?accountid=14800

Zehr, M. A. (2005, May 25). Georgia adopts integrated math. *Education Week,* 24(38).

Zimba, J. (2014). The Development and Design of the Common Core State Standards for Mathematics. *New England Journal of Public Policy, 26*(1), 1-11.

APPENDIX A:

Institutional Review Board Oversight Screening Form

Valdosta State University Graduate School

Institutional Review Board Oversight Screening Form for Graduate Student Research

Project Title: The Impact of Curriculum on the Mathematics Achievement on Georgia Public School Students

Name: Pennie Star Griffith Davis

Faculty Advisor: Donald Leech

Department: Education

E-mail: pedavis@valdosta.edu

Telephone: 912-464-0952

Please indicate the academic purpose of the proposed research:

☒ Doctoral Dissertation
☐ Master's Thesis
☐ Other:

1. ☐ YES ☒ NO **Will you utilize *existing identifiable private* information about living individuals?** "Existing" information is data that were previously collected for some other purpose, either by the researcher or, more commonly, by another party. "Identifiable" means that the identities of the individuals can be ascertained by the researcher by name, code number, pattern of answers, or in some other way, regardless of whether or not the researcher needs to know the identities of the individuals for the proposed research project. "Private" information includes information about behavior that occurs in a context in which an individual can reasonably expect that no observation or recording is taking place or information provided for specific purposes that the individual can reasonably expect will not be made public (e.g., a medical record or student record).

   Note: If you are using data that: (1) are publicly available; (2) were collected from individuals anonymously (i.e., no identifying information was included when the data were first collected); (3) will be de-identified before being given to the researcher, (i.e., the owner of the data will strip identifying information so that the researcher cannot ascertain the identities of individuals); or (4) do not include any private information about the individuals, regardless of whether or not the identities of the individuals can be ascertained, your response to Question 1 should be NO.

2. ☐ YES ☒ NO **Will you *interact* with individuals to obtain data?** "Interaction" includes communication or interpersonal contact between the researcher and the research participant, such as testing, surveying, interviewing, or conducting a focus group. It does not include observation of public behavior when the researcher does not participate in the activities being observed.

3. ☐ YES ☒ NO **Will you *intervene* with individuals to obtain data?** "Intervention" includes manipulation of the individual or his/her environment for research purposes, as well as using physical procedures (e.g., measuring body composition, using a medical device, collecting a specimen) to gather data for research purposes.

If you answered YES to ANY of the above questions, your research is subject to Institutional Review Board oversight. Please discard this form and complete and submit an IRB application. Do not begin your research until your application has been reviewed by the IRB and you are informed of the outcome of the review.

◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆

If you answered NO to ALL of the above questions, your research is not subject to Institutional Review Board oversight. Stop here, sign below, secure your faculty advisor's signature, and submit this form to the Graduate School. Please remember that, even though your project is not subject to IRB oversight, you should still observe ethical principles in the conduct of your research.

STUDENT CERTIFICATION: I certify that my responses to the above questions accurately describe my proposed research.

Student's Signature: Pennie Davis **Date:** 2-10-17

FACULTY ADVISOR CERTIFICATION: I have reviewed the student's proposed research and concur that it is not subject to Institutional Review Board oversight.

Faculty Advisor's Signature: Donald Leech **Date:** 2/10/17

Valdosta State University — Rev: 04.08.2010