THE EFFECTS OF A REMEDIAL MATH INTERVENTION ON STANDARDIZED TEST SCORES IN GEORGIA MIDDLE SCHOOLS

by

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Liberty University

A Dissertation Presented in Partial Fulfillment

of the Requirements for the Degree

Doctor of Education

Liberty University

July 2011

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ABSTRACT

Chastity London Adams, THE EFFECTS OF A REMEDIAL MATH INTERVENTION ON STANDARDIZED TEST SCORES IN GEORGIA MIDDLE SCHOOLS. (Under the direction of Dr. Amanda J. Rockinson-Szapkiw, Assistant Professor) School of Education, July, 2011.

Schools are looking for interventions to improve academic achievement and increase test scores due to the requirements of No Child Left Behind. One such intervention in middle schools is remedial math. This causal comparative study examined the differences in the standardized test scores for at-risk students who receive remedial math instruction and at-risk students who do not receive this intervention. In addition, this study examined gender differences for the remedial math students. The Georgia Criterion-Referenced Competency Test of 293 at-risk seventh-grade students was used in this study. Using the previous year's standardized math test scores as a control variable, there was a significant relationship between at-risk students taking remedial math and higher scores on standardized tests, regardless of gender.

Keywords, standardized test, achievement, remedial courses, interventions, mathematics, gender, middle school

Acknowledgements

I would like to thank my family and colleagues for their everlasting support, patience, and love throughout this process. It would not have been possible without each of you.

To my husband Scott, thank you the encouragement and patience you constantly provide.

To my sons, Grayson and Jackson, thank you for being great kids! You have demonstrated great patience and love throughout this process. It is my hope that my love of learning will serve as a model for you so that you may be encouraged to pursue your dreams.

To my mother, Donna, thank you for all of your help. I could not have completed this without all the love and support you have shown.

To my Aunt Annette and Uncle Eddie, thank you for all you have done. Not only have you encouraged me, but also you've made endless trips to assist me.

In memory of my father, David London, who always believed I could do anything--You would have been so proud!

I would like to thank Amanda Szapkiw, Ed.D., for serving as my dissertation committee chair. The constant support, assistance, and positive guidance you provided were invaluable.

I would also like to thank my committee members, Ralph Marino, Ph.D., and Judy Forbes, Ed.D., for your support and encouragement throughout this process.

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List of Abbreviations

Adequate Yearly Progress (AYP)

Analysis of Covariance (ANCOVA)

Annual Measureable Objectives (AMO)

Conditional Standard Error of Measurement (CSEM)

Criterion Referenced Competency Test (CRCT)

Does Not Meet (DNM)

Exceeds Expectations (EE)

Georgia Department of Education (GaDOE)

Georgia Performance Standards (GPS)

Individuals with Disabilities Education Act (IDEA)

Iowa Test of Basic Skills (ITBS)

Meets Expectations (ME)

No Child Left Behind (NCLB)

Response to Intervention (RTI)

Standard Error of Measurement (SEM)

Statistical Package for the Social Sciences (SPSS)

CHAPTER ONE: INTRODUCTION

The No Child Left Behind Act (NCLB) of 2001 has placed an emphasis on student achievement in mathematics. As a result, school administrators and teachers have begun a quest to find interventions to assist students, especially those at risk, in meeting the rigorous standards and passing the required standardized testing. This dissertation uses a causal-comparative research design to examine how using remedial math as an intervention affects at-risk students' standardized test math scores. Criterion Reference Competency Test (CRCT) scores of students in rural Georgia middle schools are used in this investigation. The study further examines math achievement in terms of gender for students enrolled in the remedial math intervention. This first chapter provides a background of the study, specifies the problem of the study, discusses the study's significance, presents an overview of the methodology, and defines terms important to the study.

Background of the Study

Since the publication *A Nation at Risk* proclaimed that "declines in educational performance are in large part the result of disturbing inadequacies in the way the educational process itself is often conducted," legislators have worked to produce laws to hold schools accountable for the education of the nation's youth (National Commission on Excellence in Education, 1983, Results, para. 1). In 2001, legislators passed Public Law 107-110, better known as the No Child Left Behind Act (NCLB). The goal of this law was to improve the educational system for all children by "closing the achievement gap and making sure all students, including those who are disadvantaged, achieve academic proficiency" (U.S. Department of Education, 2004, Stronger Accountability for Results section, para.1).

NCLB requires states to implement an accountability system to ensure that all students meet the same academic standards set forth by the state in each content area (NCLB, 2001). The standards are used as a guide for teachers to ensure all students learn the same content throughout the state. In order to determine if the students are learning these standards, students are required to take standardized tests (NCLB, 2001). These tests are created and administered by each state to align with the state's standards. NCLB (2001) imposes consequences for students and schools not meeting the state standards using standardized test scores.

No Child Left Behind imposes requirements on schools to use standardized tests as a measure to determine if schools make adequate yearly progress (AYP). AYP is determined by student achievement on standardized tests. If students perform poorly on standardized testing, then schools may fail to meet the Annual Measureable Objectives (AMO) set by the state. If a school fails to meet the AMO, then the school does not make AYP. Failure to make AYP changes the status of a school to the category "needs improvement." States post the list of needs improvement schools each year. Schools that remain on the needs improvement list are subject to state monitoring, which means the school will have frequent visits from a state-appointed consultant. The consultant will require the school to make changes, in an attempt to improve student achievement and test scores. Additionally, failing to make AYP for a school can also mean the school system must provide support services, such as instructional extension programs, and school choice for the students. If a student attends a school that has been labeled as needs improvement, parents may choose for their child to attend another school in the district that is not identified as needs improvement. The district is required to allow these students to attend the chosen school, and the district must provide transportation for them (Georgia Department of Education, 2010a).

Allowing school choice for those who attend a needs improvement school impacts the entire school system. Not only are there monetary costs, like those associated with providing transportation, but school choice may also change the population of the needs improvement school. Changes in population can make it more difficult for a school to achieve gains that are significant enough to make adequate yearly progress (AYP) and be free of the needs improvement status.

NCLB legislation, with the support of IDEA and parents, requires that all students in grades 3, 5, and 8 pass the reading, language arts, and mathematics portions of the required state test. Georgia uses the Criterion Referenced Competency Test (CRCT) to assess student knowledge of the standards in these areas. The tests are created to match the state's educational standards that the students learn at each grade level. These standards and corresponding tests are designed to create consistency in student learning throughout the state. Students are then given standardized tests to determine if the material presented in the classroom aligns with the standards, resulting in the desired outcome of knowledge. All students must meet the standards presented on these tests in reading, language arts, and math in order to be promoted to the next grade level in grades 3, 5, and 8. The standards are the same for all students (Georgia Department of Education, 2011) regardless of ability or gender.

In addition to NCLB's changes to education, legislators renewed the Individuals with Disabilities Education Act (IDEA) in 2004, with modifications to align IDEA with NCLB (U.S. Department of Education, 2007). While there were many modifications to IDEA, the requirement that performance goals and indicators for special education students be consistent with those of other students is the most significant. Therefore, all students must meet the same standards set forth by the state and measured through a standardized test. The result of NCLB and the changes to IDEA is accountability for all students. NCLB and the supporting IDEA have implemented required testing to provide evidence that students are meeting the state's content standards. Additionally, both laws require schools to provide research-driven support for students not meeting the required standards.

The requirements for all students to be taught the same standards and pass the same standardized test can be a daunting task given the range of abilities in classrooms. That range of abilities can seem overwhelming for teachers who are expected to teach special education students, regular education students, and gifted education students at the same time. Many may assume that the decision to create the same standards for all students was a mistake made by legislators when writing the NCLB act; however, in a study conducted by Malmgreen, McLaughlin, and Nolet (2005), data collected by the Educational Policy Reform Research Institute was analyzed to determine the effects of demographics on the performance on reading and math assessments in elementary and middle schools. The study found that a relationship exists between the performance of general education students and those in special education in both math and reading. The study was able to provide evidence that regardless of ability, if good teaching practices were used, students could meet the required standard. These results support NCLB's stipulation that standards be the same for special education students, students in honors programs, regular education students, and at-risk students.

Students who fail to meet the required objectives on standardized tests are part of the struggling student population that may be labeled as being at risk. In accordance with NCLB and IDEA, schools are required to provide interventions for these struggling students to assist them in obtaining equivalent achievement with their peers. In addition, research is demonstrating that certain interventions may make it possible to meet the requirements of NCLB and IDEA, especially in the area of math (Malmgreen, McLaughlin, & Nolet, 2005).

IDEA introduced the method known as Response to Intervention (RTI). RTI assists schools in providing and documenting research-driven support for struggling students as required by NCLB and IDEA. Response to intervention is a multi-tiered method that provides students with assistance necessary to meet their academic needs (Barnes & Harlacher, 2008). The RTI process was loosely designed, allowing states to develop their own RTI models. Many states, including Georgia, are requiring schools to use this process. In order to meet these requirements, schools are charged with implementing interventions to assist at-risk students. School administrators and teachers must look to research on available interventions to accomplish this task.

Armed with accurate information, administrators and teachers can provide interventions to assist these students in need of additional support, regardless of ability, using research-driven, effective strategies for instruction. Research is available on some interventions (Gersten et al., 2009). The first, and perhaps most obvious, intervention is the use of various teaching strategies. Effective teaching strategies can be useful interventions for many students. In mathematics, several strategies have been found to be effective. The most successful of the strategies appear to provide students with increased meaning and understanding (Lubienski, 2007). Strategies supported by research to increased meaning and understanding of mathematics are contextualized problem solving, anchored instruction, self-discovery, and representing (Bottge & Hasselburg, 1993; Bottge, Heinrichs, Mehta, & Hung, 2002; Hoffman & Brahier, 2008; Willamson, Bondy, Langley, & Mayne, 2009).

While effective teaching strategies may benefit some students, other students will need additional support. Interventions that provide additional support, such as tutoring and summer schools, have been examined. Research on tutoring programs is inconclusive, with some studies providing evidence of an improvement in skills (Baker, Rieg, & Clendaniel, 2006; Calhoon & Fuchs, 2003; Fuchs et al., 2005) and other studies revealed no significant differences in student achievement (Courtney et al., 2008; Zuelke & Nelson, 2001). Therefore, there is insufficient evidence to prove that the intervention is successful. Despite the negative results for tutoring programs, research on summer school programs provides promising results for increasing math achievement.

Results of research on summer school programs provide evidence of gains in student math achievement (Axtell, McCallum, Mee Bell, & Poncy, 2009; Cooper & Charlton, 2000). The promising results of research for summer school provide one possible intervention for those needing support beyond that of effective teaching strategies. However, the cost of these programs is prohibitive, and the retention of information and skills gained has been questioned (Cooper & Charlton, 2000). Remedial programs are another possible solution to successful math interventions that are not as cost prohibitive.

Remedial programs have been the focus of research for both post-secondary and secondary schools for many years. Remedial programs are interventions designed to assist students in areas where they are having difficulty mastering the required standards. Remedial programs can be used as an intervention to meet the requirements of RTI. However, much of the research on remedial education has been done on the post-secondary level and examines how remedial education impacts college graduation (Attawell, Lavin, Domina, & Levey, 2006; Bahr, 2007; Bahr, 2008). Evidence provided in these studies suggests that remediation is successful, showing that many of the students who pass their remedial courses also complete their academic program (Bahr, 2007; Bahr, 2008). The research on the remedial programs at the secondary level is not contents specific and limited to the focus of degree completion.

Remedial programs at the secondary level have typically been conducted outside of the normal school day, which may have resulted in the lack of available research. Many of the programs at the secondary level begin to narrow their focus to one subject. While the focus on individual subjects assists in providing evidence for subject-specific interventions, the research available on math remedial programs is limited. The few studies available do show that remediation is successful at increasing student achievement in mathematics (Bushweller, 1998; Fletcher, 1998; Mross, 2003). Remedial math programs can lead to the success of all students and can assist both schools and students in meeting the requirements of NCLB (Mross, 2003). However, in order to meet the requirements for research-driven programs, more research is needed on remedial education and its effects on students' standardized test scores.

Demographics related to math achievement also need to be considered to ensure all at-risk students benefit from the remedial math intervention. One of the demographics that will be considered in this study is gender. Research related to gender differences provides evidence that while no differences exist in math ability in the lower grades, disparities exist in upper grades, with boys outperforming girls (Din, Song, & Richardson, 2006; Georgiou, Stavrinides, & Kalavana, 2007; Liu & Wilson, 2009; Mau & Lynn, 2000; Rosselli, Ardila, Matute, & Inozemtseva, 2009; University of Wisconsin-Madision, 2009). Moreover, research that examines standardized test scores in math reveals significant differences in performance by gender (Lui & Wilson, 2009). It is also important to consider gender differences in learning styles when exploring interventions to meet the needs of all students. Many researchers point out that females need concrete instruction, whereas males can easily understand abstract concepts (Kommer, 2006; Sax, 2006). Research on interventions must address gender differences to ensure that the needs of both genders are addressed.

Problem Statement

Schools and students across America are struggling to meet the requirements imposed by the No Child Left Behind Act (NCLB). According to NCLB, schools need to make Adequate Yearly Progress (AYP). AYP is based on students’ standardized testing performance. Students’ grade level progression is also affected by the testing requirements imposed by NCLB. Georgia students must pass the math, reading, and language arts parts of standardized tests to be promoted to the next grade level in grades

3, 5, and 8. Students who receive a score of "Does Not Meet" on these standardized tests are labeled as being at risk. In order to meet the needs of these students, many schools are implementing interventions to increase math achievement and assist those at risk in gaining the necessary skills to meet the standards on standardized testing. Schools need to identify evidenced-based interventions, and research suggests that remediation may be an intervention that can support math achievement. Remediation is designed to give students extra instruction in the area(s) where they are having difficulty. While some research exists on remedial math programs, more research is needed (Bushweller, 1998; Fletcher, 1998; Hanley, 2005; Mross, 2003).

Gender differences are important to acknowledge when considering interventions for mathematics. Research indicates that the math ability of males exceeds the math ability of females in upper grades (Ai, 2002; Din et al., 2006; Georgiou et al., 2007; Liu & Wilson, 2009; Mau & Lynn, 2000; Rosselli et al., 2009; University of Wisconsin-Madison, 2009). Additional research on standardized testing in mathematics also reveals a male advantage (Liu & Wilson, 2009). Therefore, it is important to examine the impact of remedial instruction by gender to ensure that both male and female students benefit from the intervention.

Purpose Statement

The purpose of this causal comparative study is to test the theory that a remedial math course provided to at-risk students can significantly increase standardized test scores by comparing the remedial status of at-risk students and their scores on the 2010 Georgia math CRCT, while controlling for variation in ability using their 2009 Georgia CRCT math scores. In addition, the study tests the theory of gender differences in math achievement by comparing the gender of those who participated in remedial math and their scores on the 2010 Georgia math CRCT, while again controlling for variation in ability using their 2009 scores on the Georgia math CRCT. Remedial status will be defined as either participating in remedial math instruction or not participating in remedial math instruction.

Research Questions

Research questions for the present study are the following:

1. While using sixth-grade test scores as a control variable for previous math achievement, do at-risk seventh-grade students who receive remedial math instruction have statistically significant different mean scores on the 2010 Georgia mathematics CRCT when compared to at-risk students who do not receive remedial math instruction?
2. While using sixth-grade test scores as a control variable for previous math achievement, is there a difference in the mean scores on the 2010 Georgia mathematics CRCT of at-risk seventh-grade students who receive remedial math instruction based on gender?

Research Hypotheses

The research hypotheses are the following:

H1: While using sixth-grade test scores as a control variable, at-risk seventh grade students who receive remedial math instruction will have statistically significant different mean scores on the 2010 Georgia mathematics CRCT when compared to at-risk students who do not receive this intervention.

H2: While using sixth-grade test scores as a control variable, there will be a statistically significant difference in mean scores on the 2010 Georgia mathematics CRCT of at-risk seventh-grade students who receive remedial math based on gender.

Null Hypotheses

The null hypotheses are:

H1: While using sixth-grade test scores as a control variable, at-risk seventh-grade students who receive remedial math instruction will not have a statistically significant difference in mean scores on the 2010 Georgia mathematics CRCT when compared to at-risk students who do not receive math remediation.

H2: While using sixth-grade test scores as a control variable, there will not be a statistically significant difference in mean scores on the 2010 Georgia mathematics CRCT of at-risk seventh-grade students who receive remedial math based on gender.

Professional Significance of the Study

The many facets of NCLB are a concern for national, state, and local school personnel. The law's emphasis on student achievement through use of standardized testing holds all stakeholders accountable. Students must be able to pass the math, reading, and language arts portions of the test in order to be promoted to the next grade level. In addition, student scores control the labeling of schools as *needs improvement* and thus, can lead to repercussions for school administrators and teachers.

Not only are schools struggling to meet the requirements of NCLB, but schools must also incorporate response to intervention (RTI) as imposed by the Individuals with Disabilities Education Act (IDEA). Georgia's RTI policy requires schools to assist students that are at-risk, such as those not passing standardized testing, to receive some type of intervention (Georgia Department of Education, 2008). The interventions that are implemented by schools must be research based (U.S. Department of Education, 2004). Therefore, the implications of this study on how remedial math can impact student performance on standardized tests are abundant.

The findings of this study may be used by school systems to assist in making effective decisions about mathematics interventions. The study can assist teacher attitudes and perceptions of interventions, and in their understanding of how interventions can assist students with learning difficulties. Findings may provide school administrators and teachers with insight into professional development opportunities.

The untried nature of the RTI process in Georgia, coupled with the requirements of NCLB, can leave educators feeling frustrated and searching for solutions. The results from this study will provide educators an opportunity to examine one intervention in mathematics that can be used in the RTI process.

Overview of the Methodology

All Georgia students in grades 2 through 8 are administered the Criterion Referenced Competency Test each spring. The research sample of 293 at-risk seventh graders identified in this study was selected from three middle schools in northeastern Georgia. The students were selected based on their 2009 mathematics CRCT score. For students to be at risk, as identified by this study, they would have scored less than 810 on the 2009 mathematics CRCT. Students were divided into two groups--students taking a remedial math class and students not taking a remedial math class during the 2009-2010 school year.

Using the CRCT scores for both groups, an ANCOVA test was conducted, with the 2010 CRCT scores serving as the dependent variable, status of remediation (taking remedial math, not taking remedial math) serving as the independent variable, and the 2009 CRCT scores serving as the covariate. Prior to completing the ANCOVA, assumptions were tested using summary statistics, Levene's test for homogeneity of variances, scatter plots, and the checking of significance levels for an interaction between the treatment and the covariate. With no assumptions violated, the ANCOVA test was completed, comparing the differences between 2010 scores of those students who did take remedial math and those who did not take remedial math.

An additional ANCOVA examined the CRCT scores for the remedial group by gender. The 2010 CRCT scores served as the dependent variable, gender served as the independent variable, and the 2009 CRCT scores served as the covariate for this analysis. Assumption testing was conducted and no assumptions were found to be violated. All analyses were completed using SPSS.

Definitions

Criterion-Referenced Competency Test (CRCT)--Statewide assessment used in Georgia to assess each student's performance and acquisition of knowledge and skills described in the Georgia Performance Standards (GPS) (Georgia Department of Education, 2009a).

No Child Left Behind Act (NCLB)--Descriptive name for Public Law 107-110.

Performance levels--The three levels used to measure student performance on the CRCT. Levels are defined as: Three (3) Exceeds Expectations, Two (2) Meets Expectations, and One (1) Does Not Meet Expectations (Georgia Department of Education, 2009a).

Remedial math–An additional math course offered during the school day in which students receive assistance with math. Students are remediated on concepts missed in earlier grades. Examples may include basic fact recall, working with whole numbers and fractions, and decimals. Additionally, remedial math provides support for the current curriculum.

Response to Intervention (RTI)–An “early detection, prevention, and support system that identifies struggling students and assists them before they fall behind” (U.S. Department of Education, 2009b, p. 4).

Standards–The criteria set forth by each state to determine the material taught in each grade level.

Georgia Performance Standards (GPS)–Standards established by the state of Georgia to “provide clear expectations for instruction, assessment, and student work” (Georgia Department of Education, 2011).

Summary

The No Child Left Behind Act (NCLB) has placed education’s spotlight on standardized testing. Students are expected to meet the standards set forth by each state in reading, language arts, and mathematics in order to be promoted to the next grade level in grades 3, 5, and 8 (U.S. Department of Education, 2004). Additionally, changes to the Individuals with Disabilities Education Act (IDEA) has charged schools with implementing response to intervention to meet the needs of those struggling to meet the standards. The requirements of these laws have forced school administrators and teachers to look for appropriate interventions that can successfully assist at-risk students in meeting standards. Mathematics is one area where research is needed to aid in the hunt for successful interventions. This study examines remedial math as a possible intervention for at-risk math students. The following chapter examines literature related to this study, including details of the legislation and research on math interventions.

Chapter 3 reviews the methodology used in this study. The data analysis and findings are discussed in chapter 4, with the last section, chapter 5, containing recommendations for practice and future research.

CHAPTER TWO: LITERATURE REVIEW

Literature related to remedial education was reviewed to ascertain information and previous research available on the impact of remediation on test scores. The review of literature is divided into five sections. The first section discusses current legislation and its impact on schools and students. The second section explores response to intervention (RTI). The legislation and intervention components offer valuable input into educational decisions. The third section examines research on math interventions. The fourth section highlights the theoretical background for remedial education and the available research on remedial education in mathematics. The fifth section discusses research on gender difference in mathematics to better understand how gender differences may have an effect on interventions. Finally, the sixth section summarizes the findings of the literature review.

Legislation

The improvement of our educational system has been a focus of U.S. presidents and policy makers for many years. In an effort to improve education, laws have been passed to protect special populations and, more recently, to hold schools accountable for student success. In 2001, legislators passed Public Law 107-110, better known as the No Child Left Behind (NCLB) Act. Based on four pillars--stronger accountability for results, more freedom for states and communities, proven education methods, and more choices for parents--this legislation was set forth to improve the education of the children in the United States.

Stronger accountability for more results. The first pillar of the NCLB act requires states to work to close gaps in achievement to ensure all students meet academic proficiency. States were mandated to create standards to guide instruction for each grade level. Additionally, states were required to develop standardized testing to measure student progress toward meeting the standards. The standardized test scores are used to create the annual state and local school district report cards required by NCLB, which indicate the Adequate Yearly Progress (AYP) of states, districts, and schools. Standardized test scores are also used to determine student promotion (U.S. Department of Education, 2004).

State, local, and school report cards are published to inform parents and communities about state and school progress. These reports contain information about the schools' population, including a breakdown of population by ethnic group, economic status (economically disadvantaged receiving free or reduced lunch), and special education status (students with disabilities and limited English proficiency); attendance rates; and student performance on standardized testing. The report also provides the Adequate Yearly Progress (AYP) for each state, district, and school. In order to make AYP, schools must have 95% of students in each subgroup participate in standardized testing; meet or exceed the state's annual measurable objective (AMO) for proficiency in reading, language arts, and math on the standardized test; and meet the state's AMO for another academic indicator, such as attendance. Schools that do not make progress are required by NCLB to provide supplemental services to students free of charge. Schools that continue not to make AYP for a period of 5 years must make drastic changes to the way the school is run (U.S. Department of Education, 2004).

No Child Left Behind (NCLB) requires improvement for schools that fail to make adequate yearly progress (AYP). The law provides sanctions against schools failing to make AYP. The first year a school fails to make AYP, no action is taken; however, the second year a school fails to make AYP, the school is labeled *needs improvement* and must develop a plan to improve student performance. The second consecutive year of failing to make AYP also allows the parents to have school choice. School choice allows the parents to choose if they want their child to attend another public school in the district that is not classified as needs improvement. If a school fails to make AYP for three consecutive years, the school must continue to provide plans for improvement and school choice in addition to providing supplemental educational services. The supplemental educational services may be in the form of before- or after-school programs. After the fourth consecutive year of failing to make AYP, the school is subject to corrective action.

In addition to the requirements of the previous years, corrective action requires the state/district to choose at least one of the following actions: replace staff in failure area, implement new curriculum, decrease the authority of school management, appoint outside experts to consult, extend the school year/day, or restructure the internal school organization. The fifth consecutive year a school fails to make AYP, the school must continue school choice and supplemental services and prepare a restructure plan. If the school fails to make AYP for 6 consecutive years, the school must implement the restructure plan and implement one of the governance arrangements (reopen as a charter school, replace all or most of the staff, enter into a contract with a private entity with proven effectiveness at school operations, have the state take over the school, or impose a major restructuring of school governance) (American Speech-Language-Hearing Association, n.d.).

Failure to make AYP impacts the entire school community. When schools fail to make AYP and are labeled as needs improvement, the perceived image of the school is damaged. The needs improvement label suggests that the school administrators and teachers are not performing their jobs as expected and that students are not receiving a quality education. These perceptions, while often incorrect, impact all stakeholders and have the potential to change the school climate.

Other consequences of failure to make AYP also have an impact on the school staff, parents, and students. The school's administrators and teachers face the consequences of corrective action, which in the last stages may result in job loss. Parents and students must also deal with the changes to education services, student population (through school choice), and changes in school staff.

Not only do parents and students have to adjust to the school's consequences, they also have to be concerned about NCLB's requirements for students. In addition to NCLB's requirements for states, districts, and schools, standardized test scores determine the promotion of students in grades 3, 5, and 8. While requirements are set to become more stringent over time, currently the students in grades 3, 5, and 8 must pass only the reading, language arts, and math portions to be promoted to the next grade level (U.S. Department of Education, 2004).

More freedom for states and communities. The second pillar of the NCLB act allows state and local school systems more flexibility. While still subject to the accountability defined by NCLB, the law also provides states the opportunity to define many of the elements imposed by the law. States are allowed to define terms such as full academic year and ethnic subgroups. States are also allowed to set the minimum group size for accountability, provide alternative assessment and accommodations for special needs students, and choose the format of required report cards. NCLB also provides states and school districts unprecedented flexibility with the use of federal funds. School districts may use up to 50% of federal formula grant funds to help with their particular needs (U.S. Department of Education, 2004).

The flexibility of federal funds allowed by NCLB requires states, districts, and schools to determine and prioritize school needs. The flexibility of the funding can provide assistance in meeting the requirements of NCLB. Possible uses for these funds include research-driven education programs and teaching methods, which are required as part of the third pillar of NCLB.

Proven education methods. The third pillar of NCLB emphasizes use of research-driven educational programs and teaching methods. Research-driven material is supported by having federal funds target the programs and teaching methods that are proven, through rigorous scientific research, to improve student learning and achievement. NCLB requires schools that do not make Adequate Yearly Progress to provide supplemental assistance to students free of charge, which encourages use of these proven education methods (U.S. Department of Education, 2004).

The third pillar of NCLB requires educational programs and teaching methods that assist schools in developing academic rigor. In order to achieve this expectation, research that assists schools in meeting the needs of students is required.

More choices for parents. The last pillar of NCLB provides parents with new options for the education of their children. Parents have the option of transferring their children to better-performing schools within their school district if the school the child attends is a needs improvement school. Needs improvement schools are schools that do not make AYP for at least 2 consecutive years. The school system must provide transportation to these children. Additionally, the school must provide supplemental services to students still attending the needs improvement schools after 3 years of not making AYP consecutively. Parents are also given the option to have their child attend another school within their district if they attend a persistently dangerous school or their child is a victim of a violent crime at school (U.S. Department of Education, 2004).

No Child Left Behind legislation continues to make a mark on education. The requirements for schools to make AYP and students to pass standardized tests guide schools to focus on academic rigor, while the flexibility to use federal funds to meet the needs of the school and its stakeholders provides an avenue for schools to implement research-driven programs and teaching methods. These requirements stress the importance of academic achievement for all students and implementation of evidence-based interventions to improve and maintain student achievement.

The changes to education have a direct effect on parents, students, schools, and other legislation concerning education. One example of NCLB's influence on legislation is the changes to the Individuals with Disabilities Education Act (IDEA). In 2004, IDEA was reauthorized and modified to align with NCLB. While many alignments were made, including the use of highly qualified teachers and research-driven instruction, the main focus of both laws is on reducing achievement gaps and preventing learning problems by providing early interventions to struggling learners (Hanley, 2005).

Response to Intervention (RTI)

IDEA legislation introduced response to intervention (RTI) and invited "schools to use 15% of their special education money for regular education interventions" (Johnston, 2010, p. 602). Response to intervention (RTI) is "a multi-tiered method of service delivery in which all students are provided an appropriate level of evidence-based instruction based on their academic needs" (Barnes & Harlacher, 2008, p. 417). RTI is either required or permitted in all states. In Georgia, RTI is required, and schools are challenged to carry out the requirements of this law (Georgia Department of Education, 2008).

The state of Georgia uses a Four-Tier RTI model designed to provide evidence-based instruction and intervention based on student needs. Georgia's RTI model (Figure 1) presents layers of instructional efforts that provide assistance to students based on the student's individual needs. This framework, designed to provide intensifying support to those students with learning difficulties, must be implemented in all Georgia public schools. Individual school districts and schools are responsible for implementing the Tiers with interventions they feel are appropriate for each stage (Georgia Department of Education, 2008).

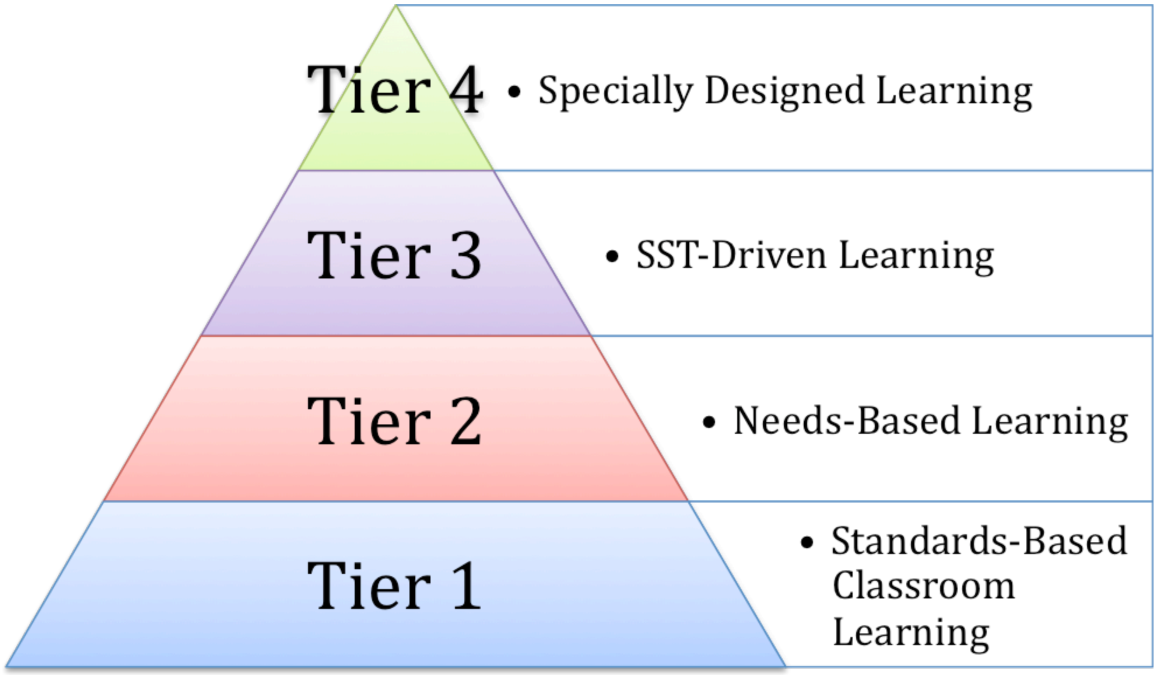

Figure 1. Tiers of Intervention for Georgia's RTI model. Adapted with permission from "Response to Intervention: The Georgia Student Achievement Pyramid of Interventions," by Georgia Department of Education, 2008, *Response to Intervention,* retrieved from http://www.doe.k12.ga.us/ci_services.aspx?PageReq=CIServRTI.

All students participate in Tier 1, Standards-Based Classroom Learning. These students are taught materials outlined by the Georgia Performance Standards (GPS). Universal screenings and multiple assessments are used to monitor student progress and target specific instructional needs. Students identified as struggling or unable to perform at expected levels in Tier 1 are moved to Tier 2 on the intervention pyramid (Georgia Department of Education, 2008).

Tier 2 students are identified as needing a standard intervention to supplement the Tier 1 classroom. Tier 2 instruction may be viewed as a "double dose" in which students receive additional instruction, remediation, or acceleration. The students in Tier 2 receive the needed intervention and are monitored to measure for their response. "Student responses to intervention are measured to determine whether they have made adequate progress and (1) no longer need intervention, (2) continue to need some intervention, or (3) need more intensive intervention" (Gersten et al., 2009, p. 4). The data provided through the progress monitoring of each individual student response is used to determine if the intervention (Tier 2) was successful. Depending on the results of the data, the student may be released back to Tier 1, continue with the needed intervention in Tier 2, or receive Tier 3 level support, in addition to Tier 1 and Tier 2. (Georgia Department of Education, 2008)

Students participating in Tier 3, Student Support Team (SST)-Driven Learning, receive interventions targeted to their individual learning needs. At this level of intervention, information is gathered about the student's performance strengths and weaknesses in addition to individualized assessments. The data gathered is used to develop more in-depth and intense interventions. Tier 3 students who are successful with the interventions provided may stay in Tier 3 or move back down the tiers to the appropriate level. If the students are not successful, as supported by the collected data and after the best efforts at remediation are provided, the student receives a referral for a Special Education comprehensive evaluation. Once the evaluation is complete, students who meet the requirements are moved to Tier 4 (Georgia Department of Education, 2008).

Last, Tier 4 is specially designed learning. Once a student reaches Tier 4, it has been determined that the student is in need of special program placement, such as gifted education or special education. In these special programs students receive specialized instruction to meet their learning needs (Georgia Department of Education, 2008).

While RTI is encouraged through NCLB, recommended by IDEA, and required by the state of Georgia, educators are just beginning to learn how to apply the model to mathematics education. Educators agree that, for students struggling in mathematics, the RTI approach is challenging because the research base is much thinner (Samuels, 2009). All students having learning difficulty, as measured by the "Does Not Meet" standards on standardized tests, must move to Tier 2 in Georgia's RTI model and receive support through an intervention. With educators only beginning to understand the RTI process, research is needed that focuses on Tier 2 interventions.

Math Interventions

The RTI process requires all students that are identified as struggling at Tier 1--those unable to perform at expected levels to meet standards--to be placed in Tier 2 of the pyramid of interventions. This would include all students having difficulty as measured by a "Does Not Meet" standards score on standardized testing. Students that are placed in Tier 2 need a standard intervention to supplement the Tier 1 classroom (Georgia Department of Education, 2008). The Tier 2 interventions may be as simple as use of unique teaching strategies, tutoring, or utilization of summer school programs.

Teaching strategies. Modifying teaching strategies can be one simple way to implement an intervention for a student on Tier 2 of the pyramid of interventions. Lubienski (2007) suggested that teachers use strategies that increase meaning and understanding. Much of the available research on strategies for teaching mathematics supports Lubienki's suggestion and provides evidence that students learn best when presented with concrete, reality-based instruction.

Using a form of contextualized problem solving, such as anchored instruction, to provide concrete, reality-based instruction has provided positive results in student math achievement (Bottge, 1999; Bottge et al, 2001; Bottge et al., 2002; Bottge et al, 2004; Bottge, Grant, Stephens, & Rueda, 2010; Bottge, Rueda, Serlin, Hung, & Kwon, 2007; Bottge, Rueda, & Skivington, 2006; Hoffman & Brahier, 2008; Kurz & Batarelo, 2005; Mulcahy & Krezmien, 2009). These strategies provide students with the opportunity to use prior knowledge to solve meaningful problems. Kurz and Batarelo (2005) stated that, "The primary goal of anchored instruction is to create shared environments that permit examination by students and teachers and enable them to understand the kinds of problems and opportunities that can be found in real life" (p. 422). Research supports the anchored instruction goal statement, providing evidence that linking math problems to real life situations assists students by connecting knowledge to future application (Bottge et al., 2001). Using anchored instruction, a form of contextualized problem solving, to teach math not only allows students to learn through discovery by drawing on their past knowledge, but also helps provide students the confidence they need to solve sophisticated math problems. Through meaningful contextualized instruction, "students become confident in their ability to tackle difficult problems, eager to figure things out own their own, flexible in exploring mathematical ideas and trying alternative paths, and willing to persevere" (National Council for Teachers of Mathematics, 2000, p. 21).

Student development of confidence and willingness to persevere when using contextualized instruction has been supported through research by Hoffman and Brahier

(2008). Hoffman and Brahier, after their research on the differences in Japanese and American instruction, suggested teachers provide opportunities for discovery and allow students to work through frustrations in an effort to increase learning. They found that in Japan the teachers focus more on discovery and embrace student frustration, whereas in the United States, teachers focus on procedures and student self-esteem. With Japanese students outperforming American students, Hoffman and Brahier concluded that the difference in performance was due to the use of the problem-solving approach (Hoffman & Brahier, 2008).

Teachers do not have to sacrifice great teaching pedagogy to achieve on high-stakes tests (Williamson et al., 2009). "Students can learn sophisticated concepts when instructional methods and materials are motivating and appropriate" (Bottge et al., 2006, p. 405). Research has provided evidence that contextualized problem solving can be a teaching strategy that is successful for increasing student achievement and motivation. Using problem-based learning as a teaching strategy can be useful as a Tier 2 intervention; however, one intervention may not be the answer for all students. Additionally, using a teaching strategy as an intervention would be difficult to document. The teacher would need to record how it is different or how it augments other instructional practices in the classroom. Teaching strategies are cost effective; however, with the time required to document and differentiate instruction, the most practical use may be as a Tier 1 intervention. Therefore, other interventions must be explored.

Tutoring. Tutoring can be defined as informal support designed to assist an individual in areas of concern (Heller & Fantuzzo, 1993; Menesses & Gresham, 2009; Read, n.d.). Tutoring occurs when an individual or a small group seeks assistance from another person (tutor) (Read, n.d.). Tutoring can take many forms. Traditionally, someone seen as having greater knowledge, like an older community member or college student, serves as the tutor; whereas with peer tutoring, another student, sometimes in the same grade or same class, serves as the tutor. Peer tutoring can be either reciprocal, where the students support each other, or non-reciprocal, where one student plays the role of the tutor (Heller & Fantuzza, 1993; Menesses & Gresham, 2009). Traditional tutoring and peer tutoring can be used as an intervention in Tier 2 of the pyramid of interventions.

The results of research on traditional tutoring, using community members or college students, is inconclusive. When measuring student achievement, researchers discover little to no change in scores (Courtney et al., 2008; Zuelke & Nelson, 2001). However, some research on the results of traditional tutoring points to increased skill and motivation (Baker et al., 2006; Calhoon & Fuchs, 2003; Fuchs et al., 2005). Regardless of the results of the research on traditional tutoring, researchers are quick to point out the difficulty of managing tutoring programs (Baker et al., 2006; Courtney et al., 2008; Zuelke & Nelson, 2001).

Traditional tutoring programs must have a person willing to manage the program. These program managers are responsible for scheduling, recruiting, and retaining tutors to make the tutoring program successful (Baker et al., 2006). Since this type of community-based tutoring is often volunteer work, it is difficult to recruit someone to manage the program. In addition to the difficulties of managing a tutoring program, it is also difficult to recruit and keep volunteers (Baker et al., 2006). Tutoring programs using community members and college students are not possible without volunteers. The ability to retain the volunteers is also critical to the viability of the program. Volunteers must be able to develop a relationship with the tutees to gain the students' trust and learn their strengths and weaknesses.

Not only are traditional tutoring programs difficult to manage, but these programs can also be difficult due to the disconnect between the classroom teacher and the tutor. Zuelke and Nelson (2001) pointed out that the communication between teacher and tutor is critical to assist the student in needs areas. If tutors are not able to provide assistance to these students in their needs areas due to lack of communication with teachers, this form of tutoring could not be used as an intervention.

While tutoring programs may be useful as a Tier 2 intervention, the research presented on traditional tutoring does not support tutoring as a successful means to assist students in increasing levels of achievement. The difficulties of traditional tutoring, management, and communication with the school may be one reason for its lack of success. Peer tutoring, unlike traditional tutoring, is often managed by the school or classroom teacher where a real connection to the classroom is present. As stated by Zuelke and Nelson (2001), the connection to the classroom is important not only for management, but also for communication. The connection of peer tutors and tutees to the classroom allows for focus on areas of concern. Research has provided evidence that students can improve academic performance and attitude toward math using peer tutoring (Allsopp, 1997; Calhoon & Fuchs, 2003; Heller & Fantuzzo, 1993; Menesses & Gresham, 2009; Topping et al., 2011). Peer tutoring can be reciprocal, where students with the same academic abilities tutor each other, or non- reciprocal, where a student demonstrating mastery of a topic is paired with a student having difficulty with the topic. While research on both peer tutoring techniques shows positive results, reciprocal tutoring appears to be the most effective (Menesses & Gresham, 2009).

Menesses and Gresham (2009) are quick to point out the advantages of peer tutoring, stating that, "a substantial advantage of peer tutoring is the decreased amount of teacher responsibility in implementing an intervention" (p. 266). However, teachers must still provide structure and guidance during peer tutoring. Additionally, teachers must provide a time for tutoring to occur during the school day.

While traditional tutoring fails to meet the requirements of evidence-based intervention, peer tutoring seems to be one possible intervention that could be considered by schools for students on Tier 2 of the pyramid of interventions. Most research supports peer tutoring as a means of improving student performance (Allsopp, 1997; Calhoon & Fuchs, 2003; Heller & Fantuzzo, 1993; Menesses & Gresham, 2009; Topping et al., 2011); however, Allsopp (1997) reported that peer tutoring is not more effective than independent practice. Additionally, the time taken out of the regular education classroom is a concern (Allsopp, 1997; Heller & Fantuzzo, 1993; Menesses & Gresham, 2009; Zuelke & Nelson, 2001). Teachers must teach the standards required by the state. Teaching these standards in the required time period can be difficult, making time a valuable commodity. Despite the research supporting peer tutoring as an effective means for assisting students, the class time required is an issue of concern; consequently, other interventions must be explored.

Summer school. Another possible intervention that does not take time away from the regular school day is summer school. Summer schools can be provided for both acceleration and remediation. The purpose of the remedial summer school is to provide students with access to support so that grade level expectations are attainable. Since the passing of No Child Left Behind (NCLB), many states require students who do not pass high-stakes testing in grades where it affects promotion--which would move the student from Tier 1 to Tier 2 in the RTI process--to attend summer school. At the end of the summer school session, students are given the opportunity to retake the standardized test in hopes of being promoted.

With the passing of NCLB in 2001, news articles began to appear in many newspapers and education related magazines about the effectiveness of summer school programs. Articles claimed a range of results, from seeing improvement in only a little over half the students attending summer school (David, 2005), to improvements in over 90% of students that attended summer school (Abby, 2003). Though many articles have made claims, the conclusions are mixed as to whether summer school is successful.

A few scholarly research studies have examined the effectiveness of summer school. These studies have found summer school to be effective (Axtel et al., 2009; Cooper & Charlton, 2000). While results discussed in many articles simply state the percentage of students able to meet the requirements of standardized tests after attending summer school, scholarly studies have compared groups attending summer school with others failing to meet standards but not able to attend the program. Using these group comparisons, the gains made by students that attended summer school were statistically significant when compared to the control group (Axtel et al., 2009; Cooper & Charlton, 2000).

While school systems appear to be using summer school as a first resort for those failing to meet the requirements of standardized testing, long-term retention of material and cost are factors to consider. Studies on the long-term effects of summer school on student achievement are needed (Cooper & Charlton, 2000). Cooper and Charlton (2000) warn that the results from the summer school study they completed, while positive, may not be permanent. Additionally, summer school can be expensive in terms of transportation, staff, and utilities. Keeping these points in mind, one must consider that "summer remedial programs have no less of an effect on achievement than programs with similar goals conducted over the course of an entire school year" (Cooper & Charlton, 2000, p.99).

The sanctions imposed by NCLB and the required implementation of RTI forces schools to look for research-driven interventions to assist students not meeting the required standards. Research-driven teaching strategies, tutoring, and summer school programs are all viable Tier 2 interventions; however, time requirements and cost may be a reason for schools to look at additional Tier 2 interventions to assist struggling students. Remedial programs, which could serve as a Tier 2 intervention, are a resource that schools can use to address student discrepancies.

Remedial Courses

A possible intervention to consider for meeting the requirements of No Child Left Behind (NCLB) and response to intervention (RTI) is use of a remedial program. A remedial program is "an instructional program designed for students in grades 6-12 who have identified deficiencies in reading, writing, and math" (Georgia Department of Education, 2010b, p. 3). According to the Georgia Department of Education's remedial education program guidelines, middle school students are eligible to participate in remedial programs if the most recent Criterion Referenced Competency Test (CRCT) scores indicate the student has a score in the "Does Not Meet" standards in reading, English/language arts, or math (Georgia Department of Education, 2008). The guidelines also indicate middle schools may provide remedial services during the school year as a pullout or an extension class or during a connections block (Georgia Department of Education, 2010b).

Theoretical background. Behaviorism is the theory upon which remedial education is based. Behaviorists believe that behavior can be described and explained without connection to mental events or psychological process (Skinner, 1974). B. F. Skinner developed the behaviorist theory in the 1930s. This theory is based on three constructs: learning strategies, external feedback, and behavioral change.

Skinner's work on schedules of reinforcement is perhaps the most recognizable research on behaviorism. His work demonstrates the belief that behavior is learned and reinforced by our external environment. Skinner's work on the schedule of reinforcement can be linked to remediation. Remediation operates on the assumption that the environment, not the mind, is at fault for the missed concepts. Thus, the remediation is used to reinforce material previously taught in the classroom but that students were unable to grasp. Skinner (1974) emphasized that, "Imitation and modeling play important roles in transmitting the results of exceptional contingencies of reinforcement" (p. 221). Through participation in remedial math courses, students experience additional modeling of math problems. Thus, remediation operates on the assumption, like the behaviorist theory, that this reinforcement will stimulate a change in student performance.

Behaviorism is evident in the remedial classroom through the use of modeling techniques and practice to master the concept. As in the typical behaviorist environment, remedial teachers model the expected performance, allow students time to practice, and correct students when the performance is not as expected. Once student performance meets expectations, students are often rewarded by dismissal from the remedial program.

History of remediation. Colleges and universities have provided remediation to students for many years. Student scores on entrance exams and/or standardized testing, such as the ACT and SAT, are used to determine if students will be required to take remedial courses in reading, writing, and mathematics. According to a study published in 2000 by the U.S. Department of Education, 22% of entering college freshmen were enrolled in a remedial math course (Wirt et al., 2004).

While remedial courses, specifically math courses, have been prevalent in the post-secondary environment, remediation of secondary school children has not routinely been offered as a course during the school day. However, the introduction of NCLB, changes to IDEA, and the onset of response to intervention (RTI) have begun to change the delivery of remediation to students.   Schools are required to provide struggling students with support using the RTI model. Students who are not successful in the classroom or do not meet the standards on standardized tests are moved from Tier 1 on the RTI model to Tier 2. Tier 2 students must receive additional support. Remediation can be considered as a Tier 2 intervention.

Challenges of remediation. Studies completed on the effectiveness of remedial courses have provided insight on some challenges. Research on post-secondary remediation reveals that students who are required to take one or more remedial mathematics courses are more likely to change their course of study or not finish their college program (Attawell, 2006; Bahr, 2007). Considering this information, one might assume attrition is an issue for students in remedial programs. However, the research reports that, of the students who took remedial courses, most passed the courses successfully and usually finished their first year of college (Attawell, 2006). The research findings are contradictory. It can be determined through these findings that these students were successful at completing the remedial course but not successful at completing a post-secondary course of study. Therefore, it cannot be determined that remediation is part of the problem; however, one can determine that with 22% of college freshmen needing math remediation (Wirt et al., 2004), remedial courses are needed in the secondary school setting (Esch, 2009; Schachter, 2008). The research examined did not reveal any findings for secondary schools to deal with attrition or high school drop-out rates.

Providing a curriculum that challenges and motivates students is another difficult task for remedial education (Bahr, 2007; Bahr, 2008; Patrick, n.d.). Remedial instruction must be more than simply repeating instruction (Patrick, n.d.). Repeating the same instruction that the students did not understand the first time will not assist students in gaining the needed concepts. Students must be taught using engaging curriculum. Bahr (2007, 2008) has found that the depth and breadth of the curriculum can affect student success. "Depth of remedial need refers to degree of deficiency in a given subject, while breadth of remedial need refers to the number of basic skill areas in which a given student requires remedial assistance: (Bahr, 2007, p. 698). The challenge of creating a curriculum that is engaging and at the correct depth and breadth for a class of individual students is difficult. Gersten et al. (2009) provide some guidance for remedial math instruction, which includes explicit and systematic instruction, opportunities for students to work with visual representations of math, and devotion of at least 10 minutes per class to building fluent retrieval of basic math facts.

Building and teaching an engaging curriculum that fits the needs of individual students are the most difficult challenge for secondary educators. This challenge alone can be discouraging. However, with the requirements of NCLB and RTI, educators must consider the benefits of remediation.

Benefits of remediation. While teaching remedial math courses can be a challenge for educators, remediation has been shown to improve the math performance of students in secondary schools (Bottge et al. 2001; Bushweller, 1998; Fletcher, 1998; Mross, 2003; Schultz, 1991). Research completed by Bottge et al. (2001) and Fletcher (1998) revealed that middle school students taking remedial math courses were able to improve their grades in mathematics after remediation. Secondary education students participating in the research completed by Fletcher (1998) were said to go from failure to honor roll. Students in these remedial programs gained organizational skills and increased understanding. While it is clear that the math grades of students increased as a result of remediation, researchers have failed to investigate the impact of remedial instruction on standardized testing.

A limited number research studies on secondary remedial math courses examine standardized test scores. These studies reveal significant improvement on standardized test scores after the completion of a remedial math course (Mross, 2003; Schultz, 1991). In the age of NCLB and RTI, standardized test improvement is extremely important for students and school systems. Improving standardized test scores can assist students in grade level promotion and schools in making adequate yearly progress (AYP). However, despite positive results, the studies are limited and dated. More research is needed before concluding that remedial math courses can assist students in increasing their standardized test scores.

While the requirements of NCLB are important, the academic gains that students can achieve with the assistance of remedial courses is most important and can impact the students' academic careers. Bushweller (1998), through use of this AVID remedial program in secondary schools, was able to find that “94 percent of AVID graduates enrolled in two-year or four-year colleges; 89 percent of those students were still in college two years later” (p. 2). Armed with this data, one must consider the suggestion of Esch (2009) and Schachter (2008) that the source of the problem for college math remediation is middle and/or high school. As a solution, research on post-secondary remedial courses suggests consideration of remediation in high school and middle school (Esch, 2009; Schachter 2008).

While the benefits of remedial math seem to outweigh the challenges, NCLB and RTI specify that strategies used to assist students be research based. In spite of the research that has been completed, the availability of research on remediation’s role in achievement in secondary schools is dated, limited, and insufficient. Further, researchers are calling for more research on mathematics because existing research is outdated or minimal (Foegon, 2008; Gersten et al., 2009). Gersten et al. (2009) supported the need for additional research, stating, “little research has been conducted to identify the most effective ways to initiate and implement RTI frameworks for mathematics” (p. 4). Additional research on remedial courses is needed to provide schools with the necessary data and information to determine if remediation can be successfully used as a Tier 2 intervention to assist at-risk students. More research is also needed on the impact of remedial math courses on standardized test scores.

Gender Differences in Math

When considering interventions for students, schools must look at gender to determine if a discrepancy exists. Research on gender differences in math has historically shown that boys outperform girls on mathematic assessments; however, current research reveals disparities occur in the upper grades, with the lower grade-level students showing little to no difference in mathematics ability (Ai, 2002; Din et al., 2006; Georgiou et al., 2007; Liu & Wilson, 2009; Mau & Lynn, 2000; Rosselli et al., 2009; University of Wisconsin-Madison, 2009). Research on the differences in male and female math ability is not clear as to which grade level the inequality of math ability begins to occur. Liu and Wilson (2009) showed differences at age 15, while Mau and Lynn (2000) reported differences in 10th through 12th grades. More research is needed to determine at exactly what age significant differences in ability begin to occur.

While much of the research on math ability related to gender supports equality between the sexes until the upper grades, research on standardized testing in mathematics shows significant differences in performance by gender (Liu & Wilson, 2009). Liu and Wilson (2009) reported that differences in standardized test scores between male and female students revealed a male advantage that was small but consistent. Other researchers have disputed these claims, finding that over time, growth trends on standardized tests were the same for both males and females (Din et al., 2006; Rosselli et al., 2009).

In order to make learning effective for both genders, teachers must consider the needs of both genders (Kommer, 2006). Teachers of remedial courses must use methods that are effective for both genders by learning to balance techniques preferred by males with techniques preferred by females. Research has provided information concerning preferred learning styles. This research reveals that since most females are left-brain dominant, they learn best with concrete concepts; whereas, males are right-brain dominant and learn easily from abstract concepts (Kommer, 2006; Sax, 2006). Additional research has pointed to social conditioning and textbook bias as a reason for gender discrepancies in math (Shaffer & Shevitz, 2001; Tsui, 2007). In order for remediation to be an effective intervention, teachers of these courses must be aware of the differences in learning preference and bias that are related to gender.

Research on gender differences is unclear. A study by Ai in 2002 claimed that low performing girls show significant growth in mathematics at a faster rate than boys. The inability to determine if differences exist and how quickly skills can be gained is an area that should be addressed when considering Tier 2 interventions for at-risk middle school students. Students should be monitored for growth to determine if gender differences in mathematics ability exist.

Discussion and Conclusion

No Child Left Behind “emphasizes accountability and teaching methods that work” (Whitney, 2008, Introduction section, para. 2). In addition, Georgia law requires schools to use Response to Intervention to assist students with difficulties (Georgia Department of Education, 2008). Through examination of these laws, it becomes apparent that something must be done to help meet the academic needs of students and to raise test scores. Both laws, NCLB and IDEA, along with the required Georgia RTI process emphasize research-based interventions. While some research is available on math interventions, the majority of the research on teaching strategies is at best a Tier 1 intervention. Much of the other research is related to programs difficult to enforce: afterschool remediation, summer school remediation, and tutoring. Research on other programs is either limited or not on math-specific interventions. Consequently, the limited amount of research available on math interventions makes following the requirements of research-driven instruction set forth by NCLB, IDEA, and RTI difficult. More research-driven math interventions are needed to support the RTI tiers of intervention and meet the requirements of NCLB on schools and students.

Schools cannot consider just any research-driven intervention; other factors must be considered. First, schools must determine which intervention will best fit the needs of their students. For example, how long will the intervention last, and how much material will be covered. If considering a remedial program, schools must recognize that positive results have been shown for short programs, like summer school, but the duration of benefits is questioned. Additionally Schultz (2001) argued that short-term programs have carried the baggage of poor attendance and are often not as effective. Research on remedial programs supports increased depth and breadth to increase and sustain student-learning outcomes (Bahr, 2007, 2008).

Schools must also consider cost associated with these programs to help determine the most beneficial and cost-effective method to assist students. Schools can save money on utilities and transportation costs encountered with afterschool and summer school programs by offering a remedial course during the school day. These programs can be offered as an elective course, minimizing cost. Schools would save on utilities, transportation, and staffing. School systems should also consider revisions to the IDEA act in 2004, which allows school districts to use up to 15% of federal funds, along with local and state funds, to provide early intervention strategies for those in the general education environment (Hanley, 2005). The 15% of funds can be applied to remedial programs as a source of intervention.

Schools must look at interventions that best fit the needs of their students, regardless of gender, and that are the most cost-effective solutions. Remedial programs conducted during the school day as an elective course appear to be the beneficial in terms of sustained learning and additional cost. Remediation can serve as a Tier 2 intervention and assist with high-stakes testing achievement. Additionally, conducting these programs during the school day allows for teacher collaboration, which has been the downfall of research on tutoring programs.

Remedial programs can provide the assistance needed to help students close gaps in achievement and provide a safe environment where students can feel as though they belong, were more likely to participate, and can feel that they are of value to the classroom. Serving as a Tier 2 intervention, remediation can result in academic gains for students, making high-stakes testing requirements more attainable, thus creating schools where AYP is reachable and no longer an intimidating concern.

The importance of Adequate Yearly Progress, as a result of NCLB, is at the forefront of concern for state and local school systems. These agencies must find a way to assist students and teachers to meet these requirements. Through early identification of student needs and explicit instruction in remedial programs, schools can decrease the number of students who fail to succeed (Hanley, 2005). Remedial programs are the obvious choice for assisting students and teachers in closing achievement gaps. Use of remediation may benefit all involved stakeholders under the No Child Left Behind Act, Individuals with Disabilities Education Act, and the requirements of Response to Intervention. However, more research is needed to determine the effects of remedial instruction on standardized test scores (Burns, Klingbeil, & Yesseldyke, 2010).

CHAPTER THREE: METHODOLOGY

No Child Left Behind legislation has had an impact on schools and students throughout the United States. The impact of NCLB has been compounded by changes to IDEA legislation, with Response to Intervention coming to the forefront in ways that schools assist students with learning difficulties (Hanley, 2005). In order to meet the challenges imposed by NCLB and IDEA legislation, schools have looked to supplemental programs to meet student needs (Gersten et al., 2009). One supplemental program that is quickly becoming a staple in Georgia middle schools is remedial mathematics. Schools are conducting a remedial math class during an elective period to increase math achievement, thus addressing the requirements of NCLB and IDEA. The course is used for Tier 2 intervention in the RTI process to meet the needs of struggling math students. The remedial math course has the potential to remedy problems with the student promotion rate and the Adequate Yearly Progress status of schools. While some research exists, many educators are promoting additional research to support supplemental programs for mathematics (Burns et al., 2010; Bushweller, 1998; Fletcher, 1998; Foegen, 2008; Gersten et al., 2009; Mross, 2003). Thus, this study investigated the impact of remedial math on the math portion of the Criterion Referenced Competency Test for 7th grade students in Georgia. The design, participants, setting, instrumentation, and procedures used to answer the following research questions are described in this chapter:

Research question #1: While using sixth-grade standardized test scores as a control variable for previous math achievement, do at-risk seventh-grade students who receive remedial math instruction have statistically significant different mean scores on the 2010 Georgia mathematics CRCT when compared to at-risk students who do not receive remedial math instruction?

Research question #2: While using sixth-grade standardized test scores as a control variable for previous math achievement, is there a difference in the mean scores on the 2010 Georgia mathematics CRCT of at-risk seventh-grade students who receive remedial math instruction based on gender?

The corresponding null hypotheses that were tested included:

H1: While using sixth-grade test scores as a control variable, at-risk seventh grade students who receive remedial math instruction will not have statistically significant different mean scores on the 2010 Georgia mathematics CRCT when compared to at-risk students who do not receive this intervention.

H2: While using sixth-grade test scores as a control variable, there will not be a statistically significant difference in mean scores on the 2010 Georgia mathematics CRCT of at-risk seventh grade students who receive remedial math based on gender.

Chapter 3 includes a description of the research design, the research participants, and the setting. Following these descriptions, information on treatment fidelity and instrumentation are provided to ensure equality of remedial courses and validity of the testing instrument examined. The chapter is completed with the description of research procedures and data analysis.

Design

A causal comparative design was used to determine if at-risk students' standardized test scores were impacted by the remedial math instruction and if gender differences in math abilities existed for the remedial students. According to Ary, Jacobs, and Sorensen (2010), although the causal comparative design "does not provide the safeguards that are necessary for making strong inferences" (p. 333), this type of research is useful to assist in discovery of relationships in education when manipulation of the independent variable--in this case, remedial math--is not ethical or possible. In this study, remedial math programs and regular math instruction were already being implemented in Georgia schools, and students could not be randomly assigned to the treatment and control groups by the researcher. All participants were deemed at risk using their scores on the 2009 Georgia CRCT. The school predetermined whether the at-risk students would receive remedial math instruction daily as an elective course based on their 2009 sixth-grade mathematics CRCT scores and teacher recommendations. The use of gender as the independent variable in the second research question further justifies the use of the causal comparative design. Manipulation of this variable is not possible.

The school chose three certified math teachers to administer the treatment, remedial math. Archival data was collected for both the treatment and control groups. Two ANCOVAs were used to test the null hypotheses. The ANCOVA was "used to partially adjust for preexisting differences between groups" (Ary et al., 2010); for the ANCOVA assisted in controlling for the selection threat to validity because of using non-equivalent groups, which is of great concern in studies using a causal comparative design. Since the statistical regression threat to validity was of concern due to studying students with low test scores, a control group was used to minimize this potential severe threat to validity in the study.

Participants

This study used a convenience sample. The participants were students identified as being at risk and enrolled in one of three middle schools located in northeastern Georgia.

At-risk students were purposely selected. Participants were identified as being at risk using 2009 sixth-grade Georgia CRCT scores. Students identified as being at risk were those receiving a score below 810. Students enrolled in a remedial math course as an elective, in addition to a regular math course, were identified as being in the treatment group. The school counselor placed these students in the elective course based on criteria used in this study (2009 CRCT score below 810), as well as other factors determined by the school (teacher recommendation, available space, schedule, etc.). All other students scoring below 810 on the 2009 sixth-grade Georgia CRCT, who received regular math instruction, served as a control group. Only students who were enrolled in remedial math for three semesters prior to CRCT testing were included in the study. Students who moved during the course of the year were not included in this study.

The sample consisted of 293 participants. There were 181 (61.8%) students in the control group and 112 (38.2%) students in the treatment group. Table 3.1 shows the gender of the sample disaggregated by group.

Table 3.1

Sample Breakdown by Gender

	Entire Sample	Control Group	Treatment Group
Male	152 (51.9%)	101 (55.8%)	51 (45.5%)
Female	141 (48.1%)	80 (44.2%)	61 (54.5%)

The majority of participants were Caucasian. The ethnic breakdown of the participant population consisted of 0.3% American Indian, 2.4% Asian/Pacific Islander, 5.5% Black, 19.5% Hispanic, 2.0% Multi-racial, and 70.3% Caucasian. Table 3.2 shows the ethnic makeup of the sample disaggregated by group.

Table 3.2

Sample Breakdown by Ethnicity

	Entire Sample	Control Group	Treatment Group
Asian	7	4	3
Black	16	12	4
Hispanic	57	23	34
Caucasian	206	135	71
Multi-racial	6	6	0
American Indian	1	1	0

Over half (209 or 71.3%) of the population was considered economically disadvantaged.

Setting

The students participating in this study all attended public schools in northeastern Georgia. Three schools were examined, and all three schools met AYP during the 2008-2009 school year. The present study specifically examined the math instruction that students received during the 2009-2010 school year; all three schools offered remedial math instruction as an elective in addition to the regular math course. As required by the state, all students were taught the same math standards and completed the Georgia CRCT.

Teachers certified by the Georgia Professional Standards Commission in mathematics taught the remedial courses. The purpose of the course was to help students who did not meet grade-level standards, as assessed by the Georgia mathematics CRCT, to reach grade-level expectations. The remedial classes contained approximately 15-20 students per class period. Various topics were covered in the course, including basic math skills, such as multiplication, division, and the use of fractions and decimals. Additionally, students were provided with support for the current curriculum. Various strategies were used to assist students: differentiation, test-taking skills, use of manipulatives, kinesthetic learning, and confidence building through tracking and sharing student growth. Student participants were also in a grade-level math course that met for 60-70 minutes daily.

Students in the control group also participated in a grade-level math course that met for 60-70 minutes daily. No additional math class or support during the school day was provided for these students. They participated in various electives during the time period when the treatment group received remedial math. These electives included study skills, remedial reading, band, art, chorus, drama, agriculture, physical education, business education, and technology. In addition, all students had the opportunity to attend the before-school or afterschool programs.

Treatment Fidelity

To ensure the equality of remedial instruction across the schools and courses, principals at the participating schools were interviewed. Each principal was initially contacted through email. An interview was then scheduled based on the principal's availability. All interviews were conducted face-to-face. The principals were asked several questions regarding the school schedule, math interventions, and selection of students for interventions. Specific questions regarding the elective course in remedial mathematics were also asked.

Principals described the schools' general class schedules. Two of the participating schools followed the same schedule, using a seven-period day. These schools had five academic classes (math, reading, language arts, social studies, and science) that met for 60 minutes each day. The schedules also included two elective classes that met daily for 50 minutes. The third school's schedule included a six-period day. The four academic courses (reading/language arts, math, social studies, and science) met for 70 minutes each day, and the two elective courses met for 45 minutes each day. Thus, all students in the treatment group participated in remedial math daily for 45 minutes.

Principals recounted how students were placed in remedial math courses. All schools used a variety of measures for determining student placement in remedial math. Students CRCT scores were the primary factor that all schools used to determine student placement in remedial math. Students scoring around or below 800 on the previous year's CRCT test in the course were placed by all three schools in the remedial math course. Space available was another criterion used in student selection. The students' academic grades and teacher recommendation also played a role in the placement of students in remedial math. School counselors were responsible for student placement using student data and teacher recommendations.

All schools allowed students identified as special education to be placed in remedial math if the decision was not interfering with the child's Individual Education

Plan. All schools also agreed that, while it was rare for students to come out of remedial math prior to the CRCT test, placement was fluid, and often students were identified and added during the school year if space was available. The remedial math elective course was used as a Tier 2 intervention in all schools examined in this study.

The principals also provided insight about the curriculum used during remedial math instruction. The principals defined the material presented in remedial math. All principals described use of similar materials, including remediation of basic skills, assistance with the material presented in the grade-level standards, and presentation of vocabulary necessary for understanding the material being presented. Principals reported that teachers used a variety of tools to assist students, including math manipulatives and computer software.

Based on the interviews, I concluded that the implementation of remedial math courses across schools was similar. These programs were determined to be similar because the descriptions of all three programs used a similar time period, similar teaching strategies, and similar selection methods for choosing students to be included in the remedial course.

In addition to the descriptions of the remedial math course, the principals discussed other math interventions that were available to all students. Principals also described additional interventions offered to struggling students. All three principals responded that their schools offered an afterschool program in addition to the remedial math elective course. While all of the schools offered an afterschool program, each principal described it differently. One school's afterschool program offered a 35-minute math specific portion of instruction, another offered 30 minutes of afterschool support, and the third offered an hour and a half of support that was not subject specific but instead based on student need. Additionally, two of the schools offered a 30-minute help session each morning for any students needing assistance. No specific standards were set for any of the afterschool or before-school sessions, and none were used as tiers of intervention. The school did not require students to participate in these additional programs. This variable is important to note because I, as the researcher, could not control for students' participation in additional interventions.

Instrumentation

Criterion Referenced Competency Test. The Criterion Referenced Competency Test was used as a dependent variable and a control variable. Student sixth and seventh-grade scores on the math portion of the Georgia CRCT were used to measure math achievement. The sixth-grade CRCT score was used as the covariate in the present study to adjust for pre-existing differences between the control and treatment groups. The seventh-grade math CRCT scores were used as the dependent variable.

The purpose of the Georgia CRCT is to measure each student's skills and knowledge of topics outlined in the Georgia Performance Standards (GPS). The math portion of the assessment contains questions that assess the students' mastery of the math standards. A student's scale scores can range between 650 and 900 or above. The CRCT uses a "Does Not Meet" (DNM), "Meets Expectations" (ME), and "Exceeds Expectations" (EE) scale to determine student success. Students that score in the DNM category have a scale score below 800. Students that score in the ME category have a total score between 800 and 849. Students that score in the EE category have a score of 850 or above.

The Georgia Department of Education (GaDOE) provides information about the validity and reliability of the CRCT in *An Assessment and Accountability Brief* (2009a). The GaDOE (2009a) states that it "can ensure that the CRCT is a valid instrument" based on the test development process (p. 3). The GaDOE uses field test items to validate questions and develops committees of educators to determine standards, to test blueprints, and to review field test items. The state also ensures all multiple forms are equated to the same level of difficulty. The GaDOE produces score and distribution results to ensure validity.

Additionally, the Georgia Department of Education reports that it has "conducted analyses as evidence of external validity by comparing how the constructs the CRCT measures compare with other well-recognized assessments (e.g., ITBS)" (Georgia Department of Education, 2009a, p. 4).

Reliability information is also provided in *An Assessment and Accountability Brief* (2009a). The GaDOE uses Cronbach's alpha reliability coefficient to "express the consistency of test scores as the ratio of true score variance to observed total score variance" (2009a, p. 4). The standard error of measurement (SEM) is also calculated as a second indicator for test score reliability. The sixth-grade mathematics CRCT has a reliability index of 0.92 and SEM of 3.26, and the seventh-grade mathematics CRCT has an alpha of 0.92 and SEM of 3.16. These reliabilities are consistent with the reliabilities of past tests completed on past CRCTs, suggesting the assessment is reliable.

The GaDOE provides conditional standard errors of measurement as a reliability measurement to "express the degree of measurement error in scale score units" (2009a, p.5). The conditional standard errors of measurement are also "conditioned on the student's score" (2009a, p. 5). The CSEMs associated with the CRCT Mathematics scale cut scores are meets 8 and exceeds 10 for both sixth and seventh-grade tests. Since the CSEMs are consistent with previous test administrations, it is suggested that the scores are well estimated and accurate.

The information given in the report by the GaDOE provides evidence of both test validity and reliability. The information on the meticulous process by which the test is developed and the consistencies of test results provide sufficient evidence to attest to the validity and reliability of the *Criterion Referenced Competency Test* (Georgia Department of Education, 2009a).

Procedures

Students participated in either the remedial math elective or non-math elective during the 2009-2010 school year. All students labeled to be at risk based on their CRCT scores were considered for placement in a remedial math course. There were not enough slots available for every student to participate in the course. The school counselor identified students to be placed in the remedial elective course based on the previous year's CRCT scores, quarterly math grades, and teacher recommendation. Students were not able to choose whether they were in the course or not. Students remained in the course for a full school year (180 days). Due to attrition, some students were enrolled later. Only students enrolled in the course for the three semesters prior to the CRCT testing were included in this study.

At the end of the 2010 school year, data was obtained from each of the three middle schools identified for the study. I emailed each school's data coordinator to obtain this information. The data coordinator replied to the researcher's email. The replies contained Excel files with the required information. The data included students' IDs, 2009 sixth-grade math CRCT scores, 2010 seventh-grade math CRCT scores (dependent variable), and demographic data. Data from all students who did not meet the at-risk criteria was removed from the data set. Students at-risk were defined as those receiving a score of less than 810 on the 2009 6th grade math CRCT.

The schools also provided me with student ID numbers for students enrolled in the remedial course. Using this information, I coded all students participating in remedial math (independent variable) with a 1, and those not receiving this intervention were coded as a 0. The decision to code students using a 1 and a 0 was based on the students in the treatment group receiving the remedial math class (1), and the students in the control group not receiving additional math support (0). In order to keep student identification confidential, all student ID numbers were separated prior to analysis.

Data Analysis

A one-way analysis of covariance (ANCOVA) was used to examine the difference in mean math achievement scores between those receiving the remedial math course as an elective and those not receiving these services, while controlling for previous academic achievement. This analysis is useful when the research has been unable to randomly assign the participants to two groups and desires to compare two groups that may differ. According to Ary et al. (2010), ANCOVA “is a statistical technique used to control for the effect of an extraneous variable known to be correlated with the dependent variable” (p. 287). The 2009 sixth-grade CRCT scale scores were used as the control variable since students in the two groups may have differed in terms of math achievement prior to the treatment. Using the 2009 sixth-grade CRCT scores as a covariate assisted in accounting for pre-existing differences in each student's math ability. The 2010 seventh-grade CRCT scale scores, also given to all Georgia students, were used as the dependent measurement variable. The treatment, receiving the remedial math instruction, and control, not receiving the extra math instruction, served as the independent variable.

A second one-way analysis of covariance (ANCOVA) was used to examine the difference in mean math achievement scores based on gender for all students receiving remedial math as an elective, while controlling for previous academic achievement. The control variable used was the 2009 CRCT math scale score. The dependent variable used was the 2010 CRCT math scale score. Gender was used as the independent variable.

For both ANCOVAs, several tests were conducted earlier to ensure no assumptions were violated. I examined the assumptions of normality by examining a histogram. A Levene's test was conducted to test for homogeneity of variances. A scatter plot was used to test for linearity. I used the scatterplot and univariate test to ensure the homogeneity of regression slopes. The alpha level of .05 was used to determine if I should reject or fail to reject the null hypothesis and to determine if students that participate in remedial math as an elective do have significantly higher mean scores when compared to those not receiving remedial math as an elective. Partial eta squared, calculated by SPSS as part of the ANCOVA test, was used to determine the effect size. The effect size was interpreted using Cohen's conventions. The interpretation was based on thresholds of .01 for a small effect, .06 for a moderate effect, and .14 for a large effect (Cohen, 1988, pp. 284-287).

CHAPTER FOUR: RESULTS

The purpose of this study was to examine the differences in standardized test scores for at-risk students who participated in remedial math instruction as an elective class and at-risk students who did not receive remedial math instruction for their elective during the 2009-2010 school year. It was also the purpose of this study to examine the differences in standardized test scores by gender for those taking remedial math.

This chapter is organized into three sections. The demographic data for participants is presented. The results of the two ANCOVAs are presented to examine the student achievement results on the Georgia mathematics portion of the CRCT for students who did receive remedial math instruction and students who did not receive remedial math instruction and the differences in standardized test scores by gender for remedial students. The final section provides a summary of the results.

Demographics

The participants for this study were 293 at-risk students from three northeastern Georgia schools. All of these students were considered to be at risk and were selected based on a score of less than 810 on the 2009 mathematics CRCT. Of the 293 students, 112 students participated in an elective course of remedial math instruction. The remaining 181 students participated in an alternative elective. The descriptive statistics of demographic information disaggregated by elective type are provided in chapter 3.

Results

Hypothesis one. A one-way analysis of covariance (ANCOVA) was conducted to determine if there was a different mean score on the mathematics portion of the 2010

CRCT for students who took remedial math and students who did not take remedial math. Remediation served as the independent variable and included two levels: received remedial math services and did not receive remedial math services. The dependent variable was the 2010 mathematics CRCT scores for each student. The 2009 mathematics CRCT scores for each student served as the covariate. Preliminary analyses were conducted to evaluate assumptions.

The reliability of the covariate was assumed due to the reliability information provided by the Georgia Department of Education (GaDOE) in *An Assessment and Accountability Brief* (2009a). The report provides reliability information using Cronbach's alpha. Reliabilities reported are consistent with past tests, suggesting the assessment is reliable (Georgia Department of Education, 2009a). Normality was examined using the statistics for the CRCT score data that are listed in Table 4.1 and the histograms in Figure 2 and Figure 3. Based on the statistics in Table 4.1, normality may be assumed based on the kurtosis and skew values close to zero. Normality was confirmed by examining the histograms in Figure 2 and Figure 3. The figures indicate that CRCT scores for 2009 and 2010 appear unimodal and approximately symmetric with the exception of a slightly positive skew on the 2009 CRCT scores for the group not taking remedial math in Figure 2. Normality is assumed based on the statistic.

Table 4.1

Descriptive Statistics by Test

	n	*M*	*SD*	Kurtosis	Skew
2010 CRCT Score	293	816.19	21.089	-.027	-.128
2009 CRCT Score	293	791.81	12.315	-.585	-.486

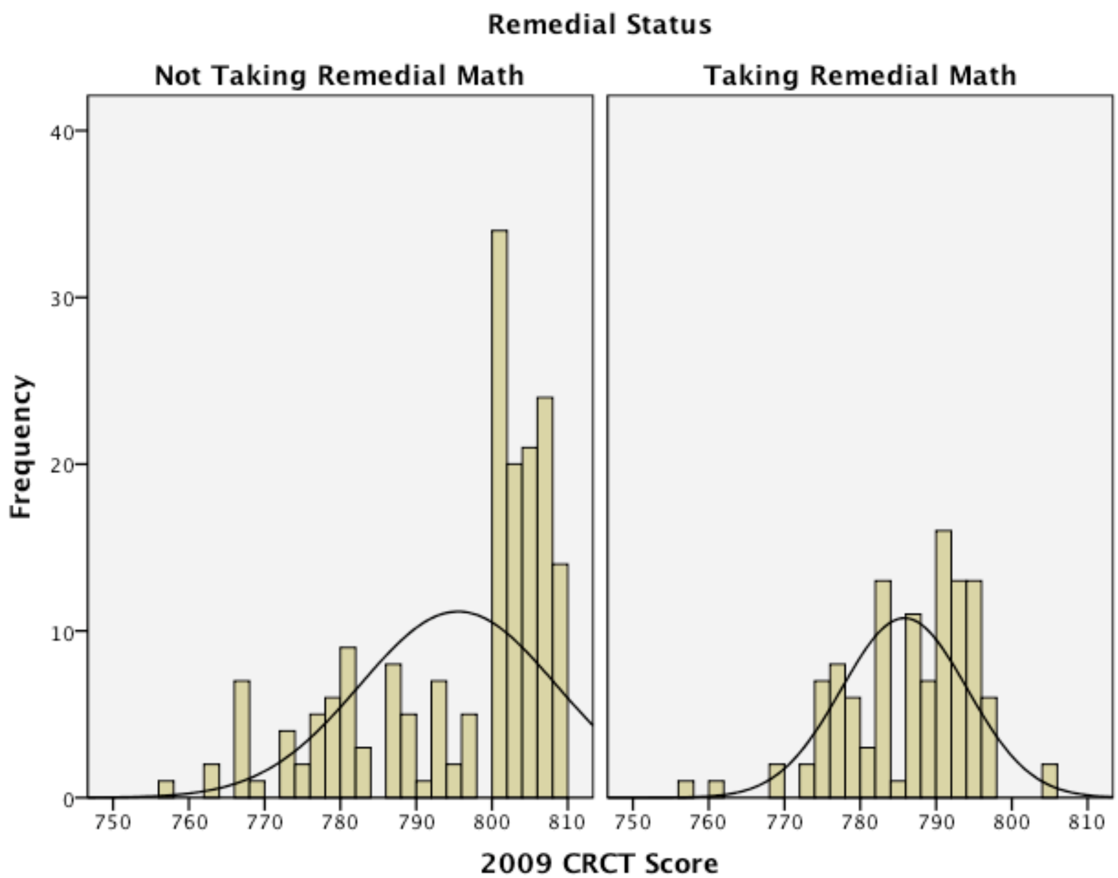

Figure 2. Histogram for 2009 CRCT scores by remedial status.

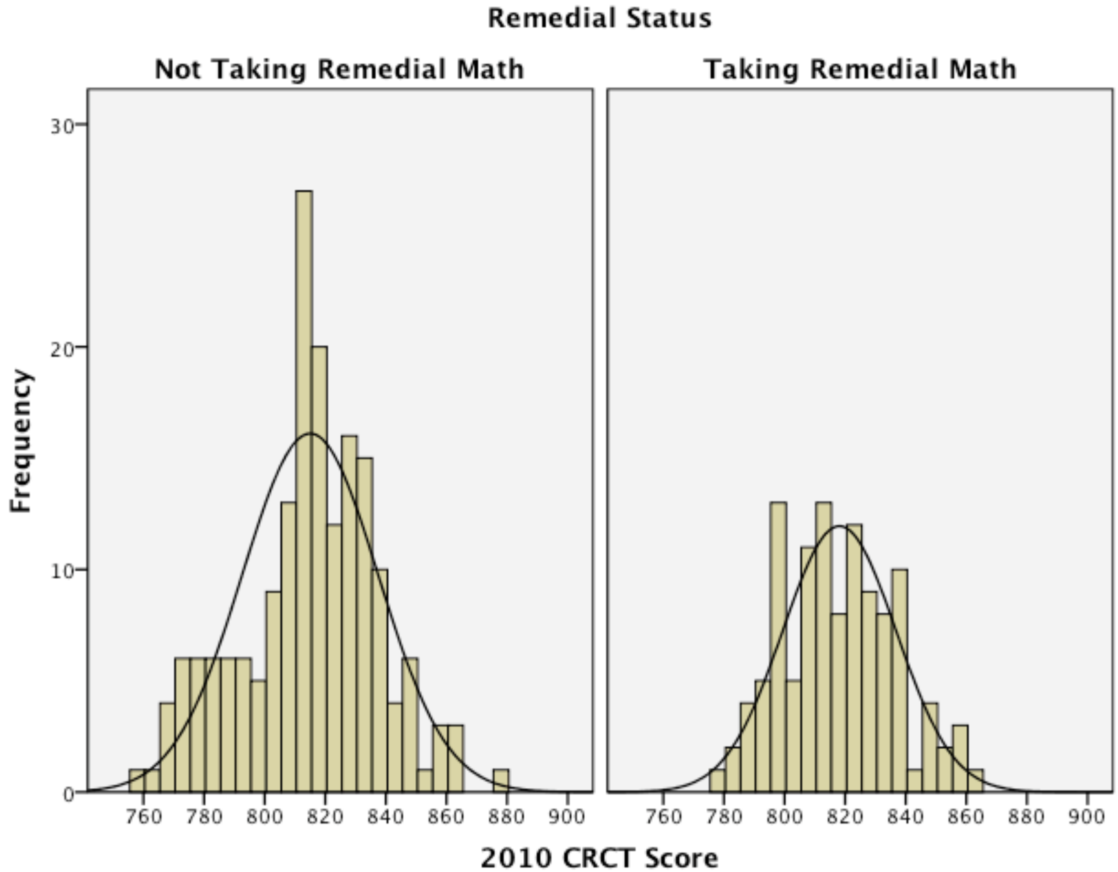

Figure 3. Histogram for 2010 CRCT scores by remedial status.

Levene's test for homogeneity of variances produced a significance level of .6, indicating that the homogeneity of variances assumption was not violated. The linearity assumption was tested by examining a scatterplot. SPSS was used to create a scatterplot using the dependent variable (2010 math CRCT scores) as the Y axis, and the covariate (2009 math CRCT scores) as the X axis. The chart generated is shown in Figure 4. Fit lines were added by subgroup, which appear to be straight. Therefore, the general distribution of scores indicates a linear relationship for each group.

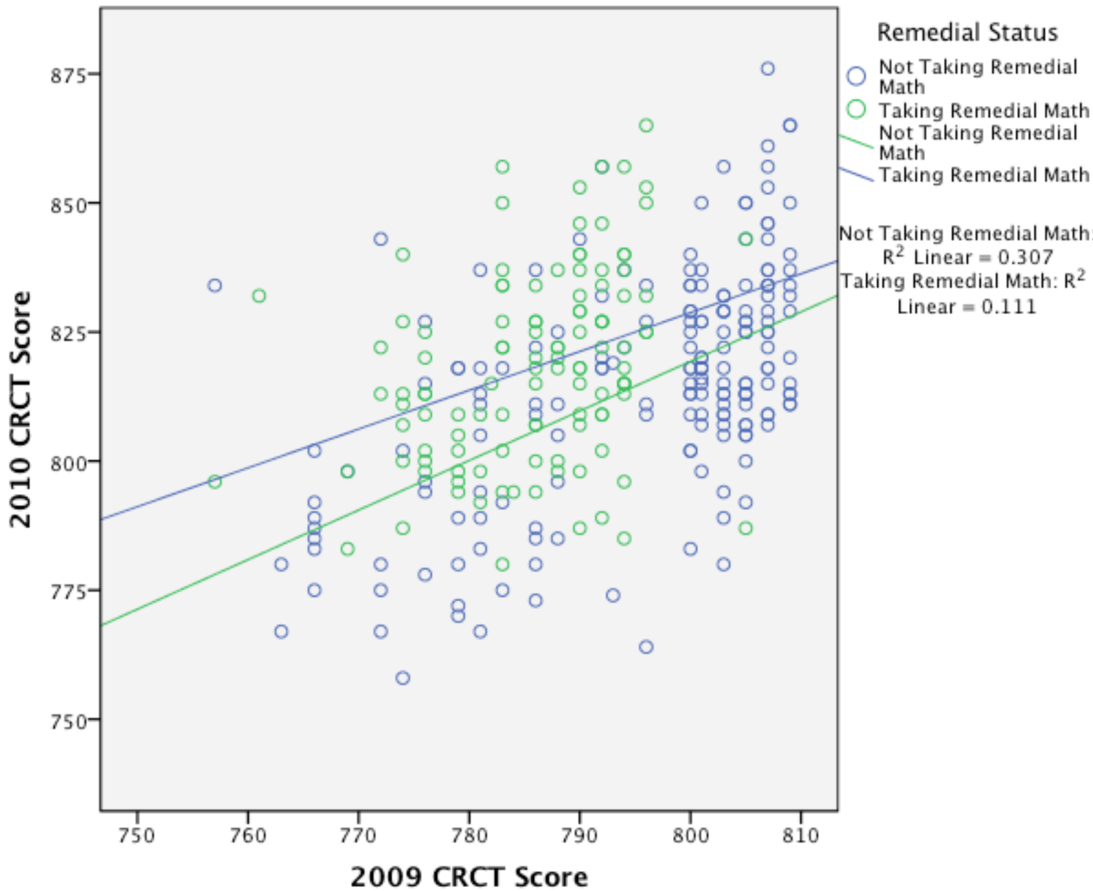

Figure 4. Scatterplot of 2009 and 2010 CRCT scores.

The assumption of homogeneity of regression slopes was also tested. The scatter plot indicated no violation of homogeneity (similar lines between dependent variable and covariate); I also chose to verify the homogeneity statistically by determining if a significant interaction between the treatment and covariate was present. A test of between-subjects effects revealed that the interaction was not significant, F (1, 289) = .785, MSE = 336.163, p = .376, indicating no homogeneity of slopes.

Since it was determined that no assumptions were violated, an ANCOVA analysis was conducted to test the null hypothesis. H1: While using sixth-grade test scores as a control variable, at-risk seventh-grade students who receive remedial math instruction daily as an elective class will not have a statistically significant difference in mean scores on the 2010 Georgia mathematics CRCT when compared to at-risk students who do not receive this intervention.

Descriptive statistics for the 2010 CRCT data before adjusting for the 2009 CRCT scores are presented in Table 4.2. Descriptive statistics for the 2009 CRCT scores are presented in Table 4.3.

Table 4.2

Descriptive Statistics for 2010 CRCT Scores by Remedial Status

Remedial Status	*n*	*M*	*SD*
Not taking Remedial Math	181	815.01	22.41
Taking Remedial Math	112	818.10	18.69

Table 4.3

Descriptive Statistics for 2009 CRCT Scores by Remedial Status

Remedial Status	*n*	*M*	*SD*
Not taking Remedial Math	181	795.52	12.94
Taking Remedial Math	112	785.81	8.30

The data with adjusted means, taking into account the covariate, revealed the adjusted mean for those not taking remedial math as 811.61 (SD = 1.41) and those taking remedial math as 823.6 (SD = 1.82).

After adjusting for the 2009 CRCT scores, there was a statistically significant difference between groups at an $\alpha = .05$ level, F (1, 290) = 25.26, $p < .001$, partial η^2 =

.08, indicating the group taking remedial math had a significantly higher mean score. As interpreted by Cohen (1988), the effect size of .08 is moderate, indicating that 8% of the variance in the 2010 CRCT scores can be explained by remedial math. The covariate explained 24.6% of the variance in the dependent variable. An observed power of 0.99 indicated the likelihood of a Type error is low. Thus, the null hypothesis was rejected.

Hypothesis two. The differences in mean score on the 2010 mathematics CRCT by gender for those taking remedial math were examined using a one-way analysis of covariance (ANCOVA). The independent variable was gender, and the 2010 mathematics CRCT scores served as the dependent variable. The covariate, to control for previous math achievement, was the 2009 mathematics CRCT scores. Assumptions were evaluated prior to conducting the ANCOVA.

The reliability of the covariate was assumed based on the reliability information provided in *An Assessment and Accountability Brief* (Georgia Department of Education, 2009a). Information presented in Table 4.4, Figure 5, and Figure 6 were used to assess normality. Kurtosis and skew values close to zero indicated that the distribution is near normal. The histograms presented in Figure 5 and Figure 6 appear unimodal and approximately symmetric, also confirming near normal distribution of scores.

Table 4.4

Descriptive Statistics by Test for Remedial Group

	n	*M*	*SD*	Kurtosis	Skew
2010 CRCT Score	112	818.10	18.69	-.487	.214
2009 CRCT Score	112	785.81	8.30	.818	-.701

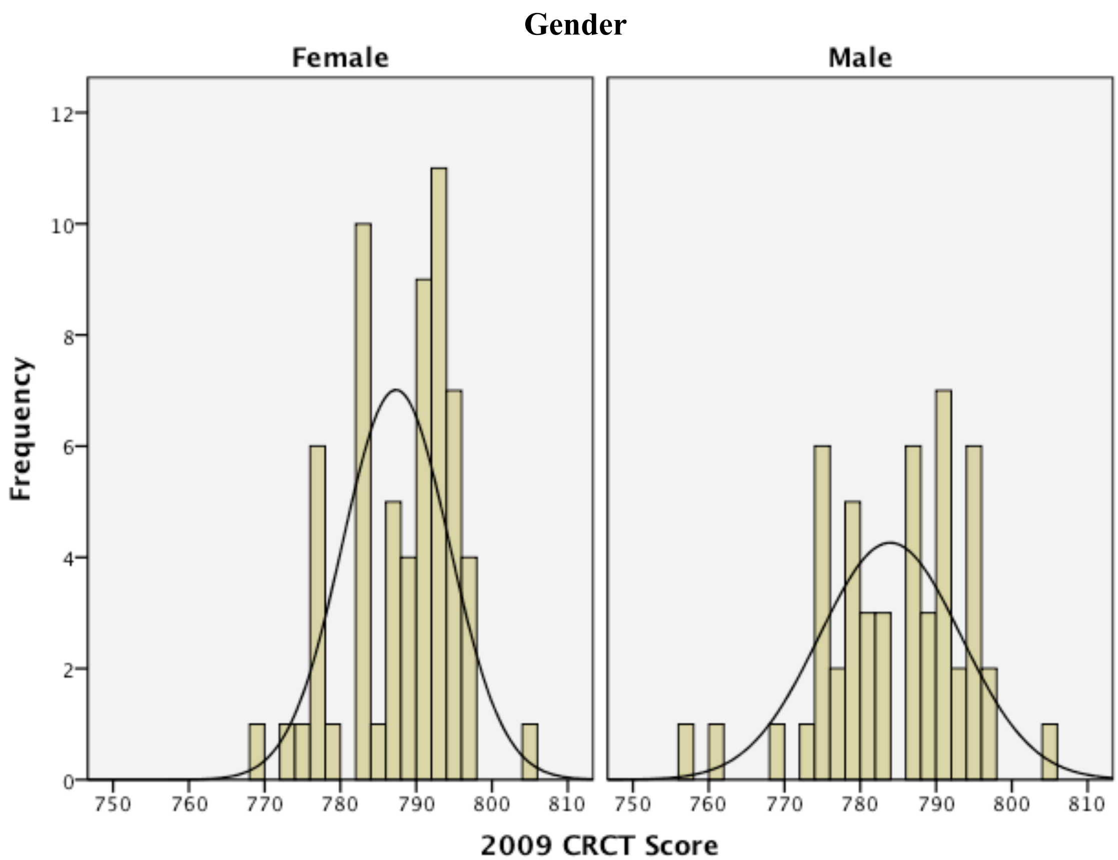

Figure 5. Histogram of remedial students for 2009 CRCT scores by gender.

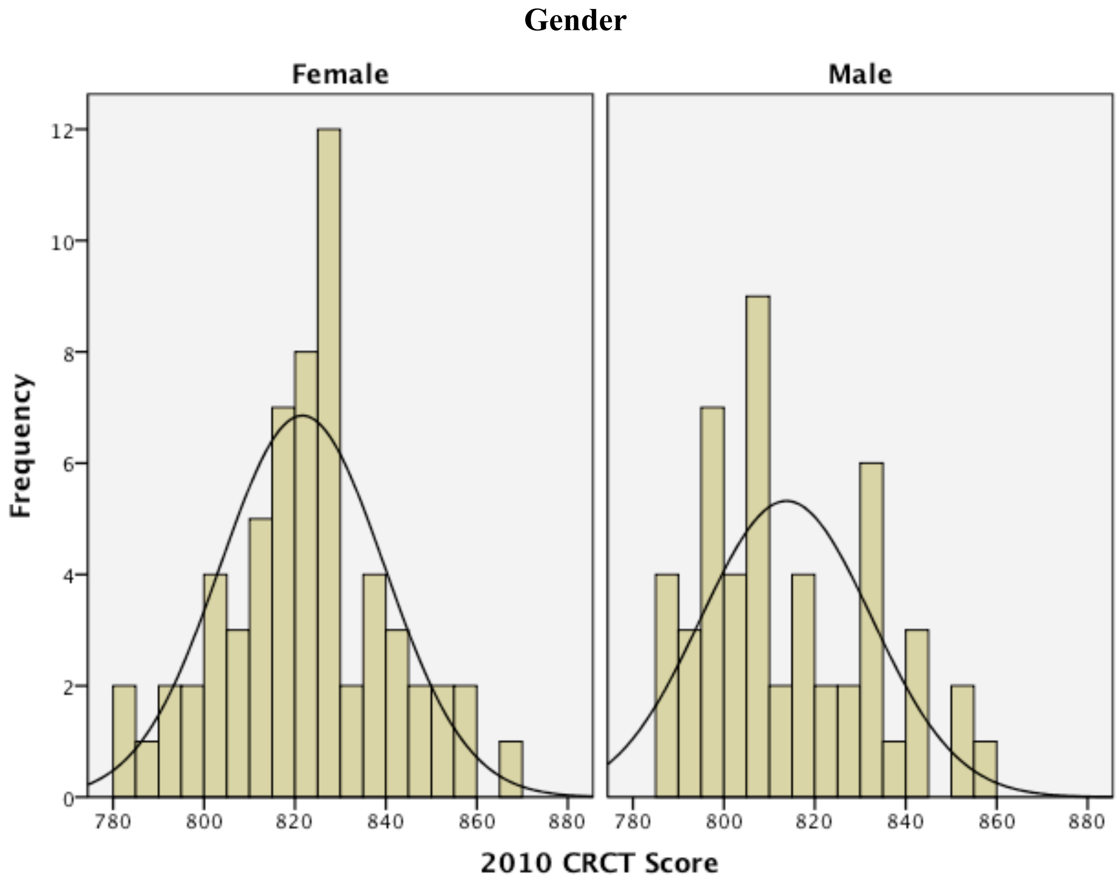

Figure 6. Histogram of remedial students for 2010 CRCT scores by gender.

A significance level of .412 produced by Levene's test for homogeneity of variances indicated that the homogeneity of variance assumption was not violated. A scatterplot was used to test the linearity assumption. Using SPSS, a scatterplot was created using 2010 math CRCT scores (dependent variable) as the Y axis and 2009 math CRCT scores (covariate) as the X axis. Figure 7 displays the chart generated. The fit lines added by subgroup appear to be straight, indicating a linear relationship for each group.

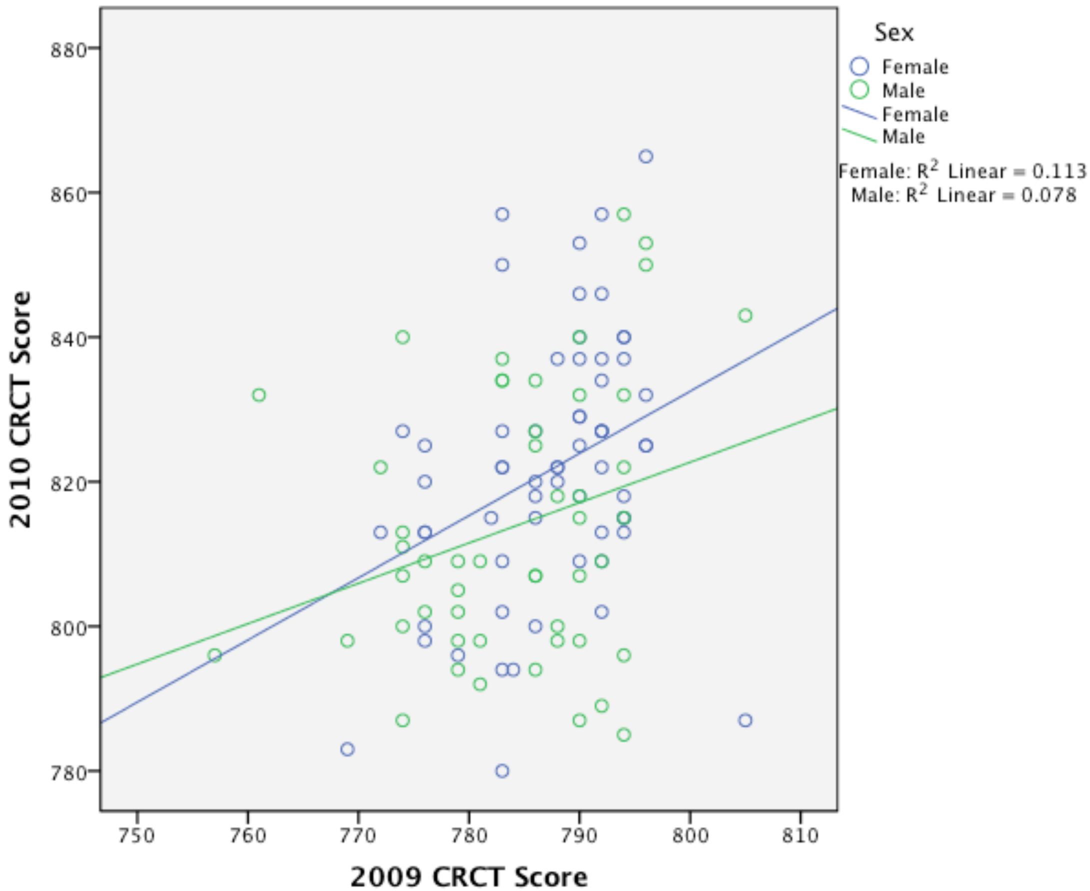

Figure 7. Scatterplot of remedial students for 2009 and 2010 CRCT scores by gender.

The scatterplot was also used to test the homogeneity of regression slopes assumption. While the scatterplot did not appear to indicate a violation of homogeneity (slopes were somewhat similar), a test of between-subjects effects was completed to confirm that the assumption was not violated. The test of between-subjects effects confirmed that the interaction was not significant, $F\,(1{,}108) = .522$, $MSE = 310.007$, $p = .472$.

With no assumptions violated, an ANCOVA was conducted to test the null hypothesis Ho2: While using sixth-grade test scores as a control variable, at-risk female students who receive remedial math instruction daily as an elective class will not have statistically significant difference in mean scores on the 2010 Georgia mathematics CRCT when compared to at-risk male students who receive remedial math instruction daily as an elective class.

Descriptive statistics for the 2010 mathematics CRCT data before adjusting for the 2009 mathematics CRCT scores are presented in Table 4.5. Descriptive statistics for the 2009 mathematics CRCT scores are presented in Table 4.6.

Table 4.5

Descriptive Statistics for Remedial Math Students' 2010 CRCT Scores by Gender

Gender	*n*	*M*	*SD*
Females	62	821.61	18.04
Males	50	813.74	18.74

Table 4.6

Descriptive Statistics for Remedial Math Students' 2009 CRCT Scores by Gender

Gender	*n*	*M*	*SD*
Females	62	787.32	7.05
Males	50	783.94	9.36

When taking into account the covariate, the adjusted mean for females was 820.58 (*SD* = 2.25) and the adjusted mean for males was 815.02 (*SD* =2.51). There was not a statistically significant difference between gender groups at an $\alpha = .05$ level, F (1, 190) = 2.66, $p = .106$, partial $\eta^2 = .024$. The observed power was 0.37, indicating the possibility of a Type II error. The Type II error is likely due to the small sample size. The covariate was not significant, as indicated by a significance level of .092. Therefore, the null hypothesis was not rejected. There was not sufficient evidence to suggest that remedial math instruction was equally effective for either males or females; however, caution should be taken due to the likelihood of a Type II error.

Results Summary

The purpose of this study was to examine the impact of remedial math instruction on standardized test scores. The differences in standardized mathematics test scores for at-risk students taking remedial math and those not taking remedial math were examined to determine if the mean scores of remedial math students were different from the mean scores of those not taking remedial math. The research from this study indicates that, while using the 2009 CRCT scores as a control variable, there is a significant relationship between at-risk students taking remedial math and higher scores on the 2010 mathematics CRCT. The researcher also examined the differences in mean scores by gender for students enrolled in remedial math. Differences by gender were not significant.

CHAPTER FIVE: SUMMARY AND DISCUSSION

The purpose of this chapter is to review the findings of this study and discuss them. The chapter is divided into the following sections: statement of the problem, summary of the results, discussion of the results, implications, limitations, and recommendations for further research.

Statement of the Problem

The downfall of education has been a topic of concern among politicians since the publication of *A Nation at Risk* in the early 1980s. Since that time, politicians have worked to impose rules and regulations on education in an attempt to improve the public school system. The first major change to the entire public school population was delivered in the No Child Left Behind Act of 2001. This new law created an accountability system in which schools, teachers, and students became accountable for academic standards (NCLB, 2001). Additionally, legislators made changes to the Individuals with Disabilities Act, aligning it with the NCLB Act. One requirement of this law was that those students in grades 3, 5, and 8 needed to pass standardized testing in math to be promoted to the next grade level (U.S. Department of Education, 2004).

IDEA legislation, in addition to changes aligning with NCLB, introduced Response to Intervention as a method for delivering evidence-based instruction to meet the academic needs of individual students (Barnes & Harlacher, 2008). This four-tier model is designed to monitor student progress, so that students who are struggling and unable to perform at expected levels can be identified in order to receive an academic intervention to address the area of concern.

Remediation is one intervention that has been identified to assist students in Tier 2 of the RTI process and to meet the requirements for grade-level progression as imposed by NCLB. However, remediation fails to meet the requirements of research-driven instruction imposed by these laws for middle school students. While research on remediation exists, there has not been sufficient research on the impact of remediation classes on the math achievement of at-risk middle school students (Esch, 2009; Foegen, 2008; Gersten et al., 2009; Schachter, 2008). Thus, this study examined the differences in the math section of standardized test scores for at-risk students who did receive remedial instruction as an elective class and those who did not receive remedial instruction, in the middle school setting. At-risk students were the focus in this study. The remedial math program provided support to the academic needs of the at-risk students as required with response to intervention and NCLB. For the purpose of this study, at-risk students are those who scored “Does Not Meet” on standardized testing the previous school year or students that teachers have determined need support to achieve this year’s standards.

In addition, the study examined the differences in standardized test scores by gender of the at-risk students participating in the remedial math class. Research on gender revealed that math discrepancies between genders are apparent in middle and high school (Ai, 2002; Din et al., 2006; Georgiou et al., 2007; Liu & Wilson, 2009; Mau & Lynn, 2000; Rosselli et al., 2009; University of Wisconsin-Madison, 2009). In addition, research has revealed that male and female students benefit from different types of teaching strategies in mathematics (Kommer, 2006; Sax, 2006). Females need more concrete examples, whereas males can learn effectively using abstract concepts

(Kommer, 2006). The purpose of examining gender differences for students taking a remedial math course is to ensure that the course is an effective Tier 2 intervention for both genders.

Summary of Findings

Research question one. The primary purpose of this causal comparative study was to examine if differences existed in mathematics standardized test scores for students who took a remedial math course as an elective and those who did not take a remedial math course, and if gender differences in math abilities existed for the remedial students. Students in two groups were examined, students taking a remedial math class or students not taking a remedial math class during the 2009-2010 school year. The research sample of 293 at-risk seventh graders identified in this study was selected from three middle schools in northeastern Georgia. The students were selected based on their 2009 mathematics CRCT score. For students to be at risk, as identified by this study, they had to have scored less than 810 on the 2009 mathematics CRCT.

The results of an ANCOVA test demonstrated that the 2010 scores of those students who did take remedial math were significantly higher than those who did not take remedial math. Students taking remedial math had a mean score of 3.09 points higher on standardized tests before accounting for the covariate; however, when accounting for the covariate, 2009 math CRCT scores, the remedial math group's mean score was 11.993 points higher than those not taking remedial math during the 2009-2010 school year. This indicates that at-risk students' participation in remedial math classes does assist in increasing student math achievement scores.

Research question two. Research question two examined differences by gender in 2010 Georgia CRCT mathematics scores for those taking remedial math. An ANCOVA was used to examine the CRCT scores for the remedial group by gender. The 2010 CRCT scores served as the dependent variable, gender served as the independent variable, and the 2009 CRCT scores served as the covariate for this analysis. The results of the ANCOVA revealed that no significant relationship existed between gender and test scores, indicating that both males and females benefit equally from remedial instruction.

Summary of the Results

The No Child Left Behind Act, in conjunction with changes to the Individuals with Disabilities Act and the newly required Response to Intervention, has forced schools to focus on providing effective interventions for at-risk students. Schools must provide students who “Do Not Meet” standards, as assessed by a standardized test (Georgia CRCT), interventions to address their academic weaknesses (Georgia Department of Education, 2008). IDEA legislation allows “schools to use 15% of their special education money for regular education interventions” (Johnston, 2010, p. 602). Schools are accountable for these funds when used for interventions such as a remedial math course; therefore, it is important to provide evidence of the student academic gain.

Research question one. Based on my review of the literature, no prior research studies were found comparing Georgia CRCT scores in mathematics for those receiving remedial math and those not receiving remedial math. However, the finding that remedial math is useful for math achievement gains is consistent with other research. Bushweller (1998) and Schultz (2001) were able to produce findings that remediation is valuable to students in the K-12 setting. Likewise, research by Bottge et al. (2001) and

Fletcher (1998) revealed improvement in academic math grades after middle school students participated in a remedial math course. The present study's examination of the effects of a remedial math course on standardized test scores as measure of student achievement extends this previous research.

While the findings are consistent with research on remediation and math achievement, it is also important to consider how this research can assist schools in meeting the requirements of NCLB. NCLB’s focus on standardized tests to determine student grade promotion and school AYP status requires schools to consider the impact of interventions on these scores. Therefore, providing evidence of an intervention's impact on test scores is increasingly important. Only one other research study was found that examined how a remedial math course affects standardized test scores. The findings of the present study are consistent with the findings of the study by Mross (2003) that examined remedial math and student scores on the Pennsylvania System of School Assessment. Both studies provide evidence that remediation can be used as a tool to assist struggling students in need of increasing standardized test scores.

Research question two. The second focus in this study was to determine if gender differences had an impact on the standardized test scores of the remedial group. The results of this study revealed that no significant differences exist in student performance for those that received remedial math courses by gender. The findings were consistent with recent research on gender differences in mathematics performance that showed that, despite earlier research claiming boys outperform girls on mathematics assessments, there is no difference in mathematics performance between boys and girls (Din et al., 2006; Rosselli et al., 2009; University of Wisconsin-Madison, 2009). The finding that gender differences are not significant, based on standardized test scores, also supports research completed by Din et al. (2006) and Rosselli et al. (2009) that revealed that both males and females show the same growth trends on standardized tests.

Implications

The results of this study have an impact on both schools and students. Results indicate that remedial math is beneficial for increasing students' standardized math test scores. Georgia CRCT scores are used as an indicator to determine if schools meet annual yearly progress (AYP) as an evaluative component for NCLB. If students are not successful on standardized tests, then schools will fail to make AYP and will be labeled as needs improvement. For each additional year the school fails to meet AYP, additional consequences exist. Standardized test scores are also used to determine promotion of students in grades 3, 5, and 8 (U.S. Department of Education, 2004). If, as results suggest, students' participation in remedial math courses results in increased standardized test scores, then students who take remedial math will have an increased opportunity to meet the standards presented on standardized tests, which would result in their being promoted to the next grade level. In addition, with student scores increasing and the possibility of increased pass rates, schools would benefit by increased opportunity to meet the annual measureable objectives (AMO) set forth by the state and, thus, increase the possibility of making adequate yearly progress (AYP). When schools are able to make AYP, then they are able to avoid the needs improvement label and other sanctions as imposed by HB1187, the No Child Left Behind Act (U.S. Department of Education, 2004).

In addition, providing remedial courses can assist schools in addressing implementation requirements of response to intervention (RTI). Schools are required to use RTI, introduced as part of the changes that align the Individuals with Disabilities Education Act (IDEA) with the No Child Left Behind Act, in the state of Georgia (Georgia Department of Education, 2008). Tier 2 of the RTI process requires that schools provide struggling students with additional instruction, remediation, or acceleration (Georgia Department of Education, 2008). This study suggests that remedial math may be an appropriate Tier 2 intervention.

Based on evidence provided in this study, remedial courses are effective for both genders when examining standardized test scores. Research on math ability and performance on standardized tests based on gender is inconclusive. Liu and Wilson (2009) reported that male scores reveal a small but consistent advantage over females when examining standardized tests in mathematics. However, other research shows similar growth trends over time for both males and females (Din et al., 2006; Rosselli et al., 2009). The No Child Left Behind Act's requirements for schools to make adequate yearly progress and students to pass standardized testing for promotion make it important to consider gender when looking at the benefits of adding a remedial math course as a Tier 2 intervention. Remedial math must benefit all students, regardless of gender, to be considered as an effective intervention for addressing the requirements of NCLB.

The current research provides some evidence that remedial programs taught as an elective course could benefit students, supporting remediation as an intervention for both genders. However, more research is needed to support these finding and address limitations inherent in the design of this study. IDEA outlines interventions used in the

RTI process as being evidence based, and with little research available on using a remedial math course in middle school, research is needed to support remediation as a successful intervention.

Study results, consistent with previous research, suggest that remedial math courses can affect test scores positively. Principal interviews provided insight to the structure and content of remedial math courses used in this study. The principals' responses to interview questions suggested common elements within each remedial course. The major implication for teachers of remedial math courses is to use organization, affiliation, and product-focus lessons. Implementing these strategies either singularly or in combination has the potential for strengthening math ability and increasing math scores. These components may have contributed to the success of remedial math courses as research is available that reveals the importance of these components in remediation.

Organization of knowledge was one common strategy principals revealed as part of the remedial math course. Organization of knowledge can be both physical and mental. For example, in remedial math, teachers may assist students in organizing their notebook or they may assist students in understanding how to correctly subtract multi-digit problems by aligning numbers. Organization of knowledge is a math strategy that is often associated with math achievement in remedial programs (Bushweller, 1998; Fletcher, 1998; Test & Ellis, 2005; Williamson et al., 2009; Witzel, 2005; Xin, Jitendra, & Deatline-Bachman, 2005). Two studies, including the AVID and FOCUS programs, verified the importance of physical organization (Bushweller, 1998; Fletcher, 1998). These two remedial programs both noted organization as a critical element in remedial education (Bushweller, 1998; Fletcher, 1998). Additionally, mental organization does not come naturally for all students but can be fostered through the use of effective instruction. Several studies have examined mental organization as a way to promote increased achievement and retention of knowledge (Test & Ellis, 2005; Williamson et al., 2009; Witzel, 2005; Xin et al., 2005). Teachers of remedial courses must assist students with both physical and mental organization so that students are able to retain the information presented and transfer the math skills gained to assist them in solving more complex math problems.

Grouping of students with similar needs developed affiliation in the remedial math courses examined in this study. All students in the remedial math class were missing skills necessary to meet their grade-level math standards. Affiliation is another theme that can be found in research as an effective method of instruction and remediation (Flores & Kaylor, 2007; Hoffman & Brahier, 2008; Kroeger & Kouche, 2006). Affiliation involves interaction between students and their peers and teachers. Through this interaction, students are able to develop understanding of important concepts and create connections to assist them in effectively learning the material. Affiliation is important in remedial programs. The students who needed remediation did not fully understand and make connections to the material being taught. Affiliation can assist in making these connections, making remediation successful (Flores & Kaylor, 2007; Hoffman & Brahier, 2008; Kroeger & Kouche, 2006).

Use of product-focused lessons and manipulatives was also discussed by principals as an important component in the remedial math course. Product-focused lessons provide activities that have some real-world meaning; often a physical product is created (although one is not required). Students involved in product-focused learning are able to make a connection (organize knowledge) and often have the opportunity to work in groups (affiliation). Product-focused lessons assist students in seeing the value of course materials in a real-world setting. Students are able to identify with how the materials will be useful to their future. Methods researched as evidence of the importance of product-focused lessons included contextualized problem solving and anchored instruction (Bottge & Hasselburg, 1993; Bottge et al., 2002; Bottge et al., 2007). Often, students can work in groups, and through group collaboration and product meaning, construct an organization of knowledge for the task. Providing meaning beyond that of the classroom will assist students in retaining the information for future use.

Limitations

Several limitations to this study must be considered. This investigation has limited generalizability. The participating schools were limited to two rural school districts in North Georgia; therefore, the results may not be applicable to other school districts with a different geographical makeup, different state math standards, or different standardized tests.

A selection threat due to non-equivalent groups existed in this study. The researcher was unable to randomly assign the control group and treatment group. The participating schools were allowed to choose the students that would participate in remedial math. A covariate, 2009 math CRCT scores, was used in this study to assist in controlling for the selection threat. Additionally, the research examined students with similar demographics; however, despite controls, selection poses a threat to validity.

An implementation threat is also of concern due to the varied courses. While principals were interviewed to ensure program consistency, no classroom visits to ensure program consistency were conducted. While one might assume through principal descriptions that the students were being remediated using similar techniques, the researcher did not document evidence of course equality. In future research, it would be beneficial to use a prescribed remedial course to ensure treatment consistency.

The scope of this study is a limitation. This study was a preliminary study to determine if remedial math was an effective intervention for increasing Georgia CRCT scores. The CRCT does not measure students' academic growth. This test is a measure of current grade level standards that does not correlate with the previous grade level test. Therefore, the results of this study cannot determine academic growth. The results of this preliminary research provide researchers with justification for additional research on remedial mathematics.

Recommendations for Further Research

Based on the limitations of this study and the limited availability of previous research, additional research is needed. A replication of this study is needed to examine how different teachers, different state standards and standardized testing, and different grade levels are impacted by math remedial instruction. Additional research is also needed to increase the rigor of the current study. A similar study is needed that implements a more rigorous research design, including randomized groups, identification of special education students, and a prescribed remedial program.

Future studies to assess the effects of remedial math for at-risk students identified by NCLB as a disaggregated group would also be beneficial. These groups may include economically disadvantaged, limited English proficiency, identified as needing special education, and members of a racial or ethnic group. In order to make AYP, schools must meet annual measureable objectives for all disaggregated groups (No Child Left Behind Act 2001, 2008).

Additional research is needed to determine the emotional benefits of remedial math. A study that examines student perceptions of math could reveal that remedial math has an emotional affect on students that promotes increased confidence levels in mathematics. The changes in student confidence may have impact the math performance of students in both the classroom and on standardized tests.

In addition, further research is needed to determine which elements of remedial math are most beneficial to student performance. This study produced results showing that remedial math is an effective intervention for increasing scores on the Georgia CRCT; however, the study did not examine which math skills provided in the remedial course were able to aid in student understanding in mathematics. Research investigating which techniques or math skills, like number sense, are most effective at assisting struggling students could provide increased understanding of how a remedial math intervention can be beneficial.

More research is needed to understand the long-term effects of remedial instruction. A longitudinal study examining the effects of remedial math on students' continued education could reveal a connection with graduation rates or post-secondary remediation. Research in the post-secondary arena suggests that students who are required to take a remedial math course in college often do not complete their program or they change their course of study to a program that requires less math skill (Attewell et al., 2006; Bahr, 2007). Research in the secondary level is needed to determine if there is a similar relationship between remedial math courses and students' high school courses of study. Likewise, research at the secondary level should also examine the relationship between remedial math courses and the high school graduation rate. Further research is also needed to determine if these students need a remedial math course in college. A future study investigating the impact of remedial math on student attitudes toward mathematics and confidence in mathematical ability could provide additional insight on the benefits of remediation.

Conclusion

NCLB, IDEA, and response to intervention require schools to provide interventions to assist struggling students. School administrators need evidence to support the interventions offered to students. Remedial math courses are an option to consider. The research in this study provided evidence that remedial math courses can increase student standardized test scores regardless of gender. Additional research on remedial math courses is needed to validate these results, determine essential components of a quality remedial math course, and increase understanding of the long-term effects on student achievement.

REFERENCES

Abby, G. (2003, June 16). Can pupils learn in one hot month what they didn't in 9?. *New York Times*. p. 1.

Ai, X. (2002). Gender differences in growth in mathematics achievement: Three-level longitudinal and multilevel analyses of individual, home, and school influences. *Mathematical Thinking & Learning, 4*(1), 1-22.

Allsopp, D. H. (1997). Using class wide peer tutoring to teach beginning algebra.. *Remedial & Special Education, 18*(6), 367.

American Speech-Language-Hearing Association (n.d.). *No Child Left Behind fact sheet on sanctions for schools in need of improvement.* Retrieved from www.asha.org/uploadedFiles/advocacy/federal/.../NCLBSanctions.pdf

Ary, D., Jacobs, L. C., Razavieh, A., & Sorensen, C. (2010). *Introduction to research in education* (7th ed.). Belmont, CA: Thomson & Wadsworth.

Attewell, P., Lavin, D., Domina, T., & Levey, T. (2006). New evidence on college remediation. *Journal of Higher Education, 77*(5), 886-924.

Axtell, P., McCallum, R., Mee Bell, S., & Poncy, B. (2009). Developing math automaticity using a class wide fluency building procedure for middle school students: A preliminary study. *Psychology in the Schools, 46*(6), 526-538.

Bahr, P. (2007). Double jeopardy: Testing the effects of multiple basic skill deficiencies on successful remediation. *Research in Higher Education, 48*(6), 695-725.

Bahr, P. (2008). Does mathematics remediation work: A comparative analysis of academic attainment among community college students. *Research in Higher*

Education, 49(5), 420-450.

Baker, J. D., Rieg, S. A., & Clendaniel, T. (2006). An investigation of an after school math tutoring program: University tutors + elementary students = a successful partnership. *Education, 127*(2), 287-293.

Barnes, A., & Harlacher, J. (2008). Clearing the confusion: Response-to-intervention as a set of principles. *Education & Treatment of Children, 31*(3), 417-431.

Bottge, B. A. (1999). Effects of contextualized math instruction on problem solving of average and below-average achieving students. *The Journal of Special Education*, *33*(2), 81-92.

Bottge, B. A., Grant, T. S., Stephens, A. C., & Rueda, E. (2010). Advancing the math skills of middle school students in technology education classrooms. *NASSP Bulletin, 94*(2), 81-106.

Bottge, B. & Hasselbring, T. (1993). A comparison of two approaches for teaching complex, authentic mathematics problems to adolescents in remedial math classes. *Exceptional Children, 59*(6), 556-566.

Bottge, B. A., Heinrichs, M., Chan, S., & Serlin, R. C. (2001). Anchoring adolescents' understanding of math concepts in rich problem-solving environments. *Remedial & Special Education*, *22*(5), 299-314.

Bottge, B., Heinrichs, M., Mehta, Z.D., & Hung, Y. (2002). Weighing the benefits of anchored math instruction for students with disabilities in general education classes. *The Journal of Special Education 35*(4), 186-200.

Bottge, B. A., Heinrichs, M., Mehta, Z., Rueda, E., Hung, Y., & Danneker, J. (2004). Teaching mathematical problem solving to middle school students in math, technology education, and special education classrooms. *RMLE Online: Research in Middle Level Education*, *27*(1), 1-17.

Bottge, B., Rueda, E., Serlin, R., Hung, Y., & Kwon, J. (2007). Shrinking achievement differences with anchored math problems: Challenges and possibilities. *Journal of Special Education, 41*(1), 31-49.

Bottge, B., Rueda, E., & Skivington, M. (2006). Situating math instruction in rich problem-solving contexts: Effects on adolescents with challenging behaviors. *Behavioral Disorders, 31*(4), 394-407.

Burns, M., Klingbeil, D., & Ysseldyke, J. (2010). The effects of technology-enhanced formative evaluation on student performance on state accountability math tests. *Psychology in the Schools, 47*(6), 582-591.

Bushweller, K. (1998). The forgotten majority. *The American School Board Journal, 185*(3), 16-21.

Calhoon, M., & Fuchs, L. S. (2003). The effects of peer-assisted learning strategies and curriculum-based measurement on the mathematics performance of secondary students with disabilities. *Remedial & Special Education, 24*(4), 235.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Hillsdale, NJ: L. Erlbaum Associates.

Cooper, H., & Charlton, K. (2000). Discussion. *Monographs of the Society for Research in Child Development*, *65*(1), 89-109.

Courtney, M., Zinn, A., Zielewski, E., Bess, R., Malm, K., Stagner, M., & Pergamit, M. (2008). Evaluation of the early start to emancipation preparation tutoring program, Los Angeles County, California: Final Report. *Administration for Children and Families.*

David, M. H. (2005). More third graders promoted after summer school this year. *New York Times*.

Din, C. S., Song, K., & Richardson, L. (2006). Do mathematical gender differences continue? A longitudinal study of gender difference and excellence in mathematics performance in the *U.S. Educational Studies*, *40*(3), 279-295.

Esch, C. (2009). Higher ed's Bermuda Triangle. *Washington Monthly*, *41*(9/10), 38-46.

Fletcher, S. (1998). A focus on students. *The American School Board Journal*.

Flores, M., & Kaylor, M. (2007). The effects of a direct instruction program on the fraction performance of middle school students at-risk for failure in mathematics. *Journal of Instructional Psychology, 34*(2), 84-94.

Foegen, A. (2008). Progress monitoring in middle school mathematics. *Remedial & Special Education*, *29*(4), 195-207.

Fuchs, L. S., Compton, D. L., Fuchs, D., Paulsen, K., Bryant, J. D., & Hamlett, C. L. (2005). The prevention, identification, and cognitive determinants of math difficulty. *Journal of Educational Psychology*, *97*(3), 493-513.

Georgia Department of Education. (2008). *Response to intervention: Georgia's student achievement pyramid of interventions.* Retrieved from http://www.doe.k12.ga.us/ci_services.aspx?PageReq=CIServRTI.

Georgia Department of Education. (2009a). *An assessment and accountability brief: Validity and reliability for the 2009 criterion-referenced competency tests.*

(Received as an email attachment from Dr. Melodee Davis, Director of Assessment Research and Development on January 20, 2010.)

Georgia Department of Education. (2009b). *State of Georgia consolidated state application accountability workbook*. Retrieved from http://www.ed.gov/admins/lead/account/stateplans03/gacsa.pdf.

Georgia Department of Education (2010a). *Education support and improvement.* Retrieved from http://www.doe.k12.ga.us/tss.aspx#.

Georgia Department of Education. (2010b). *Remedial Education Program (REP) guidelines*. Retrieved from http://www.doe.k12.ga.us/ci_services.aspx?PageReq=CIServRemedial

Georgia Department of Education (2011). *Georgia Performance Standards (GPS).* Retrieved from https://www.georgiastandards.org/Standards/Pages/BrowseStandards/BrowseGPS.aspx.

Georgiou, S. N., Stavrinides, P., & Kalavana, T. (2007). Is victor better than victoria at math? *Educational Psychology in Practice*, *23*(4), 329-342.

Gersten, R., Beckmann, S., Clark, B., Foegen, A., Marsh, L., Star, J.R., & Witzel, B. (2009). Assisting students struggling with mathematics: Response to intervention for elementary and middle schools. Retrieved from http://ies.ed.gov/ncee/wwc/publications/practiceguides/.

Hanley, T. (2005). Commentary on early identification and interventions for students with mathematical difficulties: Make sense--do the math. *Journal of Learning Disabilities 38*(4), 346-349.

Heller, L., & Fantuzzo, J. W. (1993). Reciprocal peer tutoring and parent partnership: Does parent involvement make a difference? *School Psychology Review, 22*(3), 517.

Hoffman, L., & Brahier, D. (2008). Improving planning & teaching of mathematics by reflecting on research. *Mathematics Teaching in the Middle School 13*(7), 412-417.

Johnston, P. (2010). An instructional frame for RTI. *Reading Teacher*, *63*(7), 602-604.

Kommer, D. (2006). Boys and girls together. *Clearing House, 79*(6), 247.

Kroeger, S., & Kouche, B. (2006). Using peer-assisted learning strategies to increase response to intervention in inclusive middle math settings. *Teaching Exceptional Children, 38*(5), 6-13.

Kurz, T. L., & Batarelo, I. (2005). Using anchored instruction to evaluate mathematical growth and understanding. *Journal of Educational Technology Systems*, *33*(4), 421-436.

Liu, O., & Wilson, M. (2009). Gender differences in large-scale math assessments: PISA trend 2000 and 2003. *Applied Measurement in Education*, *22*(2), 164-184.

Lubienski, S.T. (2007). What we can do about achievement disparities. *Educational Leadership (65)*3, 54-59.

Malmgren, K., McLaughlin, M., & Nolet, V. (2005). Accounting for the performance of students with disabilities on statewide assessments. *Journal of Special Education*, *39*(2), 86-96.

Mau, W., & Lynn, R. (2000). Gender differences in homework and test scores in mathematics, reading and science at tenth and twelfth grade. *Psychology,* *Evolution & Gender*, *2*(2), 119-125.

Menesses, K. F., & Gresham, F. M. (2009). Relative efficacy of reciprocal and nonreciprocal peer tutoring for students at-risk for academic failure. *School Psychology Quarterly, 24*(4), 266-275.

Mross, M. (2003). *A case study of one middle school's supplemental program designed for remediation in middle school mathematics and preparation for a statewide-standardized test* (Doctoral dissertation, Widener University, Delaware). Retrieved from EBSCOhost database.

Mulcahy, C. A., & Krezmien, M. P. (2009). Effects of a contextualized instructional package on the mathematics performance of secondary students with EBD. *Behavioral Disorders, 34*(3), 136-150.

National Commission on Excellence in Education. (1983). *A nation at risk: The imperative for educational reform.* Retrieved from http://www.ed.gov/pubs/NatAtRisk/index.html.

National Council for Teachers of Mathematics. (2007). *Principles and standards of school mathematics*. Reston, VA: Author.

No Child Left Behind Act of 2001, 20 U.S.C. § 6319 (2008).

Patrick, W. (n.d.). Math meltdown. *USA Today*.

Read, K. (n.d.). *LERN 10--Online tutor training project.* Retrieved from http://www.ccsf.edu/Services/LAC/Lern10_Online_Tutor_Training/.

Rosselli, M., Ardila, A., Matute, E., & Inozemtseva, O. (2009). Gender differences and cognitive correlates of mathematical skills in school-aged children. *Child Neuropsychology*, *15*(3), 216-231.

Samuels, C. (2009). 'Response to intervention' in math seen as challenging. *Education Week, 28*(35), 7.

Sax, L. (2006). Six degrees of separation: What teachers need to know about the emerging science of sex differences. *Educational Horizons, 84*(3), 190-200.

Schachter, R. (2008). Remedial nation. *University Business*, *11*(12), 52-56.

Schultz, E. (2001). Two classes are better than one. *Teacher Magazine*, *3*(2), 26. Retrieved from http://www.edweek.org/tm/articles/1991/10/01/2remed.h03.html.

Shaffer, S., & Shevitz, L. (2001). She bakes and he builds: Gender bias in the curriculum. In H. Rouse & M. Wehmeyer (Eds.), *Double jeopardy: Addressing gender in special education* (pp. 115-130). Albany, NY: State University of New York Press.

Skinner, B. F. (1974). *About behaviorism.* New York, NY: Vintage Books.

Test, D., & Ellis, M. (2005). The effects of LAP fractions on addition and subtraction of fractions with students with mild disabilities. *Education & Treatment of Children*, *28*(1), 11-24.

Topping, K. J., Miller, D. D., Murray, P. P., Henderson, S. S., Fortuna, C. C., & Conlin, N. N. (2011). Outcomes in a randomized controlled trial of mathematics tutoring. *Educational Research*, 53(1), 51-63. doi:10.1080/00131881.2011.552239

Tsui, M. (2007). Gender and mathematics achievement in China and the United States. *Gender Issues, 24*(3), 1-11.

U.S. Department of Education (2004). *Four pillars of NCLB.* Retrieved from http://www.ed.gov/nclb/overview/intro/4pillars.html.

U.S. Department of Education (2007). *IDEA regulations: Alignment with the No Child Left Behind Act.* Retrieved from http://idea.ed.gov/explore/view/p/%2Croot%2Cdynamic%2CTopicalBrief%2C3%2C

U.S. Department of Education (2009). *Family Educational Rights and Privacy Act (FERPA)*. Retrieved from http://www.ed.gov/policy/gen/guid/fpco/ferpa/index.html.

University of Wisconsin-Madison (2009, June 2). Culture, not biology, underpins math gender gap. *Science Daily*. Retrieved from http://www.sciencedaily.com-/releases/2009/06/090601182655.htm

Whitney, S. (2008). *Parent's guide to No Child Left Behind*. Retrieved from http://www.wrightslaw.com/info/nclb.parent.guide.heath.htm

Williamson, P., Bondy, E., Langley, L., & Mayne, D. (2009). Meeting the challenge of high stakes testing while remaining child-centered. In K. Cauley & G. Pannozzo (Eds.), *Annual Editions: Educational Psychology* (23rd ed., pp. 215-220). Boston, MA: McGraw Hill.

Wirt, J., Choy, S., Rooney, P., Provasnik, S., Sen, A., and Tobin, R. (2004). *The Condition of Education 2004* (NCES 2004-077). Washington, DC: Government Printing Office.

Witzel, B. (2005). Using CRA to teach algebra to students with math difficulties in inclusive settings. *Learning Disabilities--A Contemporary Journal*, *3*(2), 49-60.

Xin, Y., Jitendra, A., & Deatline-Buchman, A. (2005). Effects of mathematical word problem-solving instruction on middle school students with learning problems. *Journal of Special Education*, 39(3), 181-192.

Zuelke, D., & Nelson, J. (2001). The effect of a community agency's after-school tutoring program on reading and math GPA for at-risk tutored students. *Education 121*(4), 799-809.

APPENDIX A: INSTITUTIONAL REVIEW BOARD APPROVAL

IRB Approval 864.060310: Using remedial math to increase test scores

Institution Review Board

Sent: Wednesday, July 21, 2010 6:59 PM

To: Adams, Chastity; Szapkiw, Amanda; Garzon, Fernando L.

Cc: Institution Review Board

Attachments: Annual Review Form.doc (29 KB) ; Change in Protocol.doc (25 KB)

Dear Chastity,

We are pleased to inform you that your above study has been approved by the Liberty IRB. This approval is extended to you for one year. If data collection proceeds past one year, or if you make changes in the methodology as it pertains to human subjects, you must submit an appropriate update form to the IRB. Attached you'll find the forms for those cases.

Thank you for your cooperation with the IRB and we wish you well with your research project. We will be glad to send you a written memo from the Liberty IRB, as needed, upon request.

Sincerely,

Fernando Garzon, Psy.D.
IRB Chair, Liberty University
Center for Counseling and Family Studies Liberty University
1971 University Boulevard
Lynchburg, VA 24502-2269
(434) 592-4054
Fax: (434) 522-0477

APPENDIX B: SUPERINTENDENT OF SCHOOLS APPROVAL

Approval for District A

March 22, 2010

Mrs. Chastity L. Adams
[redacted]

Dear Mrs. Adams:

I have reviewed your research proposal entitled **"Using Remedial Math to Increase Student Achievement on Standardized Test."** I am please to inform you that [redacted] County School System has agreed to allow the use of our schools and students as part of your research. Please contact middle schools principals for data collection information and to schedule appointments to discuss our connections math course.

We look forward to working with you.

[redacted]

[redacted]
Superintendent of Schools
[redacted] County Schools
[redacted]

Approval for District B

Printed by: **Chastity L Adams** Tuesday, July 05, 2011 10:58:42 AM
Title: **Re: Research : County Mail** Page 1 of 1

From:	"[redacted]" <[redacted]>	Mon, Mar 22, 2010 7:45:55 AM
Subject:	Re: Research	
To:	**Chastity L. Adams**	

The principals have agreed--[redacted], [redacted], [redacted], and [redacted] Our sixth graders are housed in 3 eleomentary schools and our 7th graders are at the middle school. You need to check with each principal to determine how long students are in remediation classes
----- Original Message -----
From: "Chastity L. Adams" <[redacted]>
To: [redacted]
Sent: Friday, March 19, 2010 6:00:54 PM
Subject: Research

Dr. [redacted]

I am beginning work on my dissertation and would like to request permission to use [redacted] County middle school as part of my research on the impact of an extra 50 minutes of math instruction on CRCT scores. Through this research, I plan to compare the students receiving a math remediation during a connections period with students that have similar characteristics (based on 6th grade CRCT scores) at other middle schools not offering math remediation. It is my understanding that your middle school offers such a program as a connection class.

My research involves looking at CRCT data of 6th and 7th graders from the 2009 and 2010 test to determine if there is a difference between students who did and those who did not receive an extra 50 minutes of math instruction daily. While, I would not use the system, school, nor student names in my research, I believe the findings will prove valuable to you, as well as administrators throughout Georgia.

I am completing my doctorate at Liberty University. My committee consist of two Liberty faculty members, one which currently serves as a school superintendent in New York, and retired [redacted] superintendent, Dr. [redacted]. My research will pass through a review process by the internal review board at Liberty before I am allowed to collect data.

I have a vested interest in [redacted] County schools, [redacted]. I feel this research will be of great benefit to the school system. However, I am not aware of the research process for [redacted] County School System. Do we need to meet and discuss my research plans specifically? Would you like a copy of my methods chapter? Please let me know the next step.

Chastity L. Adams, Ed.S
Media Specialist
[redacted] Middle School
[redacted]

APPENDIX C: INTERVIEW CONSENT FORM

Consent for Principals

I, ________________________, agree to participate in a research study titled, "Using Remedial Math to Increase Test Scores," which is being conducted by Mrs. Chastity Adams, from the College of Education at Liberty University. I do not have to participate in this study if I do not want to. I can stop taking part at any time without giving any reason, and without penalty. I can ask to have the information related to my interview returned to me, removed from the research records, or destroyed.

- The reason for the study is to find out how remedial math is affecting student performance on standardized testing. In an effort to help students succeed in math, the researcher would like to learn more about how this program assists students in gaining new skills. By participating, I agree to allow the researcher to interview me about the school operations and how the remedial math program is conducted.
- The researcher hopes to learn something that may help other students and schools create successful remedial courses.
- If I participate, the interview records (recordings and transcripts) will be only be accessed by the researcher.
- Any information collected will be held confidential unless otherwise required by law. My identity will not be disclosed.
- The researcher will answer any questions about the research, now or during the course of the project, and can be reached by telephone at XXX-XXX-XXXX.
- I understand the study procedures described above. My questions have been answered to my satisfaction, and I agree to take part in this study. I have been given a copy of this form to keep.

<u>Chastity Adams</u> ________________________________
Name of Researcher Signature Date
Telephone: XXX-XXX-XXXX
Email: cadams5@liberty.edu

________________________________ ________________________________
Name of Participant Signature Date

Please sign both copies, keep one, and return one to the researcher.

APPENDIX D: GUIDING INTERVIEW QUESTIONS

Guiding Questions for Principal Interview

1. Tell me about the class schedule at your school. Length/days of the week each class meets, specifically math.
2. Do you offer math specific interventions to struggling students? If so, please describe:
    a. How often do these meet and for how long (a connection class?)?
    b. What topics are covered?
    c. Are these used as an intervention?
        i. If so, what Tier?
3. How are students identified for math interventions? Test scores/teacher recommendation/academic grades/other.
4. **If you offer a remedial math course:**
    a. Is the class used as a connections course?
        i. How many days per week?
        ii. What is the time length?
    b. Do you use CRCT scores to determine student placement?
        i. What is the cut-off score?
    c. Do all students under this score take remedial math?
        i. If not, how do you determine which students take the course?
    d. Are resource students included?
        i. If so, same remedial course as other students or a separate remedial course?
    e. Is placement fluid (students move in and out throughout the year)?
        i. How do you determine when students are ready to come out of the course?

APPENDIX E: GEORGIA RTI GRAPHIC PERMISSION

Printed by: **Chastity L Adams** Tuesday, July 05, 2011 11:27:54 AM
Title: **Re: RTI : County Mail** Page 1 of [redacted]

From: Albert Blenke <[redacted]> Tue, Jun 21, 2011 10:05:44 AM

Subject: Re: RTI

To: **Chastity L. Adams**

Attachments: Attach0.html 4K
0clip_image002.png 58K

I have no problem with you using the Georgia RTI model as long as you show somewhere on the document that it is the property of the Georgia Department of Education. I give you permission to use this with the stipulation mentioned.

Albert Patrick "Pat" Blenke
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