

EVALUATING THE EFFECTIVENESS OF AN INTERVENTION  
MATHEMATICS CLASS FOR LOW ACHIEVING MIDDLE SCHOOL STUDENTS  
IN NORTHWEST GEORGIA

by

Johnnie Hugh Coats

A Dissertation Presented in Partial Fulfillment  
Of the Requirements for the Degree  
Doctor of Education in Leadership

Liberty University

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**ABSTRACT**

High-stakes testing has become crucial in public education, requiring students to meet increasingly higher standards, regardless of their ability levels. This causal-comparative study sought to determine the effectiveness of an intervention mathematics course in the middle school setting for at-risk, sixth grade students. The Georgia Criterion Referenced Competency Test (CRCT) math scores of 143 at-risk students enrolled in a remediation mathematics course were compared to scores from a control population of 143 at-risk students who did not participate in the class. Math scores from the 2008 administration of the CRCT test were used as covariates, and comparisons were made using the 2009 math CRCT scores for students in the intervention class against scores from students not taking the class. Results showed that there were no significant gains in the scores of students who took the remediation class, regardless of ethnicity or socioeconomic status. However, statistically significant results were seen for the female population who took the class. These results imply that an extra math remediation class in addition to a regularly scheduled math class did not improve student performance on this particular high stakes test. Thus, alternative treatment formats may be considered, and more research in this field is recommended.

*Descriptors:* low achieving, at-risk, cut score, intervention mathematics course, high-stakes testing, informal assessments, connections class, subgroups

## **DEDICATION**

God has been ever present in my life and has directed my steps. As a child, my parents helped me to understand how God will never leave me, nor forsake me, and that has been so true! Following Christ's example, my wife Marilyn has also never left me, nor forsaken me. There are not enough words to express how much my wife has helped me through this journey. From the times she has read through my drafts and edits, to the times she has taken our boys to her parents so that I could have a quiet house for the night, the motivation and drive she has supplied me with, and even how she has been a constant sounding board of ideas and thoughts, there are simply no other words than thank you "hunny."

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### **List of Abbreviations**

Adequate Yearly Progress (AYP)

Confidence Limit (CL)

Criterion Referenced Competency Test (CRCT)

Degrees of Freedom (DF)

Individual Education Plan (IEP)

Institutional Review Board (IRB)

New King James Version (NKJV)

No Child Left Behind (NCLB)

Participant Number (N)

Socioeconomic Status (SES)

Standard Error (Std Err)

Standard Deviation (Std Dev)

Teach for America (TFA)

## **CHAPTER ONE: INTRODUCTION**

Accountability mandates from federal and state departments aimed towards high-stakes testing have caused educational leaders to make quick decisions regarding classroom instructional models and delivery options for students. As a result, varied instructional programs focusing on individualized instruction and multiple means of learning have been created to improve student achievement (Chen & McNamee, 2006; Mattson, Holland, & Parker, 2008). This dissertation utilized a causal-comparative design to research the impact of a remediation class for at-risk sixth grade math students who had failed or were in danger of failing the state high-stakes test. Intensive treatment was offered to struggling math students during an extra math period, in addition to a regularly scheduled math class. Achievement was measured using the Criterion Referenced Competency Test (CRCT) scores of students. Additional examination of remediation accounted for socioeconomic status (SES), ethnicity, and gender. Chapter 1 presents the background of the study, discusses the problem statement, presents the purpose and significance of the study, and defines important terms.

### **Background**

Student achievement and success within the classroom are at the forefront of public schools today. With legislation such as No Child Left Behind (NCLB) and the ever-increasing need for schools to meet Adequate Yearly Progress (AYP), public school leaders must determine how to best meet the needs of diverse learners in the classroom (Georgia Department, 2011a; Georgia Department, n.d.). One critical area is in mathematics.

With demands to meet increasing passing standards on high-stakes tests, such as the CRCT, a need exists to provide instructional programs and opportunities for all students.

Although results of the National Assessment of Educational Progress (NAEP) have shown that student math achievement is improving in grades four and eight, gaps still exist among subgroups of students (The Nation's Report, 2011). Findings indicated that in 2011, students in grades four and eight, had higher mathematic achievement than any year before, but African American and Hispanic students showed lower achievement levels than Caucasian students (The Nation's Report, 2011). However, the 2011 scores were also higher than they had been in previous years for African American and Hispanic populations. Such gaps in achievement were noted to be statistically significant (The Nation's Report, 2011).

As far back as 1983, with the publishing of the famed report, *A Nation at Risk*, there has been a “widespread public perception that something is seriously remiss in our educational system” (The National Commission, 1983, p. 7). Thus, there was a call to develop the talents of the youth of the nation to their fullest. Proposing to use the tools already available to them, the report suggested the nation support national educational reform, even citing President Ronald Regan's reference to the initial national thirst for education (The National Commission, 1983).

In 2001, the United States Department of Education passed into public law No Child Left Behind (NCLB, 2001). The goal of NCLB was to equate the achievement of students by taking out the performance gap. Minimum accountability was created for public schools to deliver education in a manner that pushed all students to succeed academically, regardless of their achievement level (U.S. Department, 2002). Success in schools is measured by making Adequate Yearly Progress (AYP). Standardized testing, high school graduation rates, and attendance also determine those successes. In order to meet the mandates of NCLB, AYP must be obtained yearly; failure to meet objectives set

forth will result in a school (or school system) being placed in need of improvement status (U.S. Department, 2001). Subsequently, the need for schools to meet standards of NCLB is very high.

Support for all students, especially students with disabilities, is now provided through the Individuals with Disabilities Act (IDEA) (U. S. Department, 2011). IDEA has been implemented to equate identified special education students to nonspecial education students. Since NCLB mandates success on standardized tests for all schools and school systems, and IDEA creates accountability for special education students, the need exists to provide support for students in a manner that will keep schools and school systems achieving at increasing rates and out of the needs improvement category with the departments of education (U. S. Department, 2011).

One such strategy to help schools and school systems is Response to Intervention (RTI), a model designed to assist school leaders and teachers in providing support for students who are not achieving at proficient levels (U.S. Department, 2008). Originating with IDEA, RTI has several levels of intervention and is flexible within different states. The state of Georgia uses this model. The interventions that are contained within the RTI model are different for each individual student or situation (U. S. Department, 2008); therefore, the specific needs for each student have to be met by researched-based strategies in order to assist those at-risk or struggling students in high-stakes testing situations and in the classroom.

With demands to meet increasing passing standards on high-stakes tests, such as the CRCT, administrators and teachers need to provide research-based instructional treatments and opportunities to assist students who need extra support in meeting the rigors of grade-level standards in math. Chen and McNamee (2006) suggested that not all

students are the same, and that no “two minds work in the same way” (p. 109).

Educational programs, then, must be tailored for the individual and not presented in the heterogeneous manner that would fit the average class of students. Mattson, Holland, and Parker (2008) noted the need to provide multiple learning experiences for each student. Therefore, teachers should consider the unique needs of the students in order to meet the variety of learning styles and levels within the classroom. This, then, suggests remediation is a process that educators can use to better meet the needs of diverse students.

Most studies on math remediation have been conducted at the postsecondary level; therefore, how these strategies work with students in secondary K-12 schools is still unclear. Bahr (2008) completed a study designed to determine the effect of a math intervention class among first time freshmen from 107 community colleges. Results of his study indicated that students who successfully passed math remediation courses successfully transferred into regular math courses over 50% of the time. Thus, these results indicated that these particular programs were effective in resolving skills deficiencies among students. Another similar study conducted by Bahr (2010) analyzed five factors of racial differences from 104 California community colleges and indicated remediation to be what African Americans and Hispanics needed for success in their first year of college. That study indicated a gap in benefits of remediation for those two ethnicities in first-year mathematics courses at the postsecondary level. Bahr also noted that long-term effects of remediation were beneficial as well.

Some studies have focused on math interventions in middle schools. Turner and Tigert (2010) studied a remediation strategy of *math camp* that entailed middle school students visiting their prior elementary schools to experience authentic math activities. A



review of 3 years of the program showed significant increases in student scores on the California Standardized test for those students who participated in the camp, as opposed to those who did not.

Specific to skill deficiency, a study was done by Weber (2008) where one-on-one math remediation was offered to a student during the course of a year. The teacher's goal was to help the student understand the course material, rather than simply encourage the rote memorization of math skills. Successes were seen after one-on-one instruction, specifically in regards to motivation, as the student was observed to have obtained small successes over the course of the year and therefore had greater joy, encouragement, and even self-motivation when doing math.

Nomi and Allensworth (2009) provided an intervention strategy of *double dosing* struggling students, allowing them to take an extra Algebra class during the school day or to participate in a block schedule class that lasted 2 hours. The results showed that the support course improved test scores for the students, and slightly improved grades and failure rates. Interestingly, those students who had low abilities coming into the course did not make as high of gains as those students whose initial abilities were close to the national mean.

Musoleno and White (2010) studied middle-grades, high-stakes testing by gathering data and opinions from educational leaders, many with 20 or more years' experience in middle-grades education. Their online surveys of several middle grades practices were analyzed. Findings from the surveys given to educational leaders from Pennsylvania illustrated that remediation strategies were used for at-risk students towards standardized testing and often other classes were sacrificed, as well as best teaching

practices. The importance of Musoleno and White's study was that remediation was applied in a problem area and towards high-stakes, middle school testing.

In an article about why school reform is an important part of implementing techniques for students with who have difficulty with math, Hanley (2005), stated that early identification coupled with interventions for students having mathematical difficulties could prove beneficial. Early identification was crucial, along with strengthening counting strategies, arithmetic combinations, and number sense. Kulm, Capraro, and Capraro (2007) found that a year of using the Connected Mathematics program for sixth grade students showed favorable results on the Texas Assessment of Academic Skills. Their study showed an increase in scores from fifth to sixth grade for all students. Non at-risk students had a 2 point mean gain, while at-risk students had a 10 point gain, supporting the strategy of the Connected Mathematics program. Likewise, Ysseldyke and Bolt (2007) conducted a technology program study with 3,000 elementary school students. They found that when teachers utilized a computer system that allowed for continual progress monitoring of student growth in intervention classes, student support was increased on two standardized, nationally-normed tests. The program allowed teachers to change their lessons based upon student responses and needs within the program. This type of result is important for educators seeking a means to find benefit and success for students.

Poncy, Skinner, and Axtell (2010) used fact fluencies and a comparison component of pretests and interventions to aid struggling math students. Results of their study indicated that remediation strategies were effective in improving student scores on posttests. Similarly, Rittle-Johnson and Koedinger (2005) utilized scaffolding and computer-based instruction for 223 sixth-grade students with the goal of enhancing

student learning as a remediation strategy. Their results of the study suggested that specific interventions of error analysis and scaffolding contextual, conceptual, and procedural knowledge, coupled with computer program support, improved student learning. Thompson (2009) employed teaching strategies that utilized manipulatives, self-assessment, cooperative projects, and computer-based technologies that showed improvement for students in approximately 400 math and science classrooms. The goal was to analyze the teaching strategies in those classrooms by having preparation, performance, and practice as the framework of the study. These techniques allowed students to score better on the Iowa Test of Basic Skills.

Dunleavy and Heinecke's (2007) research revealed that technology could have benefits. The 1:1 laptop implementation in grades six, seven, and eight was to ascertain how incorporating those technologies might aid student learning. The results showed some anticipated benefits (to assess learning, individualize learning, guide pacing of material, access online material, and provide networking for teachers and students). Dunleavy and Heinecke noted the overall difficulty teachers had with the computers; there were many problems that arose due to the technology implementation for the students' use.

The strategy of 1:1 laptop use would suggest an individualized approach to learning, since students have the access to personalize their learning experience. The strategy of using aides, whether conceptual and abstract, concrete, or technology-based, yields the same result: students will have to have specific and individualized instruction for success. Since remediation suggests individualization for students, analyses that proceed in a similar manner are needed.

These problems not only affect the middle schools, but most of the public schools within the local school system and at the state level as well, as all are accountable to the federal standards of the NCLB legislation. Some research has shown that specific instructional intervention strategies that occur within mathematics classes resulted in improved student achievement (Dunleavy, & Heinecke, 2007; Hanley, 2005; Kulm, Capraro, & Capraro, 2007; Poncy, Skinner, & Axtell, 2010; Rittle-Johnson, & Koedinger, 2005; Thompson, 2009; Ysseldyke, & Bolt, 2007). However, limited research has been conducted to determine the impact that the addition of remediation in the form of an intervention math class will have on student achievement (Wright, 2009), particularly utilizing standardized test scores, such as CRCT test scores. This study sought to provide further instructional information regarding the effectiveness of that type of remediation.

In the school system targeted for this study, sixth grade students consistently have failed to meet required proficiency levels on the CRCT, a state-mandated test. The CRCT is a standardized test used by the state of Georgia for grades three through eight and is summative in nature as it covers all the prescribed standards that are taught in those grades for the subject areas of reading, English/language arts, mathematics, science, and social studies. A passing score for the CRCT is 800 or higher. The cooperating school system has conventionally used a *cut score* of 820 or lower to denote students who were at-risk of failure.

Since the rate of failure was high for the county and state for sixth grade students on the math portion of the CRCT, the results of the study are significant to the general statewide population of struggling sixth grade students as a means of prescription for students who have failed the math CRCT in fifth grade or are close to failing. Table 1.1 contains data comparing math scores on the CRCT of all sixth grade students in the state

of Georgia against the scores of sixth grade students in the county participating in the study for the 2006-2009 school years (Georgia Department, 2008; Georgia Department, 2009). The percentage of test scores that were not passing was similar for sixth grade students on the county and state levels.

Table 1.1

*Sixth Grade Students Not Passing the Mathematics CRCT*

Year	Georgia	County
	Percentage not passing	Percentage not passing
2006	38%	39%
2007	35%	35%
2008	31%	28%
2009	25%	25%

Table 1.2 contains historical data of sixth grade students' failing math scores on the CRCT for the county studied (reported as percentages) as opposed to the same group of students tracked from first through sixth grade. The data show both a trend of sixth grade students failing at high rates and the same group of students tracked from first through sixth grade falling into that trend once they reach the sixth grade. This could mean that the elementary testing was somehow easier, or that the middle-grades testing was harder. Such a determination was nearly impossible to make, but for the county identified in this study, sixth grade students have struggled on the mathematics portion of the CRCT. It is clear in examining the data presented within the table that something needed to be done for sixth grade students' success on the mathematics portion of the CRCT.

Table 1.2

*County Students Not Passing the Mathematics CRCT*

Sixth grade students 2004-2009				2009 cohort of 6 <sup>th</sup> grade students through 1 <sup>st</sup> – 6 <sup>th</sup> Grades		
Year	Number Tested	Grade	%	Number tested	Grade	%
2004	1116	6	25%	1091	1	12%
2005	1056	6	23%	1085	2	12%
2006	1093	6	39%	1105	3	8%
2007	1040	6	35%	1093	4	21%
2008	1069	6	28%	1128	5	13%
2009	1090	6	23%	1090	6	23%

In order to provide a potential solution to this problem, the school-system leaders arrived at the decision to create an intervention class designed to provide intensive treatment for students with test scores of 820 or below who were in danger of failing the CRCT in math their sixth grade year. Thus, the purpose of this study was to examine the effectiveness of a remediation mathematics class for a population of 143 sixth grade students who were initially selected by the cooperating school system and were in danger of failing their sixth grade math CRCT in four middle schools located in one northwest Georgia school district. The control population of students in this study was 143 sixth grade students who were also considered to be at-risk, but were not chosen to participate in the remediation math class. Data were also analyzed based upon demographic subgroups of socioeconomic status (SES), ethnicity, and gender. The remediation math class was different from the regular math class in several ways. The class was smaller

(generally five to 10 students less with a maximum of 20 students); the students were only in the class as long as needed to raise their test scores (typically 1 year, but sometimes less), and it was taught during the time when the student would normally be in an elective class (physical education, music, art, technology, or band), so other core-curriculum classes were not missed. Four teachers taught the remediation math class, one at each of the four middle schools in the district. As a result, a limited number of students were able to take the course as there were only two remediation math classes per school for sixth grade students during those students' connections class times. Thus, the potential existed that more students qualified for the class than there were available seats.

To establish the sample for this study, participants for the remediation math class were selected from the target population of students who scored an 820 or below on the math portion of the CRCT by the cooperating schools' administrators and teachers. Students in the control group were randomly selected from the convenience sample of 143 sixth grade students from the remaining population of at-risk students not enrolled in the remediation mathematics course for the 2008-2009 school years who had similarly low-test scores on the mathematics CRCT.

Bandura's social cognitive theory was used in this study (Bandura, 1986; Bandura, 1989; Zimmerman, Bandura, & Martinez-Pons, 1992; Bandura, Barbaranelli, Caprara, & Pastorelli, 2001; Bandura & Bussey, 2004). In his research, Bandura consistently discovered students behaved in a manner that could be described as repeated from a previously observed point in time (Zimmerman, Bandura, & Martinez-Pons, 1992). According to the theory, individuals learn through social interaction with others, through interacting with the environment, and through observing the behavior of others. Specifically, the theory focuses on how internal and external factors impact one's

behavior (Bandura, 1986). Thus, researchers embracing this theory consider the authentic way in which people develop behavior patterns in the context of the social environment. A large impact on one's behavior also is determined by one's past experiences. These factors determine how and why one engages in certain behaviors (Bandura, 1986)

Since this dissertation sought to analyze the effectiveness of an intervention math class for at-risk students, social cognitive theory might help to explain why there were successes or failures. As such, some students who have previously struggled in math and were termed at-risk were allowed the opportunity to receive a treatment aimed at improving math test scores. Students would have been successful if they had learned in previous grades what they needed to be successful on high-stakes testing. A problem exists for students who struggle consistently in a specific area.

### **Problem Statement**

It was not known whether receiving a math class for remediation targeted toward student success on high-stakes testing would improve the math achievement of at-risk sixth grade students on the CRCT. In theory, as proposed by school leaders in the cooperating system, the remediation math course might have provided needed support for at-risk students. Literature indicated a gap between mathematics intervention and middle-grades teaching and learning, specifically in the area of remediation for at-risk math students and high-stakes tests (Wright, 2009).

There were a few studies that discussed interventions in middle-grades mathematics education for the purposes of teaching and learning for at-risk and struggling students; those relating studies were either structured differently or there were execution differences (Dunleavy, & Heinecke, 2007; Kulm, Capraro, & Capraro, 2007;



Poncy, Skinner, & Axtell, 2010; Rittle-Johnson, & Koedinger, 2005). The school system targeted for this study sought to create a class that was specific to at-risk students and address deficiencies on high-stakes testing, meaning that it was expected for all students to be able to pass their math CRCT.

### **Purpose Statement**

The purpose of this causal-comparative, quantitative study was to determine whether or not participating in an remediation math class (in addition to their regularly scheduled math class) targeted toward student success on high-stakes testing improved the math achievement of 143 at-risk sixth-grade students on the math portion of the CRCT. Additional analysis was conducted on socioeconomic status, ethnicity, and gender subgroups as a means to analyze other areas of possible effectiveness. Specifically, this study utilized a remediation math class for those identified students based upon previous scores and low performance with the hopes of raising math CRCT scores. The study then made a comparison against a control population. The independent variable for the study was the status of the students receiving or not receiving the treatment of the remediation math class for remediation. The dependent variable was the 2009 math CRCT scores of the at-risk students with the 2008 math CRCT scores serving as the covariate for analysis.

### **Significance of the Study**

This study was significant to the field of mathematics research in several ways. These significant areas include helping to bridge the gap of literature that exists regarding middle-grades mathematics education and middle-grades mathematics intervention programs for at-risk students (Wright, 2009). While few, similar studies for middle-grades math remediation in the state of Georgia existed, most either focused on another

grade level or different subgroups, or the designs of the studies were different ((Dunleavy, & Heinecke, 2007; Hanley, 2005; Kulm, Capraro, & Capraro, 2007; Poncy, Skinner, & Axtell, 2010; Rittle-Johnson, & Koedinger, 2005; Thompson, 2009; Ysseldyke, & Bolt, 2007). This study was important because it provided school leaders with a clearer direction when looking for possible solutions regarding intervention math classes as a strategy for remediation within their own populations. This study did not seek to determine the most effective design of an intervention course, but rather, solely reviewed the effectiveness of it (Wright, 2009). The results of the study provided the outcome of the treatment and not the development of the course for particular participants. It may be possible for schools with similar demographics to learn how to structure a remediation math course based upon the findings within this study.

### **Research Questions**

The following research questions guided data collection in this study:

1. Is there a difference in at-risk 6<sup>th</sup> grade students' CRCT scores based on their participation in a remediation class as compared to at-risk students who did not participate in a remediation class while controlling for the 5<sup>th</sup> grade CRCT scores of both groups?
2. Is there a difference in at-risk 6<sup>th</sup> grade students' CRCT scores who participated in a remediation class as compared to at-risk students who did not participate in the remediation class based on their socioeconomic status while controlling for the 5<sup>th</sup> grade CRCT scores of both groups?
3. Is there a difference in at-risk 6<sup>th</sup> grade students' CRCT scores who participated in a remediation class as compared to at-risk students who did not participate in the

- remediation class based on their ethnicity while controlling for the 5<sup>th</sup> grade CRCT scores of both groups?
4. Is there a difference in at-risk 6<sup>th</sup> grade students' CRCT scores who participated in a remediation class as compared to at-risk students who did not participate in the remediation class based on their gender while controlling for the 5<sup>th</sup> grade CRCT scores of both groups?

### **Hypotheses**

Null hypothesis 1:  $H_{01}$ : There will be no statistically significant difference in the mathematics CRCT scores of 6<sup>th</sup> grade students who receive a remediation class of math instruction as compared to those at-risk students who do not participate in this class, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores of both groups.

Null hypothesis 2.0:  $H_{2,0}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students based on socioeconomic status (SES), while controlling for their 5<sup>th</sup> grade mathematics CRCT scores.

Null hypothesis 2.1:  $H_{2,1}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students who receive a remediation class of math instruction as compared to those at-risk students who do not participate in the class, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores of both groups as aggregated by SES.

Null hypothesis 2.2:  $H_{2,2}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students who receive a remediation class of math instruction based on socioeconomic status (SES) as compared to those at-risk students who do not participate in the class, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores.

Null hypothesis 3.0:  $H_{3,0}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students based on ethnicity, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores.

Null hypothesis 3.1:  $H_{3,1}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students who receive a remediation class of math instruction as compared to those at-risk students who do not participate in the class, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores of both groups as aggregated by ethnicity.

Null hypothesis 3.2:  $H_{3,2}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students who receive a remediation class of math instruction based on ethnicity as compared to those at-risk students who do not participate in the class, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores of both groups.

Null hypothesis 4.0:  $H_{4,0}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students based on gender, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores.

Null hypothesis 4.1:  $H_{4,1}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students who receive a remediation class of math instruction as compared to those at-risk students who do not participate in the class, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores of both groups as aggregated by gender.

Null hypothesis 4.2:  $H_{4,2}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students who receive a remediation class of math instruction based on gender as compared to those at-risk students who do

not participate in the class, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores of both groups.

### **Identification of Variables**

An analysis of covariance (ANCOVA) was conducted where the dependent variable was the test scores of students at the end of the 2009 school year, where the independent variable was the treatment of students (students receiving the treatment and students not receiving the treatment), and the covariate was the 2008 math test (Gall, Gall, & Borg, 2007). Initial testing was conducted to analyze potential group differences and control for any of those differences through the ANCOVA (Gall, Gall, & Borg, 2007 & Howell, 2008).

Two classes of approximately 20 at-risk students from each of the four middle schools were selected by administrators and teachers to receive the treatment a remediation math class. A class for the students receiving remediation met during a time that was typically scheduled for students to have their physical education, art, music, or other exploratory classes. Those students received targeted mathematics instruction during the course of the intervention math class.

This class was approximately the same length of time as the regular math class the students were in each day. The teachers of the remediation class taught the class following the same state-issued and system-issued frameworks and timelines as the non-intervention math teacher. Those teachers focused on remediation and intervention strategies for the students in the class as well. The teachers of the remediation class conducted regular examinations and assigned homework, as this intervention class was not just a support class, but one where the students received grades based upon performance, much like a regularly scheduled class. Apart from being held during the

time when the other students attended elective classes, the students experienced a math class very similar to the one during their regularly scheduled core classes, with the exception being that the class was populated with students who had scored an 820 or below on their fifth grade math CRCT.

### **Definition of Core Terms**

*At-risk:* Students who had scored an 820 or below on their math CRCT where the passing score is an 800 are termed to be close to that failure threshold. The cooperating school system used this designation casually as an identifier for students close to failure.

*CRCT:* Criterion Referenced Competency Test is a state of Georgia assessment used in grades three through eight for purposes of analyzing learned skills with state-issued standards in the subjects of reading, English/language arts, mathematics, science, and social studies (Georgia Department, n.d.).

*GPS:* Georgia Performance Standards were developed by the state of Georgia for the dual purposes of adding rigor to the curricula and aligning standards across grade levels. Grade levels K-12 contain GPS (Georgia Department, 2008 & 2009).

## **CHAPTER TWO: REVIEW OF THE LITERATURE**

### **Introduction**

The purpose of this causal-comparative, quantitative study was to determine whether or not receiving a remediation math class (in addition to a regularly scheduled math class) geared toward student success on high-stakes testing improved the math achievement of at-risk sixth grade students on the math portion of the CRCT. The class was conducted during the student connections block and replaced one of the student's elective classes. One school district in Northwest Georgia implemented this class for purposes of remediation for the four middle schools within that system. The class followed the state-issued math standards which were similar to the standards of the non-remediation math class that all of the students had taken, as the teachers of the intervention class worked closely with the non-remediation math teachers.

A gap between mathematics intervention and middle-grades teaching and learning exists within the extant research literature. There are several pieces of research that discussed interventions in middle-grades mathematics education for the purposes of teaching and learning for at-risk and struggling students (Adams, 2011; Hobbs, 2012; Cole, 2008; Mathis, 2010; Maxwell, 2010; Travis, 2008). These studies were specifically directed at middle-grades math achievement, as they contained the CRCT as the instrument of measure. Additionally, a need exists for learning how student achievement might be maximized on high-stakes tests (Kulm, Capraro, & Capraro, 2007). Subgroup data was also important, as student differences have been shown to influence achievement data (Bahr, 2010; Morris et al., 2012; Maloney, Waechter, Risko, & Fugelsang, 2012; Nosek & Smyth, 2011; Parke & Keener, 2011; Riegle-Crumb &

Grodsky, 2010). The following review of literature sought to answer questions regarding the maximizing of student achievement and how it was affected by high-stakes testing.

### **Theoretical Framework**

Social cognitive theory states that how a person will act or even respond in certain situations is based on preconceived notions (Zimmerman, Bandura, & Martinez-Pons, 1992). Bandura's works on social context span over 50 years and cover the aspects of social cognitive theory. His writings explored behavior and gave meaning to social contexts, then applied social cognitive theory to education. A seminal study showed Bandura and Walters (1958) suggested the aggression of children stemmed from learned experiences and dependency issues with the parent. Their beliefs confirmed that dependency troubles limit children's emotions. These emotions were given definition by social cognitive theory, since it was hypothesized that behaviors are learned, and these children were behaving in a manner consistent with what they had been exposed to previously.

The discussion of emotions is evident in several of Bandura's writings (Bandura & Walters, 1958; Bandura, 1986; Bandura, 1989). Additionally, in these studies, factors such as gender, social status (perceived or actual), and family history were believed to be influential to students' abilities and therefore, affected performance at school, which is especially important to school leaders. Bandura discussed the correlation of student self-efficacy in many of his studies (Bandura, 1986; Bandura, 1989; Zimmerman, Bandura, & Martinez-Pons, 1992; Bandura, Barbaranelli, Caprara, & Pastorelli, 2001; Bandura & Bussey, 2004), a topic that is currently of special importance for teachers trying to motivate students towards success in high-stakes testing situations. Bandura (1986 & 1989) found that students behaved according to their perceived self-efficacy. If that is



indeed true, then motivation of students for academic reasons is vitally important. It appears that Bandura not only found a possible explanation for current behaviors based upon past occurrences, but a possible predictor of behaviors as well.

The students in this study had prior knowledge of mathematical concepts, but they failed to utilize their knowledge in an efficient manner. All students in the study were taught the same mathematics Georgia Performance Standards during their fifth grade year; however, some students failed to utilize that knowledge effectively and therefore, scored in the at-risk levels on their mathematics CRCT test. Such scores qualified the students for remediation.

Constructivism (Gall, Gall & Borg, 2007) supports the idea that some individuals are inherently different from others due to prior experiences or prior successes or failures. Additionally, constructivism may give some insight as to why some students are unmotivated or unwilling to learn in an environment that could be perceived as one where less intelligent students go, especially since the remediation class was designed to be offered during a time when other classmates were attending a traditional connections class.

Social cognitive theory helps individuals make sense of past occurrences, but is only as good as the concept of truth the learner already knows (Meyer, 2008). The theory is based on learned knowledge and relating previous knowledge with new occurrences (Sherman & Kurshan, 2005; Paour & Bailleux, 2009). The study utilized these ideas and focused on learning in the educational setting, as the students in the study were given a treatment if their past scores were low enough for them to qualify for the treatment of the class. Some opinions toward social cognitive theory and constructivism, such as Meyer's (2008) opinion that stated "constructivism's basic premise is not sound" (p. 340), were

not taken into account; rather, the educational meaning of those opinions and the implications that students would learn based upon previous methods of learning provided the theoretical framework for this study.

### **Review of the Literature**

Students' retention of taught material could be a problem when learning in public schools, especially mathematics. Turner (2008) noted this in his study of transitioning students from high school to college-level calculus mathematics instruction, stating "this transition/retention problem has become increasingly critical in light of the much publicized perception that proportionally fewer students arrive in college ready to undertake a serious calculus course" (p. 370). Results of this study indicated that a course offered by the college specifically aimed toward helping low-achieving students get *caught up* to their peers might help this problem. A study by Travis (2008) showed an important correlation to the middle school mathematics course in this study as both delineated a course offered for remediation purposes. Differences existed between the two courses as they were offered at different educational levels.

More recently, Bahr (2008) saw positive results from examining remediation courses and student knowledge, stating that, "remedial math programs are highly effective at resolving skill deficiencies" (p. 420). While the purpose of his study was focused on higher education, there are links between the overall purpose and design of remedial classes. Bahr demonstrated the importance of having students understand the basics of math in a similar fashion to the educational leaders within the cooperating middle schools. The schools participating in this study were all middle schools, and Bahr's study was with community college students, but there may be a link between the

purpose and design of remedial courses. The following review of the literature contains sections specific to remediation, math achievement, and math education.

### **Remediation Strategies in Math**

Strategies and treatments for low-achieving students are different in nature and design. Population size, math standards within instruction, classroom delivery, out-of-class delivery, and even the time outside of the classroom of delivery can all be different, as well as individual student differences and overall school or school system population demographic differences. Equality must also be considered, as students from differing ethnic or racial backgrounds may have been offered the opportunity to participate in math classes their Caucasian peers have been offered for years; there is still a gap in achievement as strategies are sought to benefit these students (Riegle-Crumb & Grodsky, 2010). Effectively utilizing a program of study for a population of at-risk students is a challenge that falls on the educational leaders within a school or school system, whether the problem is a failure to meet the standard, or due to subgroup differences. Knowing about effective instructional programs will help leaders make effective educational decisions regarding the at-risk population. Also, knowing what strategies have worked or failed will aid in those important decisions.

In a study conducted by Weber (2008), one student's progress was tracked through a geometry course to find reasons why successes or failures may have occurred. Weber found that remediation through another course was not necessary, but more personalized help was beneficial. Further, Weber noted this finding important to motivation. Before the successes of the student, the grades from the student were low and failing. Once the student experienced successes and gains, those scores improved. These findings differed from the intervention mathematics course as they noted one-on-

one help from the instructor, something this study did not address. The intervention mathematics course sought to offer the same GPS standards taught to the students in a non-intervention course, giving twice the amount of time for delivery.

Brown (2010) utilized an extended learning program in math and reading for targeted at-risk students. The program was similar to the one in this study as it was a learning opportunity offered to at-risk students in addition to their regular programs of study. This strategy of providing assistance to at-risk students outside of the traditional classroom was supported by Brown's (2010) findings in the study, as students showed gains in mathematics. It is unclear from Weber's (2008) and Brown's studies as to which method was better for students. Sample population is one variable that must be taken into account when searching for the best solutions for math remediation. Also, controlling variables for one student was probably much easier than controlling variables for a larger number of students.

Providing intervention math courses for struggling students may be the answer to improving student achievement. "Double-dosing" (Nomi & Allensworth, 2009, p. 113) is one such scenario, where students are enrolled in a support class in addition to their traditional education math classroom. The study conducted by Nomi and Allensworth (2009) showed higher test scores, but grades and failure rates of the courses were unaffected. These findings supported the theory that students were taught the skills needed to be successful on mathematics assessments, but were not taught how to be successful in classes with regards to their grades or with high school graduation. Similarly, Bahr (2010) concluded that remediation strategies can be beneficial, but are sensitive to several factors. He studied the racial gap and proposed having students take classes for which they are ready, as measured by strata of attainment. He found that

remediation was relatively unsuccessful with African American and Hispanic students, a conclusion that is of particular interest to the second research question of this study.

Similarly, Turner and Tigert (2010) discussed a math camp program implemented for remediation and intervention purposes. This camp addressed the gaps in student knowledge. The findings from the study showed in a significant increase in the math scores of the students participating in the camp. Additionally, the teachers associated with the study reported their students became better learners overall, believing themselves to be more capable learners than they once were. This was another treatment strategy that focused on educating students outside of the traditional classroom. However, endeavors toward remediation occurring outside of the traditional classroom can be costly and are often not the easiest to implement.

The Challenging Horizons Program (Cole, 2008) was an after-school program that was similar in design and purpose to the math camp. The Challenging Horizons Program used the same standards the students had previously seen, but were offered in a different context than the typical classroom. Cole noted that the program was so effective that even paraprofessionals could deliver the math intervention therein and allow for student gains. This is one variable that is different from other studies conducted. In all the other studies, either certified educators or college professors were the professionals who were teaching the groups of students.

One strategy used in the classroom focused on math fluency development for targeted struggling students (Poncy, Skinner, & Axtell, 2010). Their study started by analyzing the assessments of students having problems in math, enrolling students in a procedures program related to individual needs, and tracking progress to ascertain effectiveness of the program and new student achievement levels (Poncy, Skinner, &

Axtell, 2010). Techniques such as fluency development and procedural programs are similar to arithmetic combinations, counting strategies, and number sense—general construct strategies suggested by Hanley (2005) that can be implemented in the classroom. Student fluency can be translated to having the students stay at a particular standard or process until mastery is reached. Implementing mastery learning for a classroom of students takes a long period of time and is subsequently not a method that will allow a teacher to move through a variety of standards quickly.

Another in-class study that tracked student progress was a strategy incorporating technology in the classroom (Dunleavy & Heinecke, 2007). The impact of 1:1 laptop use (one student utilizing one laptop) showed no specific program effects for math achievement, as noted by Dunleavy and Heinecke (2007). However, their pretest, post-test research design illustrated the boys significantly outperformed the girls in both math and science. Importantly, the authors suggested that additional research is needed in the area of 1:1 laptop instruction and implementation techniques towards increased student achievement with regards to this specific technology delivery and instruction. Based on these findings, laptop instruction may be beneficial for at-risk boys in science and mathematics. Such a strategy is very cost prohibitive and something that might not be a realized strategy in the current economic standing of many public school systems.

### **Research on the Effects of Remediation in Math at the Middle School Level**

From the research, instructional leaders hope to find positive outcomes for students. Such outcomes would mean passing high-stakes tests or doing well in general so that greater goals, such as graduation, can be realized. Logan (2010) identified reasons why students may drop out of school, and that many of these reasons are realized during the middle school years. Other benefits include a greater appreciation for specific

programs, such as mathematics programs, positive results that can lead to whole-school comparative results, and a possible improvement in motivation for students to learn through experiencing successes. However, Nomi and Allensworth (2009) stated in their study of math treatment that there could be some disparity between doing well on tests and student success in math classes and even high school graduation rates. Simply stating that those two are connected or that one is a predictive value of the other is not supported by the research at this time. Nomi and Allensworth believed there may be a disconnect between ability and classroom success as defined as passing courses and eventual graduation. However, these findings contrasted the study conducted by Logan (2010), as she simply noted student success in mathematics as being a contributor toward high school graduation. There may be some connection, but the study conducted by Nomi and Allensworth did not confirm that.

In a study conducted by Cole (2008) middle school students received extra instruction in math. The program of study included 2 weeks of instruction in an after-school format for at-risk students. This study was unique as it was delivered in a short time period (2 weeks), after school, and by paraprofessionals who had limited instructional training (Cole, 2008). The students showed improvements on their assessments, even when taught by paraprofessionals. Cole noted that the gains on the summative assessments might have been due to external variables, but cautioned that procedures and methods used might have had an effect on the outcome of the program in general. From analyzing the results and recommendations by Cole, careful implementation of a program for educational research is of the utmost importance. Additionally, the results indicated student improvement on the assignments as given by the teacher. To give an assignment beforehand and then afterward is a good research

design, but if the teachers were teaching to the assignment itself, especially after the students had engaged in the assignment as a pretest predictive value, then the reliability of the disaggregated results can be questioned. Additionally, the study itself might not have used a standardized measurement tool, which is important in assessing reliability.

In Maxwell's (2010) study, a group of at-risk middle school students, a control group, received a supplemental education service program for means of remediation to meet the standards of the high-stakes Georgia CRCT in reading and math. After comparing the scores of the 107 students in the study, Maxwell found a statistically significant difference in the achievement levels between the students who had participated in the program versus those that did not. Maxwell added that such a program would have a positive effect on social change for schools. Such positive effects on student learning refer back to Vygotsky's learning theory, where students who are engaged and supported learn better (Maxwell, 2010). Maxwell's statement was somewhat misleading in that Maxwell sought to measure student achievement scores then made the statement about students being engaged and supported. Those are two very different pieces of information. Maxwell sought to compare pretest and posttest scores of students after a treatment of a remediation program for purposes of achieving passing scores on the Georgia CRCT, but also noted that giving students remediation that is engaging and supportive is of benefit as well.

Travis (2008) conducted a study that also utilized time during the instructional day and not after school. In this study, struggling students were enrolled in a connections math class. Travis found that students participating in the course who had a qualifying grade on their sixth grade CRCT math score affected their seventh grade score. With the null hypothesis rejected, Travis was able to explain why the seventh grade scores were



higher than the previous years for the students who participated in the connections class. One major weakness with the study was the descriptors of exactly how students qualified for the course. Travis stated that the previous year's scores were the determinate for participation, but then failed to quantify that number. It was unclear if the students all had failed the previous year or if there was a cut-off of scores that would qualify students. While Travis made a clear point that further research was needed to give meaning to the race/ethnicity aspect within the study and from the regression models, more importantly Travis inadvertently pointed out the need for clear and descriptive sampling procedures. Another strength in the structure of the design of Travis' study was that test scores were used from students that had tested within the same building. That variable was controlled for, whereas this study used scores that were taken from the participants' fifth and sixth grade years; the fifth grade CRCT test would have been administered when the students were in elementary school, while the sixth grade scores came from testing in the middle school.

Travis' (2008) study was very similar to the way this study was conducted. As Travis used previous CRCT scores as descriptive and quantifiable means of population assignment for the treatment of the intervention math course, the researcher of this study did the same. Using the same assessment tool created an equivalent control group design and strengthened the results of the studies. Travis used regression models to give meaning to the data so that a decision could be reached as to keep or reject the null hypothesis and for predicting values/scores of groups of students on their future math CRCT scores.

Mathis (2010) conducted a similar study that utilized CRCT scores for math in four cooperating schools in Georgia. When the treatment of a SuccessMaker™ program

was used for the students, Mathis saw an effect on those students' math CRCT scores. Specifically, Mathis noted that certain student subgroups, showed improvements after using the SuccessMaker™ program. After 3 years of participating in the program, the eighth grade students showed increases in their math CRCT scores. Mathis noted that the implementation of technology in the form of a computer-based program was crucial in the success for these students and this particular program. Regardless, such findings merit taking a closer look at instructional computer programs aimed at raising test scores of students at risk of failing high-stakes tests. While the use of technology as a means for instruction might have been favorable for Mathis' study, such technology is expensive and does not guarantee that school leaders will find solutions for their students.

A similar middle school remediation strategy of providing extra time for struggling students in a remediation class came from a study conducted by Brown (2010). Brown examined a summer program that sought to improve test scores for at-risk students. Results of the study showed student gains in mathematics, but not in reading. Specifically, sixth and eighth grade students showed gains in mathematics, but seventh grade did not. While some gains were made during this remediation time, gaps were still present. This supports the idea that different remediation strategies are needed to reach the general population of at-risk mathematics students. Brown's study aimed to make sense of a program that mirrors many different types of programs, where the summer break was used to educate students who had scored poorly during the previous school year. The study was different in that the entire treatment program occurred during the summer and sought remediation in two courses, reading and math. The current study focused on an intervention math class during connections times for students who were termed at-risk and only examined the effectiveness of the course for the purpose of

improving math scores. Having an operating student schedule during the summer can be cost prohibitive and limiting, as not all students will be able to attend for various reasons.

### **Student Self-Efficacy and Math Achievement**

The ways students view themselves is an important factor how they view their ability to meet with success in academic settings. Social cognitive theory addresses the concept of perceived notions of self (Zimmerman, Bandura, & Martinez-Pons, 1992). Several studies related directly to students' perceived mathematical ability. Such a perception was important to note as an internal threat to validity might exist from such phenomena.

McConney and Perry (2010) analyzed self-efficacy in students and found that it, coupled with realized socioeconomic status, made a substantial difference in math achievement. Particularly, they found that the lower the socioeconomic status and math achievement in students, the more difficult it was for those students to increase their math scores. Low income was also a factor in math achievement, as demonstrated by Benner and Hatch (2009). More contributing factors to student math self-efficacy were increasing math achievement scores and higher teacher expectations (Larwin, 2010). Knowing what factors that influence student self-efficacy related to math may help teachers with the delivery of the material and could possibly affect student assessment scores on high-stakes tests.

Risser (2010) analyzed students' perceptions of external factors that may have contributed to their learning within a mathematics course. The external factors could have been as subjective as perceived notions of how other students view one another, or even socioeconomic status. Risser found that students who were positive about these

external factors scored higher than students who were negative. These results proposed a link between success, motivation, and perception.

The results of a study conducted by Ward, et al. (2010) showed students who were challenged in mathematics appreciated the challenge, even though they did not feel confident about their own personal knowledge. In a similar study that tracked students' feelings toward mathematics classes, Carbonaro (2005) noted that students in higher levels courses exerted more effort than those in lower tracks. Carbonaro explained that students would exhibit a history of similar efforts in previous tracks. The findings of these two studies contradicted those evidenced by Risser (2010) as discussed earlier. The specifics of age, gender, math ability, and even past success were important factors contributing to these studies. Such factors were considered in this researcher's study as well. Possibly, these trends may stretch across disciplines and subject matter within schools and are not just confined to middle-grades mathematics.

Trends were evident in a study conducted by Mason and McFeetors (2007) where students would enroll in a particular course for reasons of "socioeconomic status and prior achievement" (p. 291), even if that course did not meet the specific learning goals of the individual student. Students were concerned about courses, but almost equally concerned with the social aspects of class. The research indicated that students took the class for social reasons. Hannula (2006) suggested that "to understand student's behavior we need to know their motives," as they relate to curriculum choices (p. 165). Hannula's study exhibited similar correlations. Hannula utilized a method of having the intervention course during the school day and (with approval from the parents) pulled students out of previously scheduled connections classes. That dynamic may have contributed to individual performance in the class.

Gender was influenced student self-efficacy regarding mathematics. Maloney, Waechter, Risko, and Fugelsang (2012) found that females had greater anxiety towards math than did males. Results of this study found spatial processing ability to be the greatest remediating factor. A similar study found that women were generally more negative toward math than males (Nosek & Smyth, 2011). These studies are important to note for this study, where subgroup data of gender were analyzed.

Rudolph, Lambert, Clark, and Kurlakowsky (2001) discussed the similarities between student self-efficacy and motivation. In their study of students transitioning from elementary to middle school, they noted changes in attitude and perception of the students toward school and learning environment. Results of their study showed that students who went from fifth to sixth grade in the same school building showed less stress and depressive symptoms toward school than students who transitioned between school buildings. There was little doubt that the transition to a different school could impact a student's learning.

### **Student Motivation and Math Achievement**

Motivation is an external factor of learning and classroom structuring, but it is also a byproduct of successful implementation of classroom instruction. Weber (2008) noted in a study of a female student who did not become interested in math until she understood the course material better. After experiencing small successes, the student was motivated to try harder at the coursework and to seek out opportunities to study further. The positive aspects of learning motivated the student to learn mathematics. Frye (2010) further discussed motivation strategies that can work with middle school students. Frye iterated that middle-grades students' transition "to middle school with beliefs and experiences from elementary school that influence their motivation and

learning” (p. 61). With this assumption, Frye implemented a system of allowing students to self-assess their work in addition to receiving teacher assessment and noted the students’ successes by telling how few reteaching modules were needed after each assessment. This study was limited, however, since the population of individual pieces of data was isolated and small in number. More research in this area was suggested.

A great importance exists for students to be ready to learn, and the role of the classroom teacher is to make sure they are ready to learn, even if the students are unmotivated (Ball & Forzani, 2010). Ball and Forzani suggested that teachers need to understand not only what to teach, but how to teach the material, suggesting that teachers have a good idea of what is relevant and should be ready to present such information in a manner that students can understand. Similarly, Risser (2010) found students performed better in class when they had identified external factors in a positive manner rather than negatively. Motivation can be a historical piece of student data that will typically be consistent, regardless of the student’s instructional level (Carbonaro 2005; Bahr, 2009). Finding correlations between student motivation and success would help educators better understand how to structure schools, courses, and even the material therein. The benefits of such discoveries could have long lasting effects for individuals, schools, and school systems seeking solutions towards remediation.

In a tertiary preparatory course at the University of Southern Queensland, Carmichael and Taylor (2005) found that motivation was a strong predictor of success. In their study, “students’ assessments on their confidence to successfully undertake mathematics questions is based, in part, on their current level of knowledge and skills, and that this will influence their ultimate performance” (p. 718). Those data suggested that students had preconceived notions about their performance in an upcoming course,

and those feelings may have determined how well they performed in addition to realizing the current level of understanding and mastery of mathematics skills. Hannula (2006) supported this suggestion and found that goals set by students were directly linked to emotion as well as motivation, and that similar notions dictated what students worked toward.

### **Teacher Preparation and Math Achievement**

Teachers' knowledge of mathematics material could determine student understanding and ability to learn in class. Kajander (2010) found that some teachers had a weak knowledge of material needed for teaching. Reasons given by Kajander came from deficiencies in teacher preparatory classes. As the standards-based classroom becomes more of a reality with new legislation, teacher preparation must occur for delivery of those standards. Thompson (2009) examined teacher preparation toward student math and science performance in the secondary classroom. The study found that the standards-based classroom strategies contributed to higher scores than the classroom instructional strategies that were not standards-based. Kajander noted that no particular strategies were supported as being consistently effective toward student math achievement in the standards-based classroom, suggesting that teachers needed to have training in teaching math that was perhaps different from what they had learned while in school. Similarly, Kajander made the recommendation that teachers needed to further their conceptualization of their own mathematics knowledge beyond what they learned in their own schooling.

In contrast to those findings, Cole (2008) analyzed the effects of a study focused on 10 weeks of intense math intervention for remedial middle school students. At the conclusion of the program, results showed positive effect sizes even when the program

was taught by paraprofessionals with limited educational teacher preparation. Perhaps in that study the program was more beneficial for the students taught than the actual preparation of the instructors; such a finding contrasts what so many researchers believe to be true about teacher training and preparation. Benner and Hatch (2009) stated, “We must prepare teachers for early childhood settings in ways that disrupt the problem of low mathematics achievement rather than sustain it” (p. 307) and to do so “requires careful thought” (p. 308) toward teacher preparation.

Adding to the thought that teachers need careful and thought-out preparation, Conklin (2007) wrote the educational level of preservice teachers did not adequately prepare them for the difficulties of understanding how to effectively teach adolescents. She added that even though methods of instruction at the college level can present preservice teachers with methods on how to teach and understand material, they might not be ready to deliver those to middle-grades students. Thus, further support for novice teachers during their first year on the job may add to their repertoire of skills. A study such as this might be ultimately aimed at schools and school systems to create learning opportunities for teachers out of college. Such a program may consist of previous teacher observations, overall student successes or failures, and even colleague feedback in an organized and formal delivery format. Either way, Conklin argued that many teachers are simply not prepared when they graduate college.

Apart from traditional teacher preparation are alternative programs such as Teach for America (TFA) that allow degree-holding adults to earn certification as a teacher. Glazerman, Mayer, and Decker (2006) found that such professionals can be successful in the field of teaching and even can have a positive impact on student math achievement. TFA and other programs are especially important since one of the four teachers of the



intervention math for at-risk middle school students in this study obtained a teaching certificate in like-manner. It may be that successful teachers come from many and varying backgrounds, a note that educational leaders should consider when deciding on candidates for employment.

### **Instructional Strategies and Math Education**

Bahr (2008) stated in his study of remediation courses that specific treatment and remediation programs could be beneficial in helping struggling students with math. As previously discussed, teacher preparation is one method for helping students who have deficiencies (Benner & Hatch, 2009; Thompson, 2009). Kulm, Capraro, and Capraro (2007) stated that teachers need to instruct for overall student understanding, but high-stakes testing achievement was perhaps more important. The results of their study yielded a program of teaching mathematics that was more successful for students who were at risk than for students not at risk. Since the goal of their study was to find a method that would yield such a result, the program could perhaps be questioned. Additionally, their study might be scrutinized for focusing on only one program. Thus, Hattie and Timperley's (2007) comments on careful analysis of results must be taken into account.

Ysseldyke and Bolt (2007) studied a progress-monitoring program that utilized technology as a means of data collection. Variability of teacher implementation of the program coupled with math results in classrooms using the technology versus classrooms not using the technology showed significant gains in student achievement. The researchers were careful to note the implementation of the program as intervention integrity might have made the outcome of the data different, especially since the technology was introduced as a tool for recording progress monitoring of students.

Perhaps the novelty of having technology created interest in learning. Noting such phenomena is important to any study and will help readers decipher the reliability.

Thompson (2009) created and utilized a model of implementation and design to analyze student achievement. Two important pieces within the model were teacher preparation and teacher practices. According to Thompson, teacher preparation is an important instructional strategy as it helps to meet the demands of education reform, along with the implementation of standards-based classrooms. Meeting an instructional student demand often requires unique methods of implementation and instruction, as outlined in the earlier section of the theoretical framework. Rittle-Johnson and Koedinger (2005) found that scaffolding techniques add to students' abilities to use fractions with simple operations of addition and subtraction. The results from their test analysis suggested utilizing conceptual, contextual, and scaffolding techniques increased procedural knowledge toward the use of fractions.

Studies have also shown to contain diverse populations and help give meaning to those phenomena. Parke and Kenner (2011) studied math achievement on achievement tests with results that suggested significant gaps for subgroups based on socioeconomic status. More research in these areas was suggested. Another study showed gains on treatments across differing subgroups, including SES (Morris et al., 2012). These studies suggest analyzing subgroup data to ascertain any differences that may occur due to innate student characteristics.

### **Summary**

A gap exists in the current area of research for middle-grade mathematics interventions for the purpose of student achievement, as there are few studies that are specific to this area of focus. Similar and correlating studies help to foster an

understanding of this gap, which is necessary in encouraging student success. Design of the course is important as instructional time must be adapted and utilized in the most effective means. Many times the design itself will yield success or failure. The purpose of the intervention math class in this particular study was to create higher test scores on high-stakes tests for at-risk students. The previously outlined studies helped explain what specific gap existed in the research, as well as the overall course for the students. Understanding what has occurred through research and then either modeling a good design or redesigning a poor utilization of resources is of the utmost importance.

This study sought to find the best solution for the cooperating school system for the purposes of student achievement. Classroom instruction and student learning were closely linked; the need for a study to analyze the relationship that existed for a treatment strategy that was employed by four middle schools and the outcomes of students' summative exams was imperative. If exams are an important indicator of learning, then there must be a treatment that will help students of differing learning abilities. The constructivist mode of thinking supports this belief and this study sought to bridge the gap that exists within the research. However, are student successes on standardized tests enough? What about the possibility of a student who performs well but still struggles with school within the classroom? This study was conducted to see if a treatment in the form of a remediation mathematics class gives middle school students enough help to contribute to higher scores on the CRCT and not if the course will help them to be better overall students. This study sought to add information in the form of one small piece in the larger puzzle of maximizing student achievement. The next three chapters guide the study itself as the overall setup of the study, the analysis, and the discussion of the analysis are addressed. Chapters 3,4, and 5 discuss a methodology that will guide the

study, provide the results from the analysis described in Chapter 3, and discuss the results seen in Chapter 4.

## **CHAPTER THREE: METHODOLOGY**

### **Introduction**

The purpose of this causal-comparative, quantitative study was to determine whether or not receiving a remediation math class (in addition to a regularly scheduled math class) targeted toward student success on high-stakes testing improved the math achievement of at-risk sixth grade students on the CRCT. This chapter will present the methodology, research design, research questions, participants, settings, instrumentation, procedures and data analysis plan.

### **Design**

The design used for this quantitative study was causal-comparative. In this quantitative design, two groups are compared on a dependent variable and an independent variable (Brewer & Kuhn, 2010). A causal-comparative study is also ex-post facto in nature, meaning that both initial data and after-treatment data have already occurred, and thus, are studied in retrospect. Brewer and Kuhn (2010) stated causal-comparative studies include historical data from a previously experienced event, and that two or more groups of subjects are studied. For the purposes of this study, the dependent variable included non-manipulated, secondary ex-post facto data in the form of 2009 CRCT math test scores. The independent variable was a remediation strategy in the form of an intervention class for at-risk and struggling math students, designed to improve student math achievement (Fraenkel & Wallen, 2006).

Analysis of covariance (ANCOVA) was the statistical test used as it utilized ex-post facto data. The 2008 math portion of the CRCT was the control variable (covariate) for the ANCOVAs while the 2009 CRCT was the dependent variable; that outcome

would address the null hypotheses. For the second, third, and fourth null hypotheses, socioeconomic status, ethnicity (as defined as White and Ethnic Minority), and gender, along with assignment to either control or treatment, were the independent variables.

Participants in causal-comparative studies are not randomly selected, but are conveniently selected because they belonged to an existing grouping (Brewer & Kuhn, 2010). Several students had been placed in a math intervention class due to being considered at risk as defined by scoring at or below 820 on their fifth grade CRCT. Students were also placed in the remediation class based on teacher, administrator or parent recommendation. This study also analyzed potential differences between scores of certain subgroups. Factors of socioeconomic status, ethnicity, and gender were analyzed as a further means of investigating test scores from the treatment of and intervention class for remediation.

This study utilized the 2008 and 2009 math CRCT score to give meaning to group achievement scores. Math CRCT scores from 2008 were used to control for the selection threat to validity for the 2009 math CRCT scores. The after-treatment scores consisted of the students' sixth grade math CRCT test scores from 2009. The scores of the students who received remediation and participated in the class were compared to the scores of a control group of students who did not participate in the class.

Both the 2008 and 2009 math CRCTs showed to have a high Cronbach's alpha (0.92) and were administered in controlled testing environments (Georgia Department, 2008; Georgia Department, 2009). The controlled testing allowed for higher reliability of the scores as true indicators of students' abilities in mathematics. A controlled testing environment, at the time of the administration of the tests, included keeping the tests

locked in a secure location before and after testing, specific time allotment for all sections of the test, and minimizing distractions within and outside of testing classrooms.

### **Questions and Hypotheses**

1. Is there a difference in at-risk 6<sup>th</sup> grade students' CRCT scores based on their participation in a remediation class as compared to at-risk students who did not participate in an intervention class while controlling for the 5<sup>th</sup> grade CRCT scores of both groups?
2. Is there a difference in at-risk 6<sup>th</sup> grade students' CRCT scores who participated in a remediation class as compared to at-risk students who did not participate in the intervention class based on their socio-economic status while controlling for the 5<sup>th</sup> grade CRCT scores of both groups?
3. Is there a difference in at-risk 6<sup>th</sup> grade students' CRCT scores who participated in a remediation class as compared to at-risk students who did not participate in the intervention class based on their ethnicity while controlling for the 5<sup>th</sup> grade CRCT scores of both groups?
4. Is there a difference in at-risk 6<sup>th</sup> grade students' CRCT scores who participated in a remediation class as compared to at-risk students who did not participate in the intervention class based on their gender while controlling for the 5<sup>th</sup> grade CRCT scores of both groups?

Null hypothesis 1:  $H_{01}$ : There will be no statistically significant difference in the mathematics CRCT scores of 6<sup>th</sup> grade students who receive a remediation class of math instruction as compared to those at-risk students who do not participate in this class, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores of both groups.

Null hypothesis 2.0:  $H_{2,0}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students based on socioeconomic status (SES), while controlling for their 5<sup>th</sup> grade mathematics CRCT scores.

Null hypothesis 2.1:  $H_{2,1}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students who receive a remediation class of math instruction as compared to those at-risk students who do not participate in the class, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores of both groups as aggregated by SES.

Null hypothesis 2.2:  $H_{2,2}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students who receive a remediation class of math instruction based on socioeconomic status (SES) as compared to those at-risk students who do not participate in the class, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores.

Null hypothesis 3.0:  $H_{3,0}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students based on ethnicity, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores.

Null hypothesis 3.1:  $H_{3,1}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students who receive a remediation class of math instruction as compared to those at-risk students who do not participate in the class, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores of both groups as aggregated by ethnicity.

Null hypothesis 3.2:  $H_{3,2}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students who receive a remediation class of math instruction based on ethnicity as compared to those at-risk students who do



not participate in the class, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores of both groups.

Null hypothesis 4.0:  $H_{4.0}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students based on gender, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores.

Null hypothesis 4.1:  $H_{4.1}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students who receive a remediation class of math instruction as compared to those at-risk students who do not participate in the class, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores of both groups as aggregated by gender.

Null hypothesis 4.2:  $H_{4.2}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students who receive a remediation class of math instruction based on gender as compared to those at-risk students who do not participate in the class, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores of both groups.

### **Participants**

Data for this study were ex post facto in nature and consisted of math CRCT test scores from two groups of students, one group of sixth graders who had participated in a remediation math class designed to improve their achievement on the CRCT, and a second group of sixth graders randomly selected from the general population of sixth graders at the schools who did not take the class, but were also labeled at-risk. Students were not randomly assigned to the treatment group (classes), but were purposefully selected by their teachers and administrators, based on personal recommendation or based on the students' CRCT scores. The following criteria were used to identify which

students qualified for the sample used in the study. The students starting sixth grade had to score at or below 820 on the mathematics portion of their CRCT fifth grade math test to be considered. Students could also qualify for the class based on teacher recommendations, although their 2008 scores could have been higher than 820. These students may have exhibited low grades in their core math class, low grades in other classes, and low scores on informal assessments. The informal assessments included anything the teacher could report to an administrator or parent as being observed, but not tallied or scored, for purposes of giving a class grade.

Due to limited staffing and resources, only two intervention classes at each of the four middle schools in the district were scheduled. Thus, approximately 40 students were able to take advantage of this class at each of the four schools. For this study, 143 students' test data were included from the treatment of the remediation class. The main reason for not having 160 participants (as four schools of 40 students would have yielded an overall participant number of 160) was due to high transiency within the participating school system or simply that students moved outside the school system before the 2009 CRCT tests were administered, an occurrence that could not be controlled. Causal-comparative studies are designed to make comparisons between groups (Brewer & Kuhn, 2010), thus, a control group was also used in this study. The control group was comprised of at-risk students who did not have the opportunity to participate in the limited-space remediation class. In this study, the convenience sample of the control group also contained 143 participants; the number of students used in the control group was equal to the number that was being studied in the experimental grouping, thus creating homogeneity in the number of participants for the statistical analysis (Fraenkel & Wallen, 2006; Gall, Gall & Borg, 2007). Howell (2008) suggested having the same

number of participants in the control and treatment groups. The sixth grade students from both control and treatment populations were a homogeneous mixture of several demographic factors (ethnicity, gender, and socioeconomic status).

In total, the test scores of 286 sixth graders were used as ex post facto data for the study. The four middle schools together created a total population of 286 students whose test data were used. Both the control and treatment groups contained 143 students.

Figure 3.1 illustrates how participants were placed in control and treatment groups based on their 2008 fifth grade CRCT, and then disaggregated into subgroups.

Figure 3.1 Participant Population Distribution Flowchart

Participating Students Scored Below 820 (n=286)

Control (n=143)		Treatment (143)	
White (n=111)	Ethnic Minority (n=32)	White (n=122)	Ethnic Minority (n=21)
ED (n=82)	Non-ED (n=61)	ED (n=97)	Non-ED (n=46)
Male (n=59)	Female (n=84)	Male (n=69)	Female (n=74)

*Figure 3.1.* Population of students as aggregated into intervention or control groups then by subgroup. The numbers were taken from the data listed in the cooperating school system's overall data as adapted from <http://www.bartow.k12.ga.us/education/components/scrapbook/default.php?sectiondetailid=20876>, BCSS. (2011). *Community and School District Profile*.

The reason sixth grade students were selected was due to the researcher having taught in seventh grade the year from which the data was taken; therefore, researcher bias was kept to a minimum. The number of students was large enough in the experimental and control groups for the study to contain many different subgroups (Gall, Gall, & Borg, 2007). The demographic information of the students in the study was considered, but student demographics played no part in the convenience sampling from the control or experimental groups. Additionally, neither the students nor the teachers from the middle schools studied were aware of their scores being used in this study, as the scores were ex-post facto.

### Setting

The four middle schools from which the populations were chosen were in the same school system where the researcher worked in northwest Georgia. The district in

2009 was the 25th largest in the state and had slightly more males than females—a total population of 14,649—and served approximately 12.5% students with disabilities, 4% limited English proficient, and more than 51% economically disadvantaged. The subgroups that populated the school system contained less than 1% Asian or American Indian, 8.5% African American, 7.6% Hispanic, and just over 80% Caucasian (BCSS, 2011). Each of the four middle schools had a population of between 800 and 1,100 sixth through eighth grade students. School A had a population of 749 students, school B had a population of 1,043 students, school C had a population of 652 students, and school D had a population of 927 students (KBB, 2011).

### **Structure of Intervention Class**

The class met during a time that was typically scheduled for physical education, art, music, or other exploratory classes. Those students received approximately five extra hours per week of mathematics instruction, which was more than students not selected to be in the class. Classes met three times during the week. The class met for 2 hours, whereas the third meeting was about 1 hour long each week. Another important factor is that the class sizes were limited to 20 students with a total of two sixth grade classes per school due to the fact only one teacher per school was assigned to teach that class.

The content of the intensive math class followed the Georgia Performance Standards the same as the traditional education classes. The teachers were instructed to assess their unique population of students on those standards and to have worked on the areas of improvement for each student. Those teachers gave a pretest for all the standards that were covered for the year, including those from the previous year. The teacher then analyzed each standard, element, and domain from the GPS and made a plan from which to start teaching. That plan meant the class of students might have deviated from the

exact framework the school system had in place as remediation strategies were used for specific students or groups of students, but the overall framework and nine-week plan was still to be followed. Such teaching methods allowed for individual flexibility from teacher-to-teacher and within each unique class, with the overall goal of supporting low-achieving students for success on the math CRCT. There was flexibility as to exactly what grades and assessments the teacher could give as the school systems' frameworks only required two to three common assessments per 9-week period. Typically, those assessments were in the form of a test, final, or a performance task designed around the lessons within that grading period. Thus, apart from being held during the time when other students attended elective classes, the remediated students experienced a math class very similar to the one during their regularly scheduled core classes with the exception of the class being populated with students who had all scored at or below an 820 on their fifth grade math CRCT. Instructionally, the class was very similar.

### **Instructional Design of Intervention Class**

The entire school year was broken into fourths by the cooperating school system. Doing so created grading opportunities for the school system that were equally spaced and consistent. That timeline followed a 9-week calendar where report cards were sent home after each of the four nine-week periods. Two of the nine weeks occurred before Christmas, with the other two after the Christmas break. The teacher of the remediation math course gave grades to the student based upon student work. The grading system exactly mirrored the traditional math class with the weights of homework, classwork, tests, and final exams being 10%, 40%, 30%, and 20% respectively, as required by the cooperating system's board of education policy. Having four different teachers (one in

each of the different middle schools) strengthened the study and in turn made the reliability of the scores higher.

For this study, the researcher was acting as an outsider viewing and considering data, not interacting with the students or the teacher of the remediation math class, even though the researcher worked in an elementary school in the system at the time of the data analysis and the students' scores used for the analysis came from four middle schools. Sixth grade students were chosen rather than seventh or eighth grades because at the time of the testing the researcher had taught seventh grade students for several years in one of the four schools.

### **Instrumentation**

The Criterion Referenced Competency Test is a test administered in the state of Georgia once a year to third through eighth grade students as a means of determining the level of acquisition of essential skills for those students (Georgia Department, 2008; Georgia Department, 2009). The CRCT tested students in the areas of reading, English/language arts, mathematics, science, and social studies. Implemented in 2000, the CRCT originally assessed first through eighth grades but has more recently retracted tests for students in grades 1 and 2 for budgetary reasons.

The CRCT, as the testing instrument, was standardized and a reliable and valid testing instrument. According to the state of Georgia, the sixth grade math CRCT for the 2009 testing year had a Cronbach's reliability alpha of 0.92 with the fifth grade CRCT for the 2008 testing year having a Cronbach's reliability alpha of 0.92 as well (Georgia Governor's Office, 2011). The students' test scores from two standardized assessments were the basic and most important variable within the study. The tools that gauged student performance were the assessments in the form of after-treatment exams. The

placement of the students in the class was indicated by selection from teachers and administrators of at-risk students (students scoring 820 or below on the CRCT) using the math score from their previous, fifth grade year. Since the remediation mathematics course was the independent variable utilized, thinking of the students' scores and performance on the 2009 CRCT as an indicator of the effectiveness of the class itself is important.

The schools, students, student populations, teachers, classrooms, grade levels, assessments, data collection, timeline, and even the subject taught are all variables within the study. Some of the variables were controlled while some could not be. The schools that participated in the study were one controlled variables. Another variable was the isolated population of at-risk sixth grade students. Assessments used, time frame of the study, and mathematics were all controlled. The researcher chose to use math and not more than one subject area, as the intervention class was designed to improve student scores in that one subject. Controlling variables was limited due to the nature of the data that were analyzed, as the study occurred within a public school system.

Both tests taken by the students were initiated and collected by third parties and then scores were redistributed to the teacher; to do so reduced teacher error and created assessments that were untainted and outside of teacher control. Both tests were generated at the state level and reliability scores for both tests were then standardized. Even with such good measures of student knowledge, eliminating all outside forces of control for the testing population was impossible. Additionally, considering the margin of student error that existed as an extraneous variable was necessary and could have been a possibility due to students *bubbling-in* answers themselves on the multiple-choice CRCT tests. Several variables were out of the control of the researcher. External factors such as



time of the day for the class, materials used for teaching, the delivery methods for the lessons, or researcher assignment of students were not be controlled in any manner. Extraneous data of these sorts are seldom controllable and the researcher of public school phenomena will never be rid of the need to report the presence of extraneous variables.

The CRCT was administered in the spring of the year during an allotted testing window, and the state educational department reported the scores to both the school system and the individual schools. The sixth grade mathematics CRCT for the 2008 and 2009 school year had a Cronbach's reliability alpha of 0.92, making the instrument highly reliable (Fraenkel & Wallen, 2006). The at-risk students' test scores from one year of implementation of the intervention mathematics course were analyzed, reflecting student performance and understanding of learned mathematical concepts. All those tests scores are still currently accessible by the administrators and teachers in the schools and by other central office personnel within the school system.

The tests were administered to all students in the same time frame. The main difference could be found in students that have testing accommodations according to their IEP. For instance, those differences might have allowed for one student to take more time on the mathematics portion of the test, to use a calculator, have the test questions read aloud, or have been tested in a smaller grouping of students. Such a variable was out of the realm of control for the researcher. To do so would have been a violation of the student's disability as stated in the IEP. Any accommodations that had been made for students that needed accommodations would have happened in much the same manner as throughout the school year, as directed by the IEP.

## **Procedures**

The study was submitted to the Institutional Review Board with a research exemption request form since the field study was noninvasive for the students. Test scores were the only variable analyzed, and those were not collected until after the tests had been sent back to the state level and then returned to the cooperating school system and entered into the data collection systems. Student scores were coded after the data gathering to eliminate identification of individual students.

Before research could begin, permission was obtained from the superintendent of the school system. It was anticipated the IRB would take between 2 and 4 weeks to receive and process the study. By the time the IRB had reviewed the proposed study, the student test data had been stored in the databases the cooperating school system employed. Obtaining approval from the superintendent and the IRB took approximately four weeks. Tabulating the scores mentioned previously and starting the process of disaggregating the data took 3 weeks.

The data collection and disaggregation period lasted 2 weeks, from January 30, 2012, through February 10, 2012. From that point, the researcher spent several months detailing the results of the study in a complete fourth chapter, which took until the end of November 2012. Such detailing was then followed by the writing of the fifth and final chapter of the study, which took another 2 weeks, the process ending in December 2012. Those chapters give meaning toward external validity and expound on any trends, issues, necessary revisions, and the importance of the findings of the study after disaggregating pertinent data.

In total, the data collection and analysis took just under 12 months. Data collection started with granted permission from the school system superintendent, as

required by the local school board policy for data collection purposes. The CRCT scores of the students who participated in the intervention math period were compared to a random selection of students who had similarly low scores on the math portion of their fifth grade CRCT, in order to establish initial differences. The CRCT was given to both groups, the fifth grade CRCT at the end of the previous year and the CRCT again at the end of the sixth grade year, as it was only released once a year during an examination window in the month of April.

The data collection followed: the fifth grade math CRCT scores were gathered from all sixth grade students enrolled in the school system during the 2008-2009 school year, along with their sixth grade math CRCT scores. Data collection then proceeded through the testing and assessment coordinator in the school system. All of the data retrieved were pulled from databases the cooperating school system uses. DocuWare was the secure and online system used for housing and retrieving sensitive testing material for the schools within the system; both tests used for this study were retrieved from that system. Personnel from the participating school system provided class rosters, as those documents are not stored in the same systems as the test scores. Those rosters contained every student who was in the sixth grade during that school year, as well as information as to which students were in the intervention math class during that period of time. Student demographic data also accompanied the rosters.

### **Data Analysis**

Analysis of covariance (ANCOVA) was the best choice for this study in that they were “particularly helpful in causal-comparative research because a researcher cannot always match the comparison groups on all relevant variables other than the ones of primary interest” (Fraenkel & Wallen, 2006, p. 377). A one-way ANCOVA was used to

analyze the fifth and sixth grade mean CRCT scores in an effort to reject or retain the null hypothesis  $H_{01}$ . The independent variable was the treatment of the class, with the dependent variable being the 2009 math CRCT. The 2008 scores gathered served as the covariate for assumption testing. The control variable was the at-risk students' 2009 math CRCT, scores as those students did not receive the treatment of the remediation class. ANCOVAs were run for the subgroups in the study. The hypotheses tested by the two-way ANCOVAs were  $H_{2,0}$ ,  $H_{2,1}$ ,  $H_{2,2}$  (for Research Question 2),  $H_{3,0}$ ,  $H_{3,1}$ ,  $H_{3,2}$  (for Research Question 3), and  $H_{4,0}$ ,  $H_{4,1}$ , and  $H_{4,2}$  (for Research Question 4). A separate ANCOVA was utilized for Hypotheses sets 2, 3, and 4. Before the analyses were performed, several tests were conducted to confirm no assumptions to variance for the covariates. Prior to completing the ANCOVAs, chi-square analyses, histograms, regression slopes, summary statistics, and Levene's covariate analysis were used to address the issue of assumptions in initial group differences. The statistical tests controlled for any initial differences in the 2008 math CRCT as means from the 2009 math CRCT were compared. To provide further meaning, the data were disaggregated into subgroups to ascertain any differences for ethnicity, SES, or gender, as these were the independent variables for Research Questions 2, 3, and 4. A confidence level of  $\alpha=0.05$  was used to describe the data from the ANCOVAs.

## **CHAPTER FOUR: FINDINGS**

### **Introduction**

The purpose of this causal-comparative, quantitative study was to determine whether or not receiving a remediation math class (in addition to their regularly scheduled math class) targeted toward student success on high-stakes testing improved the math achievement of at-risk sixth grade students on the CRCT. Specifically, the fifth and sixth grade math Criterion Referenced Competency Test scores of 286 sixth grade students from a school system in Northwest Georgia were analyzed. The independent variable was the remediation treatment of the remediation mathematics class, and the dependent variable was the students' 2009 math CRCT test scores. The control variable was the at-risk students' 2009 math CRCT test scores from students not receiving the remediation treatment. Ex-post facto data were used since the program had been in place two years before the study was conducted. The 2008 CRCT scores of the students as fifth graders were used as the covariate and as an achievement measure to establish baseline data. Those data helped to serve as a means of understanding initial group differences. The mean from the students' sixth grade math CRCT scores, from 2009 were used to determine if the intervention class was beneficial for sixth grade students during the 2008-2009 school years. Additional statistical analyses were run on the scores of subgroups to ascertain the effectiveness of the intervention class towards varying student demographics (Fraenkel & Wallen, 2006). This chapter will present the results of the study.

### **Research Questions**

The following research questions guided this study:

1. Is there a difference in at-risk 6<sup>th</sup> grade students' CRCT scores based on their participation in a remediation class as compared to at-risk students who did not participate in an intervention class while controlling for the 5<sup>th</sup> grade CRCT scores of both groups?
2. Is there a difference in at-risk 6<sup>th</sup> grade students' CRCT scores who participated in a remediation class as compared to at-risk students who did not participate in the intervention class based on their socioeconomic status while controlling for the 5<sup>th</sup> grade CRCT scores of both groups?
3. Is there a difference in at-risk 6<sup>th</sup> grade students' CRCT scores who participated in a remediation class as compared to at-risk students who did not participate in the intervention class based on their ethnicity while controlling for the 5<sup>th</sup> grade CRCT scores of both groups?
4. Is there a difference in at-risk 6<sup>th</sup> grade students' CRCT scores who participated in a remediation class as compared to at-risk students who did not participate in the intervention class based on their gender while controlling for the 5<sup>th</sup> grade CRCT scores of both groups?

### **Hypotheses**

Null hypothesis 1:  $H_{01}$ : There will be no statistically significant difference in the mathematics CRCT scores of 6<sup>th</sup> grade students who receive a remediation class of math instruction as compared to those at-risk students who do not participate in this class, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores of both groups.

Null hypothesis 2.0:  $H_{2.0}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students based on socioeconomic status (SES), while controlling for their 5<sup>th</sup> grade mathematics CRCT scores.

Null hypothesis 2.1:  $H_{2,1}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students who receive a remediation class of math instruction as compared to those at-risk students who do not participate in the class, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores of both groups as aggregated by SES.

Null hypothesis 2.2:  $H_{2,2}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students who receive a remediation class of math instruction based on socioeconomic status (SES) as compared to those at-risk students who do not participate in the class, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores.

Null hypothesis 3.0:  $H_{3,0}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students based on ethnicity, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores.

Null hypothesis 3.1:  $H_{3,1}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students who receive a remediation class of math instruction as compared to those at-risk students who do not participate in the class, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores of both groups as aggregated by ethnicity.

Null hypothesis 3.2:  $H_{3,2}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students who receive a remediation class of math instruction based on ethnicity as compared to those at-risk students who do not participate in the class, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores of both groups.

Null hypothesis 4.0:  $H_{4.0}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students based on gender, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores.

Null hypothesis 4.1:  $H_{4.1}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students who a remediation class of math instruction as compared to those at-risk students who do not participate in the class, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores of both groups as aggregated by gender.

Null hypothesis 4.2:  $H_{4.2}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students who receive a remediation class of math instruction based on gender as compared to those at-risk students who do not participate in the class, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores of both groups.

### **Data Analysis**

Table 4.1 lists student population disaggregated by subgroup distribution as defined by the socioeconomic status, ethnicity, and gender subgroups of all participants in both the treatment and control groups. The abbreviations for the SES subgroups are economically disadvantaged (ED) or non-economically disadvantaged (non-ED), as reported by the cooperating school system.



Table 4.1

*Student Population Distribution*

Subgroup	Control	Treatment
ED	82 (57%)	97 (68%)
Non-ED	61 (43%)	46 (32%)
White	111 (78%)	122 (85%)
Ethnic Minority	32 (22%)	21 (15%)
Male	59 (41%)	69 (48%)
Female	84 (59%)	74 (52%)
Total	143 (100%)	143 (100%)

**Research Question 1**

A one-way analysis of covariance (ANCOVA) was utilized to determine if there was a statistically significant different mean score on the 2009 math CRCT for at-risk students who had taken a remediation math class versus students who did not take the class while controlling variances on the mean scores from the 2008 math CRCT. That 2009 test score served as the dependent variable while the 2008 score was the covariate.

Table 4.2 lists the dependent and control variable used in this study and provides descriptive statistics for number for participants. The 2008 CRCT scores of both the control and treatment groups were analyzed as a covariate to assist with analysis of potential group differences.

Table 4.2

*Population Descriptive Statistics*

Variable	N	Mean	Standard Deviation
2008 Control	143	797.993	18.194
2009 Control	143	804.343	19.631
2008 Treatment	143	787.930	19.682
2009 Treatment	143	795.783	16.300

Establishing the dependability of any measure that is used in educational research is crucial. For this study, both the dependent variable and covariate were deemed reliable (Georgia Governor's Office, 2011). The reliability of the covariate was high, as the Cronbach's alpha was 0.92 for the 2008 CRCT (Georgia Governor's Office, 2011). Normality of data for both the control and treatment groups was adequate based on the skew and kurtosis values being close to zero. Normality was confirmed by analyzing histograms for the control and treatment groups in Figure 4.1 and Figure 4.2. Those somewhat similarly distributed histograms indicated that scores between the two groups were not significantly different. There seems to be a slight positive skew to the control populations' 2008 math CRCT scores in Figure 4.1. Normality for the two groups was assumed.

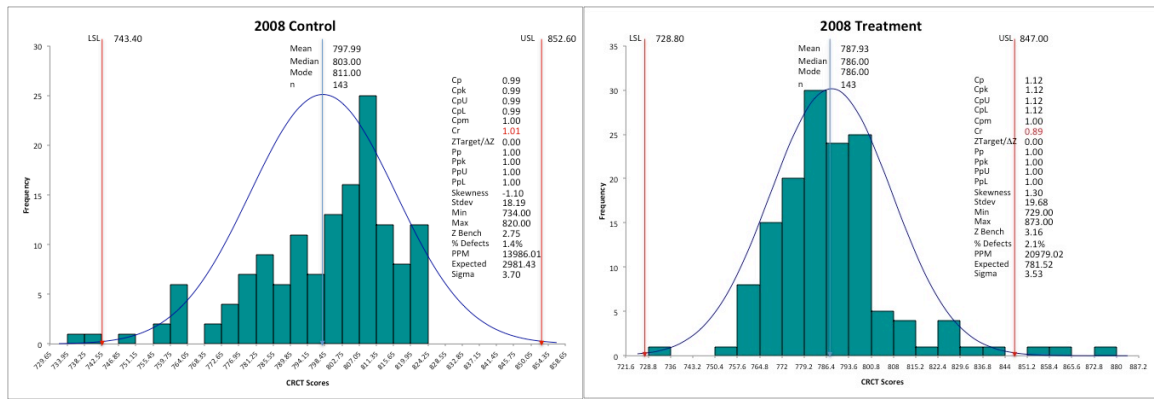


Figure 4.1. Histograms for 2008 CRCT Scores for Control and Treatment

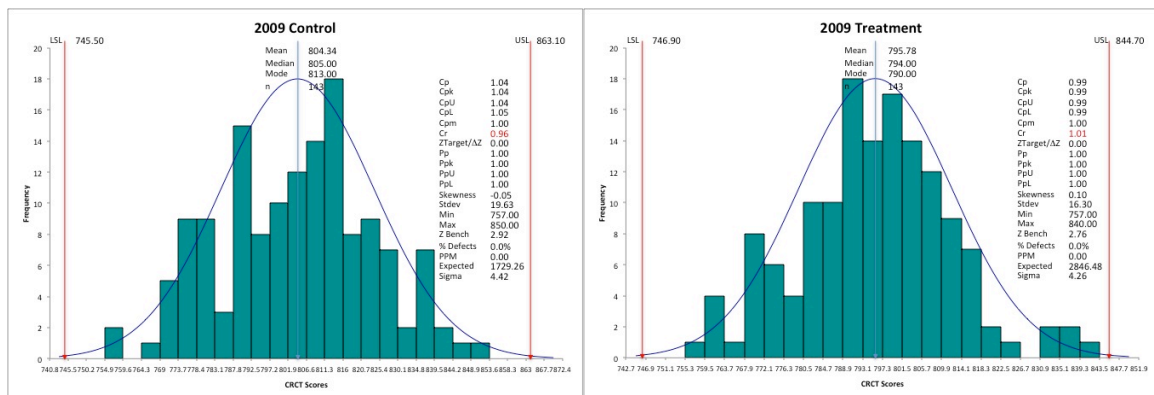


Figure 4.2. Histograms for 2009 CRCT Scores for Control and Treatment

Assumption testing is important to any study that utilizes an ANCOVA as a means of determining statistical significance (Fraenkel & Wallen, 2006). A chi-square analysis yielded a  $p$ -value of 0.107; that value was higher than 0.05, signifying sufficient independence between the covariates (Howell, 2008). Homogeneity of variances was tested using Levene's Test of Equality of Error Variances in SPSS. The significance level produced was .98. Thus, a statistic indication assumption of variance was not violated. The mean scores from the 2008 tests from both control and treatment populations were significantly different. The difference in those averages of the student scores in the control and treatment groups from 2008 was 10.063 where an independent samples  $t$  test comparison between mean of the two groups with confidence interval between 5.65 and 14.47 (95% confidence),  $n = 286$ , indicated ( $M = 10.06$ ,  $SD = 18.95$ ),  $t$

(284) = 4.49,  $p = <.0001$ . This indicated a significant difference between the mean scores of treatment and control groups for the 2008 CRCT. Thus, the ANCOVA was deemed an appropriate measure (Howell, 2008).

The scatterplot in Figure 4.3 appears to show linear relationships for each group, meaning that the trends of scores from 2008 to 2009 for those populations are somewhat similar. The 2008 math CRCT scores are along the X-axis while the 2009 math CRCT scores are on the Y-axis. Additionally, the slopes of the lines are similar to one another as graphed in a relationship of the covariate and the independent variable, which confirmed homogeneity of regression slopes; having similar slopes would indicate either similar gains or losses from covariate to dependent variable for both populations.

Homogeneity of regression slopes was tested statistically, yielding a result of  $F(1,283) = 3.799$ ,  $MSE = 224.362$ ,  $p = .052$ , which further supports no violation to the assumption of homogeneity (although the  $p$ -value is slightly higher than the alpha level) which suggests further testing should occur.

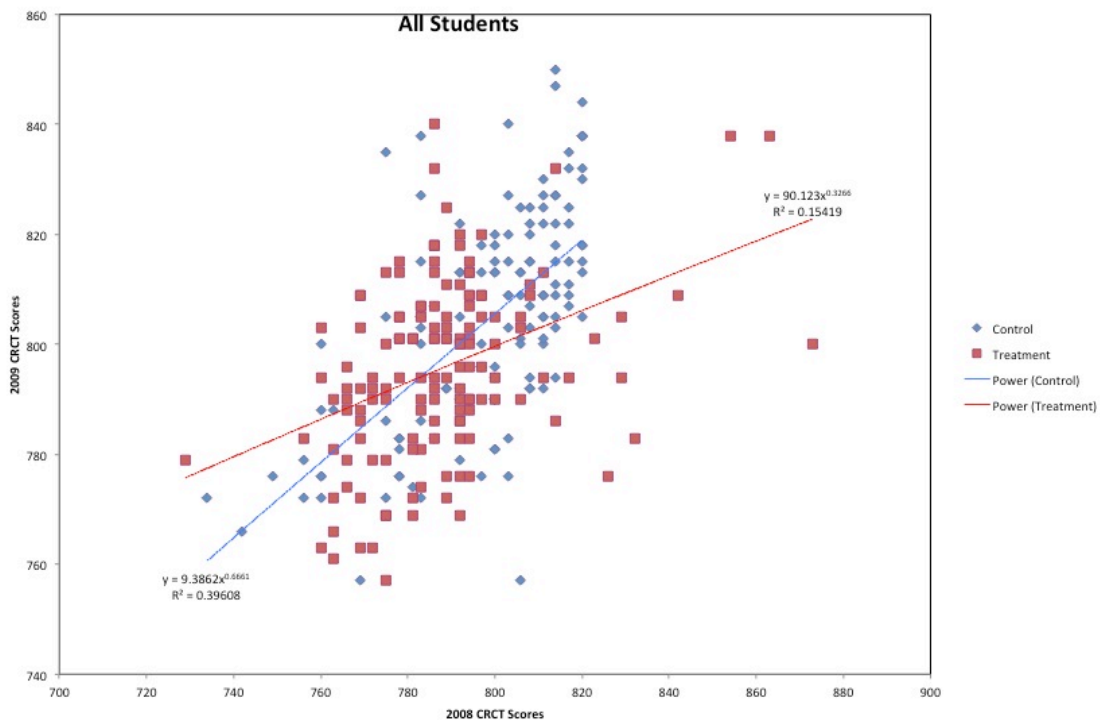


Figure 4.3. Scatterplot of 2008 and 2009 CRCT Scores

Since the assumptions that the groups were similar from the previous tests were not violated, a one-way ANCOVA was run. Mean adjustment was necessary for the 2008 CRCT scores in order to equate the groups due to slight variance on those tests (Fraenkel & Wallen, 2006). Table 4.3 shows adjusted means for the 2009 CRCT mean for the treatment and control groups.

Table 4.3

*2009 Adjusted Means*

Variable	Mean	Standard Error
Control	801.891	1.321
Treatment	798.235	1.321

After adjusting the means from the 2008 CRCT scores, there was a statistically significant difference between students receiving treatment and those students not

receiving treatment at the alpha level of .05. The ANCOVA showed  $F(1, 283) = 3.7, p = 0.055$ , partial  $\eta^2 = .013$ . Eta squared showed to have a value of .013 that accounted for about 1% of the variance between groups on the 2009 CRCT (Howell, 2008). Observed power was .483, resulting in the possibility of making a Type II error. With a p-value of 0.055, statistically significant differences were seen between the control and treatment groups. The adjusted mean score for the treatment group was lower than for the control group, indicating that remediation was not effective, as seen on the 2009 math CRCT, for the treatment group. Since the adjusted mean of the control population was higher than that treatment group, the null hypothesis  $H_{01}$  was not rejected.

## **Research Question 2**

Research Question 2, which asked if there was a difference in student performance based on participation in the intervention math class and socioeconomic status, was addressed by conducting a two-way ANCOVA. For this analysis, the dependent variable was the 2009 math CRCT scores from the SES subgroup, the independent variable was the SES of the students, and the covariate was the 2008 scores from that same group. This analysis was important to ascertain if there was a statistically significant difference in SES for the population of sixth grade students. The group differences were measured against assignment in control or intervention classes, as those assignments have been described previously. As with the ANCOVA for Research Question 1, assumptions of group differences were assessed prior to running the two-way ANCOVA.

Reliability of the CRCT tests was high and both tests were deemed valid, according to the Georgia Governor's Office (2011). Table 4.4 and Figures 4.4, 4.5, 4.6,

and 4.7 assessed normality of group assumptions. Table 4.4 indicates kurtosis and skew values close to 0, supporting normality.

Table 4.4

*Research Question 2 Descriptive Statistics*

CRCT Score	<i>n</i>	<i>M</i>	<i>SD</i>
2008 ED Control	82	797.378	19.101
2008 ED Treatment	97	785.566	18.375
2008 Non-ED Control	61	798.844	16.992
2008 Non-ED Treatment	46	792.330	21.339
2009 ED Control	82	802.707	20.962
2009 ED Treatment	97	793.670	16.432
2009 Non-ED Control	61	806.541	17.618
2009 Non-ED Treatment	46	800.239	15.242

Figures 4.4, 4.5, 4.6, and 4.7 are histograms showing near symmetric data for the ED and non-ED populations on the math CRCT for the 2008 and 2009 testing years, respectively. Those data confirm normal distribution of scores for the SES subgroup.

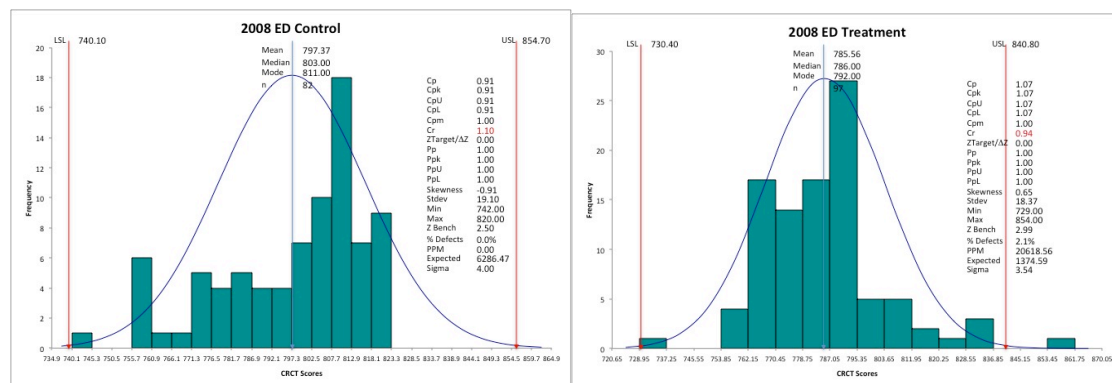


Figure 4.4. Histograms for 2008 CRCT Scores for ED SES

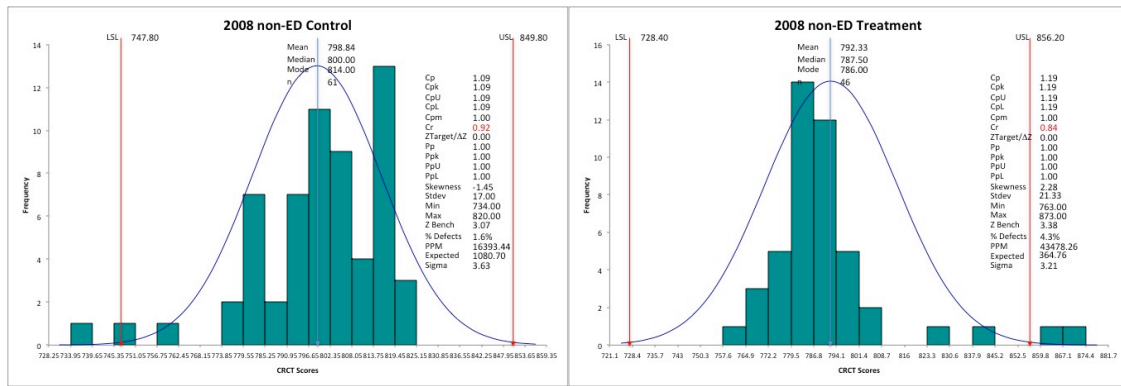


Figure 4.5. Histograms for 2008 CRCT Scores for Non-ED SES

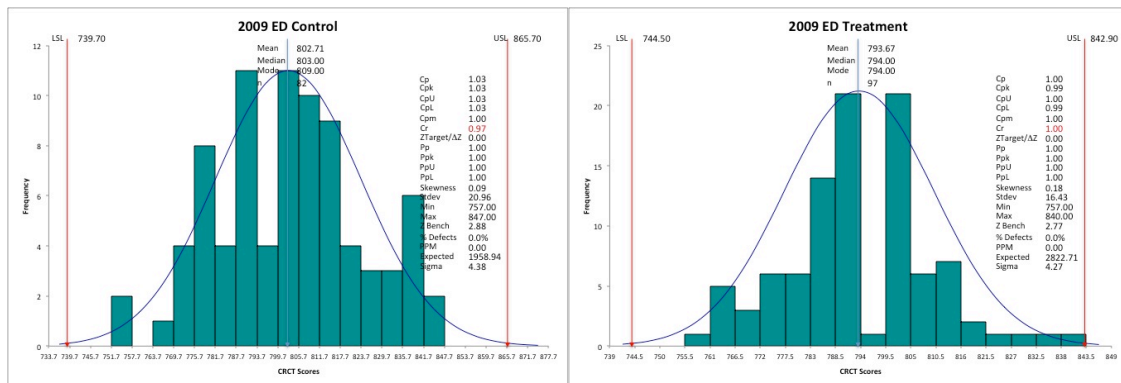


Figure 4.6. Histograms for 2009 CRCT Scores for ED SES

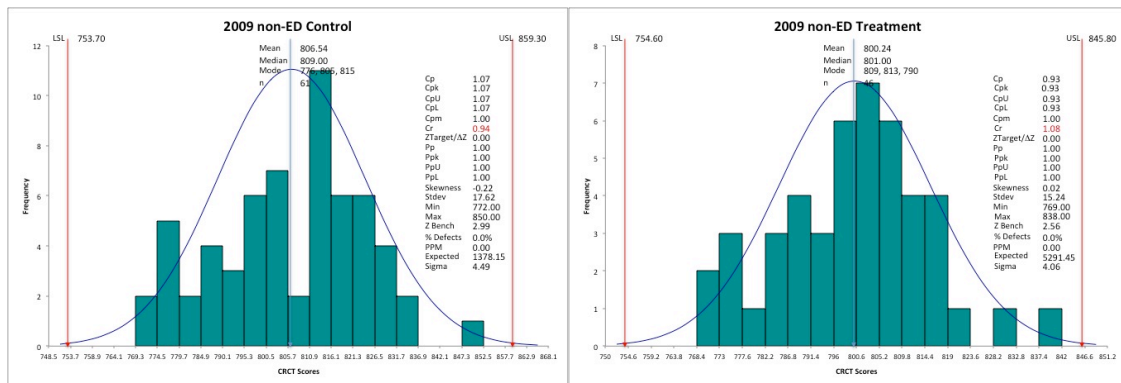


Figure 4.7. Histograms for 2009 CRCT Scores for Non-ED SES

The homogeneity of variances was tested using Levene's Test of Equality of Error Variances within SPSS. The significance level produced was .924, a statistic indication assumption for variance was not violated, illustrating that the differences between groups were not seen. The scatterplot in Figure 4.8 appears to show linear relationships for each



group. The 2008 math CRCT scores for each population within the SES subgroup are along the X-axis, while the 2009 math CRCT scores for each population within the SES subgroup are on the Y-axis. Additionally, the slopes of the lines were similar to one another as graphed in a relationship of the covariate and the independent variable, which confirmed homogeneity of regression slopes. Homogeneity of regression slopes was tested statistically at  $F(1,283) = 3.007$ ,  $MSE = 236.404$ ,  $p = .084$ , which further support no violation to the assumption of homogeneity, indicating the scores from the four groups of students did not overtly vary from one another.

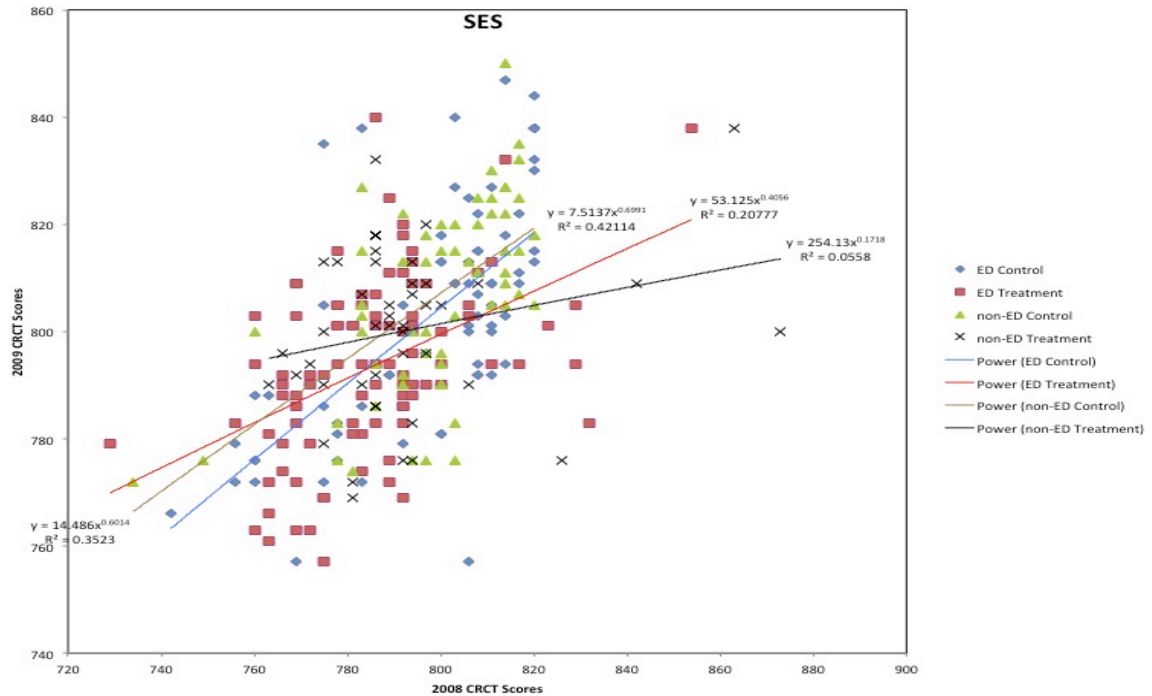


Figure 4.8. Scatterplot of 2008 and 2009 CRCT Scores for SES

Adjusted means for the two-way ANCOVA are displayed in tables 4.5, 4.6, and 4.7 for the three null hypotheses associated with the second research question.

Table 4.5

*2009 H<sub>2,0</sub> Adjusted Means*

Variable	Mean	Standard Error
ED	798.869	1.161
Non-ED	802.073	1.515

Table 4.6

*2009 H<sub>2,1</sub> Adjusted Means*

Variable	Mean	Standard Error
Control	802.085	1.332
Treatment	798.856	1.397

Table 4.7

*2009 H<sub>2,2</sub> Adjusted Means*

Variable	Mean	Standard Error
ED Control	800.525	1.721
ED Treatment	797.213	1.610
Non-ED Control	803.645	2.001
Non-ED Treatment	800.500	2.279

Since there were no threats to initial variance, conducting the ANCOVA proceeded. There was not a statistically significant difference for SES,  $F(1,281) =$

2.803,  $p = .095$ , partial  $\eta^2 = .010$ . The accompanying observed power was .385, creating confidence in not making a Type II error. Since the adjusted mean for the control population was higher than for the treatment and the  $p$ -value was higher than 0.05, null hypothesis  $H_{2.0}$  was not rejected. There were not significant differences for students based on SES.

There was not a statistically significant difference for the dependent variable of intervention against the control population for the 2009 CRCT within,  $F(1,281) = 2.727$ ,  $p = .100$ , partial  $\eta^2 = .010$ . The power for this statistic was .377, resulting in a lack of confidence in not making a Type II error. For  $H_{2.1}$ , the adjusted mean for the control population was four points higher than for the treatment group; the null  $H_{2.1}$  was not rejected and there was no statistically significant difference for SES as students were populated in control and treatment groups.

There was not a statistically significant difference between SES at an alpha level of .05,  $F(1,281) = .002$ ,  $p = .965$ , partial  $\eta^2 = .000$ . The observed power was .05, indicating low power and likelihood of creating a Type II error. For  $H_{2.2}$ , the null was not rejected due to the high  $p$ -value and the control populations' means being higher than the treatment groups' means, resulting in no statistically significant differences for the interaction effect of intervention and SES.

### **Research Question 3**

Research Question 3, which focused on ethnic subgroups, was addressed by a two-way ANCOVA. As stated earlier, the subgroups that populated the school system contained less than 1% Asian or American Indian, 8.5% African American, 7.6% Hispanic, and just over 80% Caucasian (BCSS, 2011). Therefore, since there were a limited number of ethnicities represented in the subgroups other than White, the two

categories established for statistical analysis were White and Ethnic Minority. The Ethnic Minority subgroup consisted of the combined Asian or American Indian, African American, and Hispanic subgroups. Grouping of students in this fashion was done to maintain statistical power and nominally group students for analysis (Gall, Gall & Borg, 2007). The American Psychological Association (2010) iterated that use of the word, *minority*, carries a negative connotation. Therefore, whenever possible a modifier should be used with the word, minority.

Analysis interpreted differences in mean scores on the 2009 math CRCT for the SES subgroup. The independent variable was the 2009 math CRCT scores from the ethnicity subgroup, while the covariate was the 2008 scores from that same group. The group differences were measured against assignment in control or treatment classes. As with the ANCOVA for research questions one and two, assumptions of group dynamics were assessed prior to running the two-way ANCOVA.

Again, reliability of the independent variable and the covariate were both assumed, according to the Georgia Governor's Office (2011). Table 4.8 and Figures 4.9, 4.10, 4.11, and 4.12 assessed normality of group assumptions. Normality was assumed due to kurtosis and skew values close to 0 in Table 4.8, even though there appears to be a slight positive skew for the 2008 white control population.

Table 4.8

*Research Question 3 Descriptive Statistics*

CRCT Score	<i>n</i>	<i>M</i>	<i>SD</i>
2008 White Control	111	799.625	18.183
2008 White Treatment	122	789.345	19.747
2008 Ethnic Minority Control	32	792.340	17.342
2008 Ethnic Minority Treatment	21	779.713	17.588
2009 White Control	111	806.099	20.705
2009 White Treatment	122	795.762	16.404
2009 Ethnic Minority Control	32	798.250	13.961
2009 Ethnic Minority Treatment	21	795.905	16.065

Figures 4.9, 4.10, 4.11, and 4.12 are histograms showing near symmetric data for the White and Ethnic Minority populations on the math CRCT for the 2008 and 2009 testing years, respectively. Those data confirm normal distribution of scores for the ethnicity subgroup.

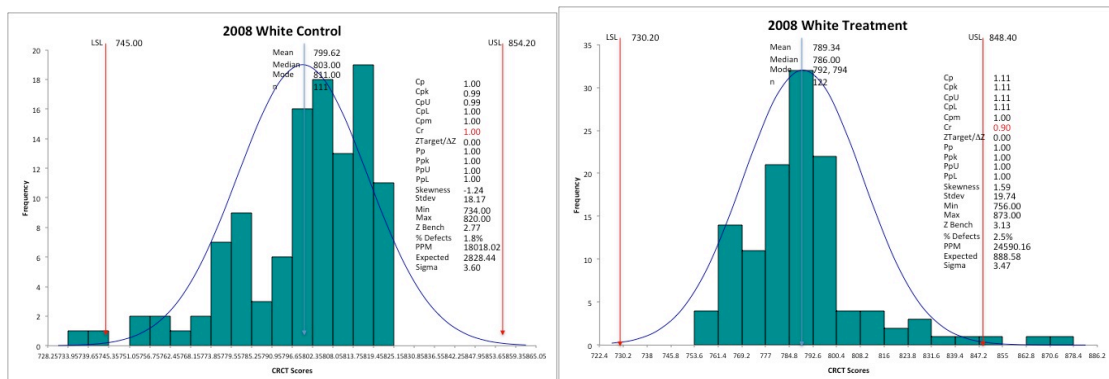


Figure 4.9. Histograms for 2008 CRCT Scores for White Ethnicity

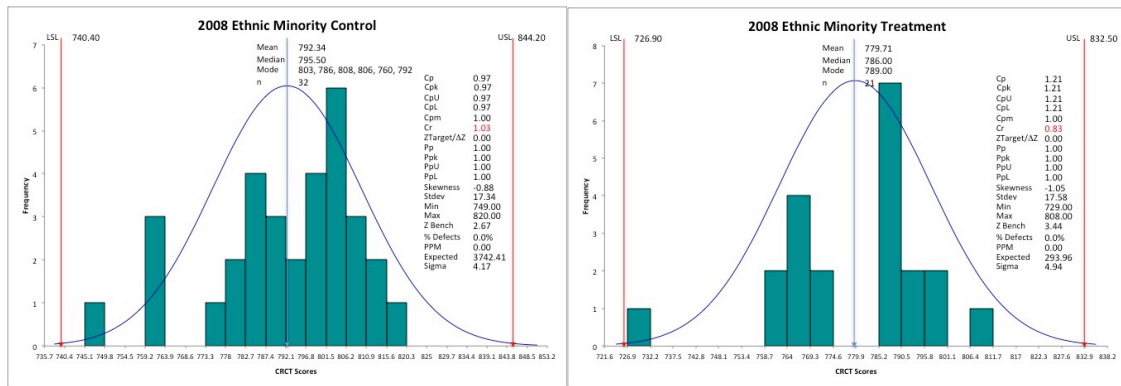


Figure 4.10. Histograms for 2008 CRCT Scores for Ethnic Minority Subgroup

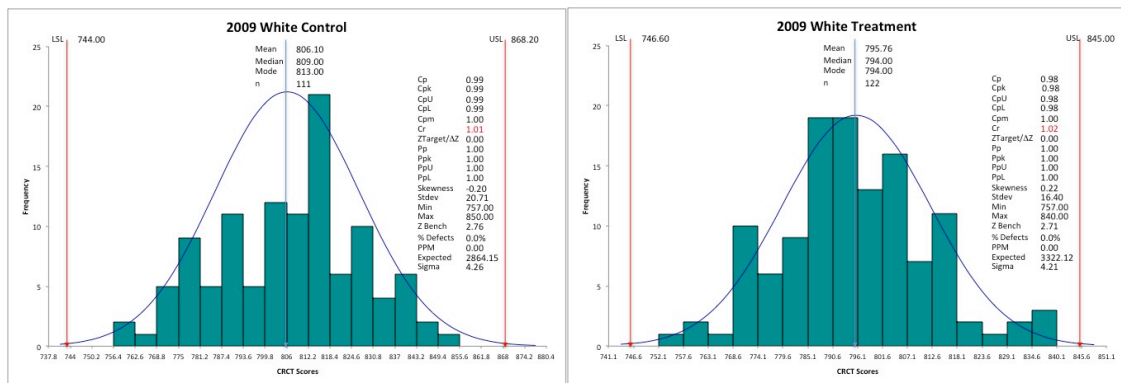


Figure 4.11. Histograms for 2009 CRCT Scores for White Ethnicity

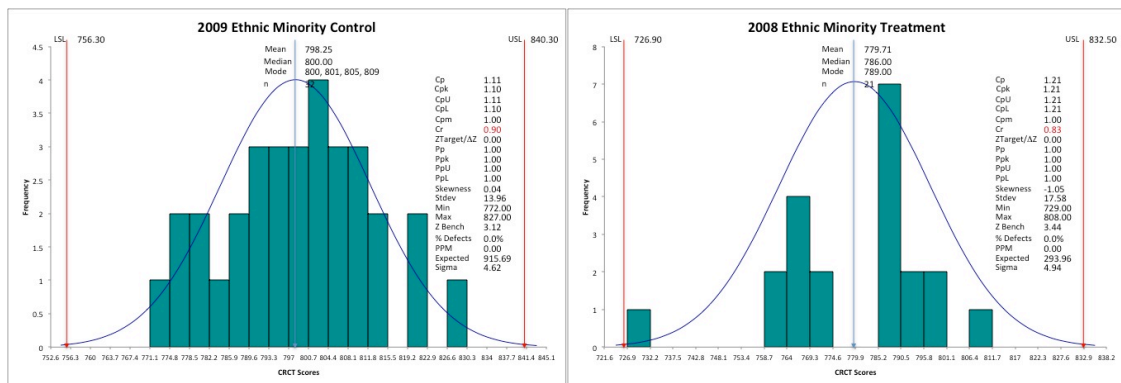


Figure 4.12. Histograms for 2009 CRCT Scores for Ethnic Minority Subgroup

Homogeneity of variances was tested using Levene's Test of Equality of Error Variances with SPSS, as this analysis would indicate the amount of difference between populations for the 2008 math CRCT. The significance level was .075; a statistic indication assumption for variance was not violated as the value was higher than .05.

The scatterplot shown in Figure 4.13 shows linear relationships for each group in addition to the plotting of scores for the students' 2008 and 2009 math CRCT. Lines of fit were generated for each set of plots for the four separate populations. The 2008 math CRCT scores for each population within the ethnicity subgroup are on the X-axis, while the 2009 math CRCT scores for each population within the ethnicity subgroup are on the Y-axis. Slopes of these lines were similar to one another as graphed in a relationship of the covariate and the independent variable, which confirmed homogeneity of variance. Homogeneity of regression slopes was tested at  $F(1,283) = .5$ ,  $MSE = 242.391$ ,  $p = 0.487$ , which further support no violation to the assumption of homogeneity.

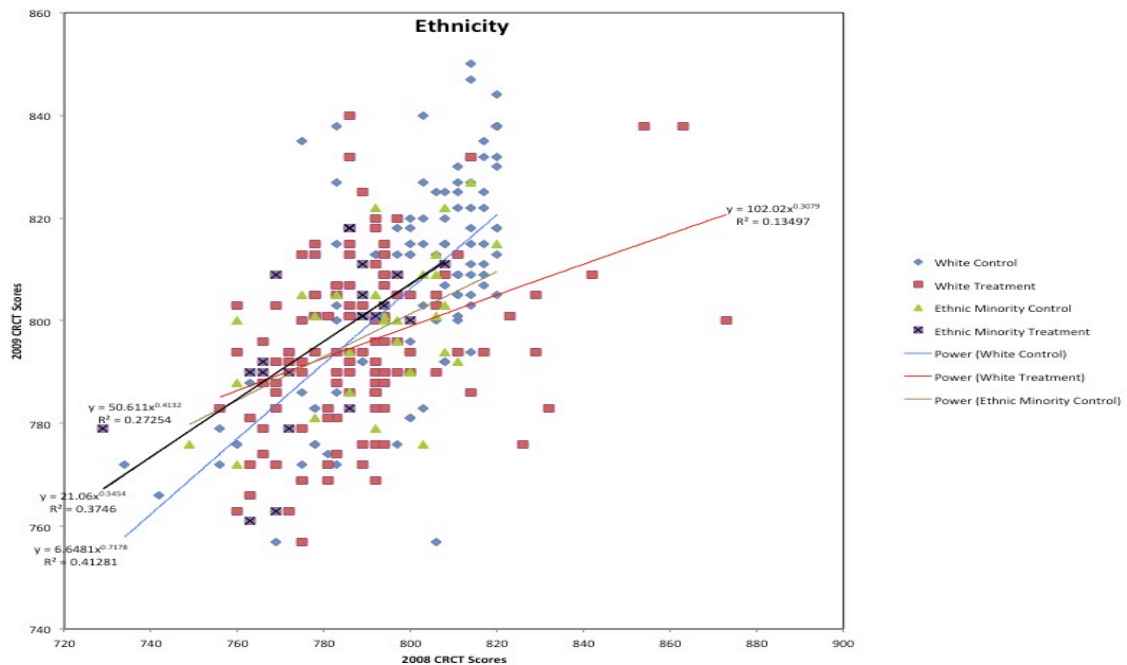


Figure 4.13. Scatterplot of 2008 and 2009 CRCT Scores for Ethnicity

With no assumptions violated, a two-way ANCOVA was run to test the three accompanying null hypotheses  $H_{3,0}$ ,  $H_{3,1}$ , and  $H_{3,2}$  in regards to the populations, as aggregated by ethnicity. Adjusted means for Research Question 3 and the associating null hypotheses are displayed in Table 4.9, Table 4.10, and Table 4.11.

Table 4.9

*2009 H<sub>3,0</sub> Adjusted Means*

Variable	Mean	Standard Error
White	800.188	1.018
Ethnic Minority	800.459	2.201

Table 4.10

*2009 H<sub>3,1</sub> Adjusted Means*

Variable	Mean	Standard Error
Control	800.701	1.560
Treatment	799.947	1.875

Table 4.11

*2009 H<sub>3,2</sub> Adjusted Means*

Variable	Mean	Standard Error
White Control	802.850	1.506
White Treatment	797.527	1.413
Ethnic Minority Control	798.551	2.737
Ethnic Minority Treatment	802.367	3.441

There was not a statistically significant difference for ethnicity,  $F(1,281) = .012$ ,  $p = .912$ , partial  $\eta^2 = .000$ . The accompanying observed power was .05, a low statistical



power, indicating the likelihood of creating a Type II error. For  $H_{3,0}$ , the null hypothesis was not rejected due to the  $p$ -value being higher than 0.05 and the means for White/Ethnic Minority being close to the same value.

There was not a statistically significant difference for control versus treatment for the 2009 CRCT within the ANCOVA at an alpha level of .05,  $F(1,281) = 0.093$ ,  $p = .760$ , partial  $\eta^2 = .000$ . The adjusted mean for the control population was 800.701 ( $SE = 1.560$ ) and treatment was 799.947 ( $SE = 1.875$ ). Power analysis for this statistic was .061, indicating low confidence in not making a Type II error. Even though the power statistic is higher than .05, care should be taken in retaining the null. For  $H_{3,1}$ , the null was not rejected due to the  $p$ -value being higher than 0.05 and the means for the control and treatment groups being close to one another.

A statistically significant difference between ethnicity and intervention was seen at the alpha level of .05,  $F(1,281) = 3.624$ ,  $p = .058$ , partial  $\eta^2 = .013$ . The observed power was .47 indicating medium-sufficient power (Howell, 2008), minimizing the likelihood of creating a Type I error. For  $H_{3,2}$ , the null was not rejected due to a  $p$ -value higher than 0.05.

#### **Research Question 4**

Research Question 4 was addressed with a two-way ANCOVA. That statistic focused on the gender subgroup. Analysis interpreted differences in mean scores on the 2009 math CRCT for the gender subgroup. The independent variable was the 2009 math CRCT scores from the gender subgroup, while the covariate was the 2008 scores from that same group. The group differences were measured against assignment in control or intervention classes. As with the ANCOVA for Research Questions 1, 2, and 3, assumptions of group dynamics were assessed prior to running the two-way ANCOVA.

Reliability of the independent variable and the covariate were both assumed, according to the Georgia Governor's Office (2011), as those both had high reliability alphas. Table 4.12 and Figures 4.14, 4.15, 4.16, and 4.17 assessed normality of group assumptions. Normality was assumed due to kurtosis and skew values close to zero in Table 4.12.

Table 4.12

*Research Question 4 Descriptive Statistics*

CRCT Score	<i>n</i>	<i>M</i>	<i>SD</i>
2008 Male Control	59	799.610	15.831
2008 Male Treatment	69	789.861	17.224
2008 Female Control	84	796.867	19.692
2008 Female Treatment	74	786.145	21.690
2009 Male Control	59	802.424	17.092
2009 Male Treatment	69	798.362	15.136
2009 Female Control	84	805.690	21.232
2009 Female Treatment	74	793.378	17.065

Figures 4.14, 4.15, 4.16, and 4.17 are histograms showing symmetric and normal distribution data for the male and female populations on the math CRCT for the 2008 and 2009 testing years, respectively. Those data confirm normal distribution of scores for the gender subgroup.

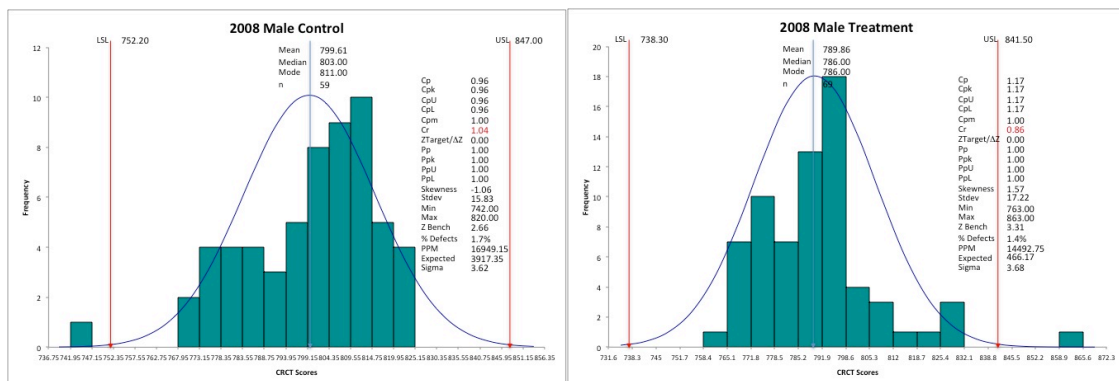


Figure 4.14. Histograms for 2008 CRCT Scores for Male Gender

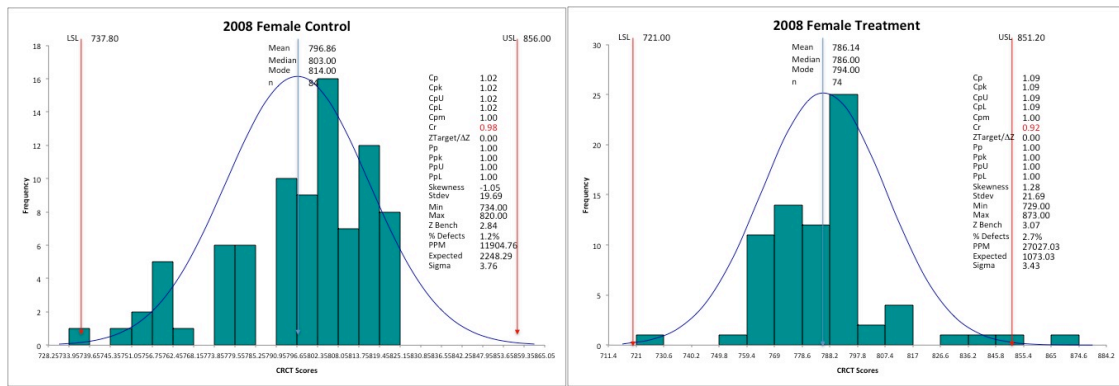


Figure 4.15. Histograms for 2008 CRCT Scores for Female Gender

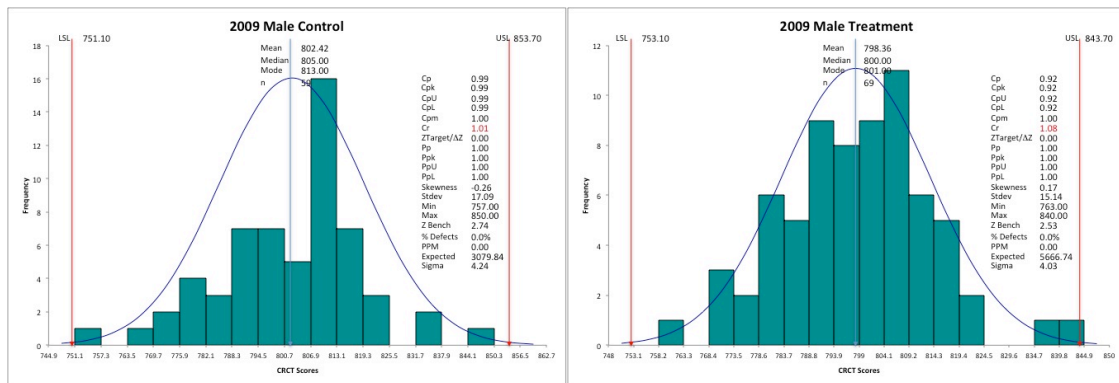


Figure 4.16. Histograms for 2009 CRCT Scores for Male Gender

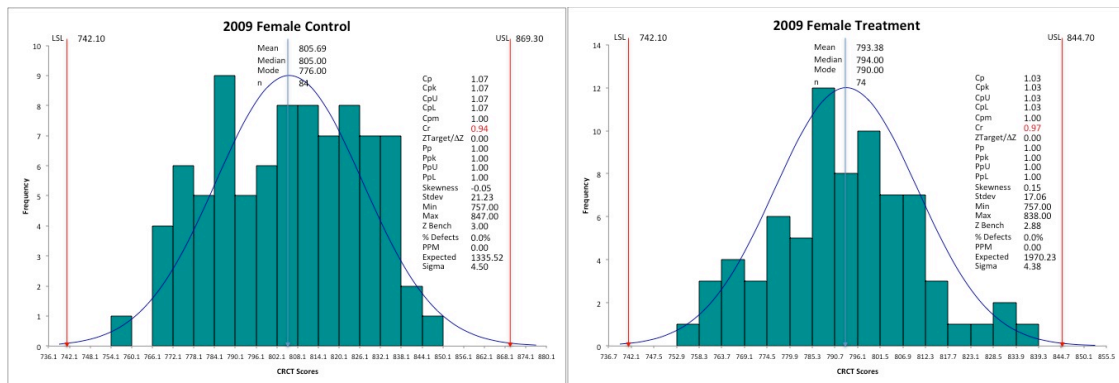


Figure 4.17. Histograms for 2009 CRCT Scores for Female Gender

The homogeneity of variances was tested using Levene's Test of Equality of Error Variances with SPSS. The significance level produced was .059, an indication that the assumption for variance was not violated, as the value was slightly higher than .05. The scatterplot below in Figure 4.18 shows linear relationships for each group. The 2008

math CRCT scores for each population within the gender subgroup are on the X-axis, while the 2009 math CRCT scores for each population within the gender subgroup are on the Y-axis. The slopes of these lines were similar to one another as graphed in a relationship of the covariate and the independent variable, which confirmed homogeneity of variance. Homogeneity of regression slopes was tested at  $F(333.822) = 1.382$ ,  $MSE = 241.559$ ,  $p = 0.241$ , which further support no violation to the assumption of homogeneity.

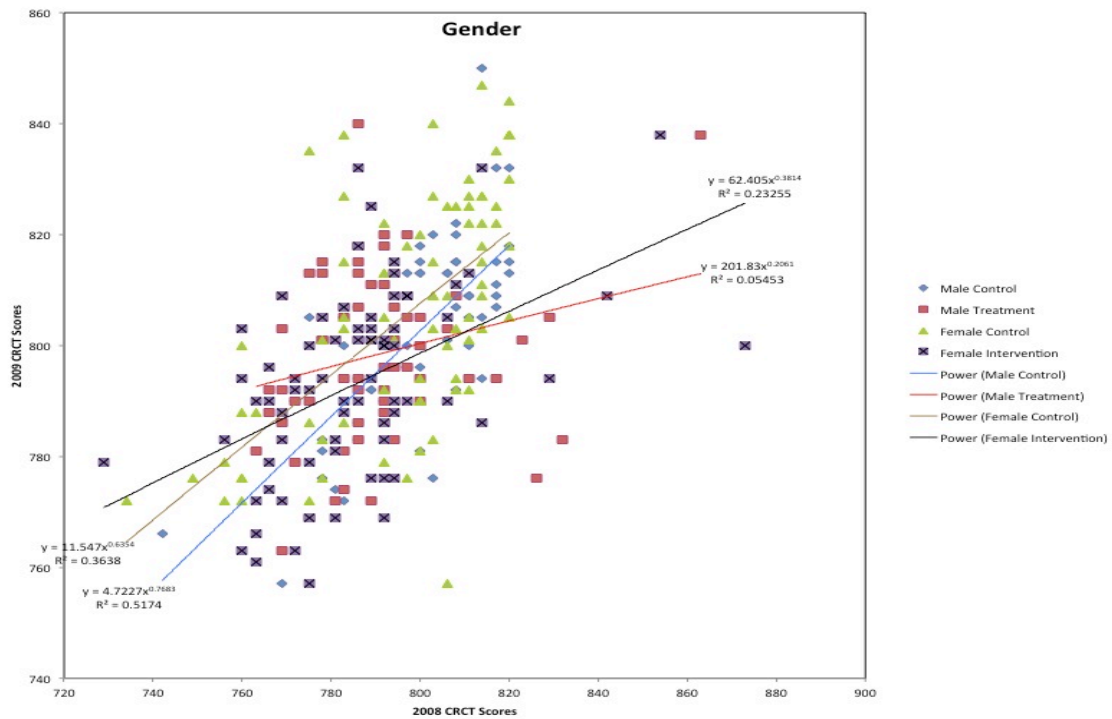


Figure 4.18. Scatterplot of 2008 and 2009 CRCT Scores for Gender

With no assumptions violated, a two-way ANCOVA was run to test the three accompanying null hypotheses  $H_{4.0}$ ,  $H_{4.1}$ , and  $H_{4.2}$ . Adjusted means for gender are displayed in Table 4.13, Table 4.14, and Table 4.15 for the null hypotheses associated with Research Question 4.

Table 4.13

*2009 H<sub>4,0</sub> Adjusted Means*

Variable	Mean	Standard Error
Male	799.530	1.373
Female	800.249	1.234

Table 4.14

*2009 H<sub>4,1</sub> Adjusted Means*

Variable	Mean	Standard Error
Control	801.487	1.338
Treatment	798.291	1.316

Table 4.15

*2009 H<sub>4,2</sub> Adjusted Means*

Variable	Mean	Standard Error
Male Control	799.183	2.038
Male Treatment	799.877	1.867
Female Control	803.792	1.697
Female Treatment	796.706	1.827

There was not a statistically significant difference for gender, as included in the two-way ANCOVA at an alpha level of .05,  $F(1,281) = .151$ ,  $p = .698$ , partial  $\eta^2 = .001$ .

The accompanying observed power was .067, a low power statistic resulting in the possibility of creating a Type II error. Care should be taken when interpreting the score. For  $H_{4.0}$ , the null was not rejected. There was no statistically significant difference between genders. Additionally, the difference in the adjusted means was less than one point.

There was not a statistically significant difference for control versus treatment for the 2009 CRCT within the ANCOVA at an alpha level of .05,  $F(1,281) = 2.803$ ,  $p = .095$ , partial  $\eta^2 = .010$ . The power for this statistic was .385, indicating sufficient confidence in not making a Type II error. For  $H_{4.1}$ , the null was not rejected. There was no statistically significant difference between the treatment and control populations, as aggregated by gender. In addition, the control group scored higher than the treatment, suggesting intervention was not beneficial.

A statistically significant difference between gender and group assignment (male and female) was seen at the alpha level of .05,  $F(1,281) = 4.453$ ,  $p = .036$ , partial  $\eta^2 = .016$ . The observed power was .557, indicating sufficient power and minimizing the likelihood of creating a Type I error. For  $H_{4.2}$ , the null was rejected, although the control group had a higher mean score than the treatment group. Such a result suggests remediation was not beneficial.

### **Findings and Summary**

The research questions for this analysis project were answered using ANCOVAs. Research Question 1 addressed the effect of a remediation math class on sixth grade math CRCT scores. The 2009 math CRCT scores for the treatment group were not significantly different from the control group at a  $p$ -value of 0.055. Thus, the first null hypothesis,  $H_{01}$ , that there would be no statistically significant difference in the math

scores of students who received a remediation class of math instruction as compared to those students who do not participate in this class, was not rejected, meaning a statistically significant difference between mean scores for the treatment group and control group was not found. Also, the mean score for the control group was higher than that of the treatment group, suggesting no overall benefit was seen from remediation for sixth grade students in the cooperating school system during the 2008-2009 school years.

Research Question 2 analyzed whether SES affected math CRCT scores. The two-way ANCOVA that was conducted with SES and intervention assignment data yielded a  $p$ -value of 0.095 for the SES main effect, a high value that allowed for sufficient confidence in not rejecting null hypothesis  $H_{2.0}$ , indicating that there was no significant difference between ED and non-ED. The treatment main effect of the treatment and control groupings yielded a  $p$ -value of 0.100, a value greater than 0.05 that resulted in not rejecting null hypothesis  $H_{2.1}$ , suggesting there was no significant difference between the control and treatment, as aggregated by SES. The interaction effect between SES and the remediation class yielded a  $p$ -value of 0.965, greater than 5% confidence. Therefore, null hypothesis  $H_{2.2}$  was not rejected. These findings suggest there were no significant findings for SES with regards to intervention.

Research Question 3 was asked to see if ethnicity made a difference in math CRCT scores. The two-way ANCOVA that was conducted yielded a  $p$ -value of 0.912 for the ethnicity main effect, a high value that allowed for sufficient confidence in not rejecting null hypothesis  $H_{3.0}$ , suggesting no difference in means for ethnicity. The treatment main effect of the treatment and control groupings yielded a  $p$ -value of 0.760, a high value that resulted in not rejecting null hypothesis  $H_{3.1}$ . Significant difference was not found for treatment population and control population means. The interaction effect



between ethnicity and the intervention class yielded a  $p$ -value of 0.058, a value that failed to reject the null hypothesis  $H_{3,2}$ , suggesting a statistically significant difference for ethnicity and control/treatment assignment does not exist and benefit was not seen for varying ethnicities on the 2008-2009 math CRCT for the cooperating school system's sixth grade students.

Finally, Research Question 4 was asked to see if gender affected math CRCT scores. The two-way ANCOVA that was conducted and yielded a  $p$ -value of 0.698 for the gender main effect, a high value that allowed for sufficient confidence in not rejecting null hypothesis  $H_{4,0}$ , suggesting no significant difference between genders. The treatment main effect of the treatment and control groupings yielded a  $p$ -value of 0.095, a high value the resulted in not rejecting null hypothesis  $H_{4,1}$ , which suggested no significant difference between treatment and control group means. The interaction effect between gender and the intervention class yielded a  $p$ -value of 0.036, a significant value that resulted in rejection of null hypothesis  $H_{4,2}$ . There was a statistically significant difference in the means for gender and control/treatment groups. Specifically, the female gender had a higher mean score with regards to remediation as compared to the male gender that had control and treatment means very similar to one another. Table 4.16 shows the results of the ANCOVAs.

Table 4.16

*Findings for Research Questions and Null Hypotheses*

		p-value	Reject Null
RQ1	H <sub>01</sub>	0.055	NO
RQ2	H <sub>2.0</sub>	0.095	NO
	H <sub>2.1</sub>	0.100	NO
	H <sub>2.2</sub>	0.965	NO
RQ3	H <sub>3.0</sub>	0.912	NO
	H <sub>3.1</sub>	0.760	NO
	H <sub>3.2</sub>	0.058	NO
RQ4	H <sub>4.0</sub>	0.698	NO
	H <sub>4.1</sub>	0.095	NO
	H <sub>4.2</sub>	0.036	YES

The results from these analyses are different from previous studies as not a lot of benefit was seen from remediation; however, this study open doors for more areas of research in regards to remediation for female students on the math portion of the CRCT for middle grades. It is entirely possible for more subgroups to exist or for different grade levels to be analyzed. The purpose of this study was to analyze all of the sixth grade intervention math students within the cooperating school system to determine if those classes had any bearing on their participating students' CRCT math scores. The data suggest that all but one null hypothesis could not be rejected since there were no significant differences between the control and treatment populations and demographics.

Chapter 5 will conclude the study with discussion of the findings and offer an explanation as to the importance and implications that may be derived.

## **CHAPTER FIVE: DISCUSSION**

School leaders need to find the best solutions to working with and meeting the needs of diverse learners in the classroom. With legislation such as No Child Left Behind and the ever-increasing need for schools to meet Adequate Yearly Progress (Georgia Department, 2011a), student success is an ongoing concern. Student success and student achievement within the public education classroom are becoming more important than ever. Educational programs must be tailored for the individual and not presented in a way that would fit the average student.

The purpose of this study was to determine the effectiveness of a remediation mathematics course in a middle school setting for sixth grade students. Criterion Referenced Competency Test math scores from students enrolled in an intervention mathematics course were compared to scores from a control population of students not receiving the treatment of the class. The course was organized for the purpose of remediation in mathematics of at-risk students for success in high-stakes testing. This chapter will present the findings from the research and then a discussion of those findings. Limitations, implications, and recommendations for future research will follow and end with a conclusion.

Four research questions guided data collection for the study.

### **Research Questions**

1. Is there a difference in at-risk 6<sup>th</sup> grade students' CRCT scores based on their participation in a remediation class as compared to at-risk students who did not participate in a remediation class while controlling for the 5<sup>th</sup> grade CRCT scores of both groups?

2. Is there a difference in at-risk 6<sup>th</sup> grade students' CRCT scores who participated in a remediation class as compared to at-risk students who did not participate in the remediation class based on their socio-economic status while controlling for the 5<sup>th</sup> grade CRCT scores of both groups?
3. Is there a difference in at-risk 6<sup>th</sup> grade students' CRCT scores who participated in a remediation class as compared to at-risk students who did not participate in the remediation class based on their ethnicity while controlling for the 5<sup>th</sup> grade CRCT scores of both groups?
4. Is there a difference in at-risk 6<sup>th</sup> grade students' CRCT scores who participated in a remediation class as compared to at-risk students who did not participate in the remediation class based on their gender while controlling for the 5<sup>th</sup> grade CRCT scores of both groups?

### **Hypotheses**

Null hypothesis 1:  $H_{01}$ : There will be no statistically significant difference in the mathematics CRCT scores of 6<sup>th</sup> grade students who receive a remediation class of math instruction as compared to those at-risk students who do not participate in this class, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores of both groups.

Null hypothesis 2.0:  $H_{2,0}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students based on socioeconomic status (SES), while controlling for their 5<sup>th</sup> grade mathematics CRCT scores.

Null hypothesis 2.1:  $H_{2,1}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students who receive a remediation class of math instruction as compared to those at-risk students who do not participate in

the class, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores of both groups as aggregated by SES.

Null hypothesis 2.2:  $H_{2,2}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students who receive a remediation class of math instruction based on socioeconomic status (SES) as compared to those at-risk students who do not participate in the class, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores.

Null hypothesis 3.0:  $H_{3,0}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students based on ethnicity, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores.

Null hypothesis 3.1:  $H_{3,1}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students who receive a remediation class of math instruction as compared to those at-risk students who do not participate in the class, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores of both groups as aggregated by ethnicity.

Null hypothesis 3.2:  $H_{3,2}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students who receive a remediation class of math instruction based on ethnicity as compared to those at-risk students who do not participate in the class, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores of both groups.

Null hypothesis 4.0:  $H_{4,0}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students based on gender, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores.

Null hypothesis 4.1:  $H_{4.1}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students who receive a remediation class of math instruction as compared to those at-risk students who do not participate in the class, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores of both groups as aggregated by gender.

Null hypothesis 4.2:  $H_{4.2}$ : There will be no statistically significant difference in the mathematics CRCT scores of at-risk 6<sup>th</sup> grade students who receive a remediation class of math instruction based on gender as compared to those at-risk students who do not participate in the class, while controlling for the 5<sup>th</sup> grade mathematics CRCT scores of both groups.

## **Findings**

### **Findings for Research Question 1**

Research Question 1 focused on the effect that a math remediation class had on the achievement scores of sixth grade students in one Georgia school system as measured by the 2009 mathematics CRCT. The data analyses revealed a *p*-value for the analysis of covariance (ANCOVA) between the control and treatment groups for the 2009 CRCT testing year of 0.055, indicating no statistically significant difference. From this finding, the determination was made not to reject the null hypothesis; in effect, this showed that the remediation class yielded different scores from the control population and more importantly, that the control group had a higher mean score than the treatment group. This study suggests that overall, treatment in the form of a remediation math class for at-risk students was not beneficial.

## **Findings for Research Question 2**

The second research question focused on the effect factors of socioeconomic status on the math achievement scores of sixth grade students in a Georgia school system as measured by the CRCT towards the intensive remediation class. High  $p$ -values for the main treatment, SES main, and interaction effects confirm there were no statistically significant differences between the at-risk sixth grade students who participated in an class in the 2008-2009 school year and those at-risk students that did not participate. The data did show that the non-ED group had an almost 4-point higher adjusted mean score than the ED group, but that difference was not shown to be statistically significantly different. The control scores for all other groups were higher than the treatment groups, suggesting that remediation in the intervention class was not beneficial for students as aggregated by SES.

## **Findings for Research Question 3**

The third research question focused on the effect factors of varying ethnicity on the math achievement scores of sixth grade students in a Georgia school system as measured by the CRCT towards the intensive remediation class. The high, associated  $p$ -values for the interaction effect between ethnicity and treatment confirm there was no statistically significant differences between the at-risk sixth grade students who participated in an intervention class in the 2008-2009 school year and those at-risk students that did not participate as aggregated by ethnicity. The data showed that the Ethnic Minority students who received treatment had a 4-point higher score for treatment than those Ethnic Minority students in the control group; however, that difference was not shown to be statistically significant. The control scores for all other groups were



higher than the treatment groups, suggesting that remediation in the class was not beneficial for students as aggregated by ethnicity.

#### **Findings for Research Question 4**

The fourth research question focused on the effect factors of gender on the math achievement scores of sixth grade students in a Georgia school system as measured by the CRCT towards the intensive remediation class. The low 0.036  $p$ -value for the interaction effect between gender and treatment confirmed there were statistically significant differences between the at-risk female, sixth-grade students who participated in a remediation class in the 2008-2009 school year and those at-risk students that did not participate, as described by gender. All other values and data suggest that treatment was not beneficial for at-risk sixth grade students who were aggregated by gender for the 2008-2009 school years within the cooperating system.

#### **Discussion**

Remediation courses and programs that include extra instruction above and beyond the normal classroom instruction may be beneficial for students needing more math instruction or a more focused math instruction (Adams, 2011; Bahr, 2008; Brown, 2010; Cole, 2008; Hobbs, 2012; Mathis, 2010; Maxwell, 2010; Nomi & Allensworth, 2009; Travis, 2008; Turner & Tigert, 2010). Others noted specific techniques, such as progress-monitoring or teacher preparation for remediation that may be beneficial for the purposes of intervention instruction (Benner & Hatch, 2009; Kulm, Capraro, & Capraro, 2007; Dunleavy & Heinecke, 2007; Rittle-Johnson & Koedinger, 2005; Poncy, Skinner, & Axtell, 2010; Thompson, 2009; Weber, 2008; Ysseldyke & Bolt, 2007). No matter the method, Hattie and Timperley (2007) have stated that careful analysis is essential for

identifying and prescribing remediation programs for student achievement as described by progress-monitoring methods.

This study focused on one cohort of students over a one-year period. The students' math scores on the standardized Georgia Criterion Referenced Competency Test (CRCT) were analyzed to ascertain the effectiveness of a remediation class. The researcher was a teacher in one of the cooperating schools, which limited the number of students that were examined in an attempt to keep researcher bias at a minimum. Including more years of study could have shown different results. The results of this study add to a small field of research conducted in the area of math intervention for middle-grades students.

This study found that the students who had received remediation through the class had lower mean test scores than the students who did not receive remediation, a result different from those seen in several other studies (Adams, 2011; Cole, 2008; Hobbs, 2012; Maxwell, 2010; Travis, 2008). Some of those mean differences were statistically significant. A statistically significant difference was seen between the control populations' CRCT scores as compared to the scores from the remediation math class, although the differences might have been between control and treatment groups where the control group had the higher adjusted mean.

The one-way ANCOVA for Research Question 1 showed no differences for students who were in the control group and the group that had received treatment. SES and ethnicity subgroups showed no statistically significant differences between the adjusted means of the treatment and the control group's 2009 math CRCT scores. The female subgroup was the only population to have yielded a statistically significant difference on the 2009 math CRCT. The teachers at the four different schools might have

approached the intervention class differently, technologies might have been implemented differently or not used at all, and even the time of the day of teaching the intervention class may have affected the outcomes. While it is possible that student behavior towards the intervention class might have affected scores, the disparities between the schools in that the standards were taught differently could have had a larger effect.

The outcome showed the student scores in the intervention class to be statistically different from the control population; however, the adjusted means for the treatment group was lower than the control, suggesting no benefit from remediation. Perhaps the reason for not rejecting  $H_{01}$  was due to some extraneous variables that were not understood by the researcher, more so than just having a remediation class. Those could be varied as much as subtle differences in the tests to something colloquial that happened around the time the students were taking their 2009 math CRCT that would have affected the scores. Even the fact that there were 12 elementary schools (and perhaps more if data were included for transient students) that had given the 2008 CRCT tests for this population of students versus the four middle schools that had given the 2009 math CRCT might have had an adverse effect.

Student behavior, according to social cognitive theory, is often influenced by perceived thoughts or ideas (Zimmerman, Bandura, & Martinez-Pons, 1992). Additionally, Bandura has found that parental influence was a great factor in how students will behave and perform (Bandura & Walters, 1958) and that emotion was dictated by such influential factors (Bandura & Walters, 1958; Bandura, 1986; Bandura, 1989). If such is the case, then initial student differences may affect how they perform in the classroom, and perhaps even on standardized tests. With that being said, these studies

might suggest that varying student demographics, such as gender and perceived SES, had bearings on student performance.

The constructivist theory of individuals existing in a societal context that has been influenced by past occurrences has been supported in many studies (Gall, Gall, & Borg, 2007; Paour & Bailleux, 2009; Sherman & Kurshan, 2005). The passage in Proverbs (22:6 [NKJV]) supports theories that previously learned material will stay with a student. Social cognitive theory and constructivism support the idea that students will have learned a behavior or way of learning that will either help them or hinder their educational practices, and that student perceptions will determine achievement (Risser, 2010). Chen and McNamee (2006) stated no “two minds work in the same way” (p. 109).

For this study, math achievement scores were used to make an initial prognosis of an intervention math class for at-risk students and add to a small field of existing literature. McConney and Perry (2010) found that self-efficacy and math achievement go hand-in-hand, that the lower the SES, the more difficult the process of improving math scores, a finding that was not directly linked to this study, as students were simply ED or non-ED, not categorized by levels of ED. Benner and Hatch (2009) found low income to be an issue for students’ achievement levels, even though those findings were not supported in this study. It could have been possible that the demographics of their study were different from this one. Varying levels of SES might affect student achievement. Other studies have supported ideas that perception and self-efficacy influence student math achievement (Carbonaro, 2005; Hannula, 2006; Larwin, 2010; Risser, 2010; Rudolph, Lambert, Clark, & Kurlakowsky, 2001; Ward et al., 2010).

Similarly, motivation seems to have been an influence toward math achievement in several researched studies (Bahr, 2009; Carbonaro, 2005; Frye, 2010; Weber, 2008). In fact, Carmichael and Taylor (2005) discovered that motivation was a strong predictor of student assessment success. Of these noted studies, one passage can help give meaning to student math success: Weber (2008) found that small successes for one student turned into greater and longer lasting math achievement successes. Weber noted that interest was improved for students after positive results were seen. While motivation may be important, this study did not measure motivation as the data were ex-post facto.

Weber's (2008) study included a female student who showed favorable success on high-stakes testing. Since a female in his study showed gains on testing after experiencing remediation, the possibility exists that females in this study would have had similar results. Since the female population also showed statistically significant differences versus the subgroups in the control populations, there might be a link between gender and remediation success.

For students who were lacking in the areas of motivation or self-efficacy and were not achieving as well on standardized tests as they should have been, an educational plan needed to be made (Bahr, 2008). The educational plan set forth as the basis of this study sought to find a means for success for at-risk students taking high-stakes standardized tests. Since high-stakes testing has become more important than overall learning (Kulm, Capraro, & Capraro, 2007), strategies need to be implemented that will help students achieve successes on those high-stakes tests. Many studies have given focus as to how programs should be structured based on their individual results. The importance of isolating variables and focusing remediation and treatments for students might be a determining factor for those successes or failures, as noted in these studies.

A similar study conducted by Hobbs (2012) found that additional help toward at-risk upper elementary and middle school students was not beneficial. That study, while different as Hobbs utilized an after-school tutoring program, showed similar results. Such findings are in direct conflict with a study completed by Adams (2011), which showed the positive benefits from a remediation class toward student achievement on the CRCT. Adams' study, similar to this study in every way but one, did find the intervention class to be statistically significant for the test scores of the population of students. The one difference was that Adams included multiple grade levels, whereas this study only utilized one year for one cohort of students, a noted limitation.

This study adds to the limited field of research conducted for at-risk middle-grades math remediation. Similar results have been seen in Hobbs' (2012) study, where there was no overall statistically significant gain. Conversely, this study is different from several studies that did show benefit of such an intervention class for at-risk students (Adams, 2011; Cole, 2008; Maxwell, 2010; Travis, 2008). This study helps to close a research gap in middle-grades math interventions for at-risk students, as not many studies in public education with that focus exist. There was not a statistical significance in the achievement scores of students who had taken an intervention math class. That interesting result could have come from the several factors, each of which was noted as a limitation.

### **Limitations**

Several limitations existed in this study. The overall generalizability of the participant data within the study was somewhat limited and the results from the study are unique within that reference. The implications from this study have to be analyzed through the scope of the limitations that existed. Those limitations are often found to be

common to the public education field of research. To reduce internal validity (Kazdin, 2003), all student data analyzed were from at-risk students.

Teaching approach was one limitation. The four schools cooperating in this study each had their own intervention math teacher. The teachers would have been as different from each other as any other grouping of teachers within a math department housed in the same school. The instructional delivery was probably different from teacher to teacher; however, it could have been possible that their teaching methods were similar in nature since they were to follow the state-mandated frameworks and standards for teaching math to the sixth grade students, thus the focus and goals of each math unit would have at least been the same.

The possibility existed that the teachers of the remediation mathematics classes may not have taught along the exact timeline throughout the year and may have even taught the students in different manners (student-focused versus teacher-focused). These differences can be understood in that all teachers were given freedom to assess students with various tests or quizzes throughout the school year, in addition to the commonly developed and mandatory assessments within the different math units. Controlling for such possible teaching-style differences would strengthen the study. The time and logistics involved for controlling such variables, however, might have affected the teachers themselves or their own effectiveness. To obtain teachers who had similar styles solely for the purpose of conducting the study, analysis of those teachers would have had to occur before proper placement could have followed. To do so may possibly have meant a change of school assignment for those teachers, something the researcher did not control for and as such can only be presented as a limitation.

The cooperating school system experienced a high transition of students enrolling and withdrawing. The transiency rate within that system was something that could not be controlled since all four schools that participated were public schools. This phenomenon created an uneven dispersing of students in the intervention math course. Some students were able to take the course throughout their entire sixth grade year as prescribed, while some were only enrolled in a varying degree of one to three 9-week sessions; such placement was not controlled. The leaders who populated the intervention class also included a small number of students that had scored above 820, at-risk mark. The research could only use ex-post facto data for analyses. The limitation of student attendance was also a variable of consideration. The possibility existed that students might have had differing attendance rates during the course of the study. Variables pertaining to attendance and enrollment in the schools could not be controlled and were consequently reported as a limitation. Reporting all of the academic factors of the participants involved would be the most beneficial and intuitive in regards toward data analysis. One subgroup, ethnicity, had to be reported and disaggregated as Ethnic Minority due to the low number Asian, American Indian, African American, and Hispanic students. The resulting form of analysis was to group these groups together in the category of Ethnic Minority.

Another limitation to this study was the small sample size of students. Since this study was isolated to four schools within one school district and there were approximately 286 students in the experimental and control groups together, the student sample sizes were assumed to be representative of the entire population and the results generalizable to other districts, populations, or schools. The small sample size also limited the statistical analysis in that a subgroup of Ethnic Minority students had to exist



since there were not enough Hispanic students to study with sufficient statistical power. Those student data were combined with the African American students' data to form the Ethnic Minority student population. Ideally, studying specific ethnic subgroup data would have been best with disaggregation. Neither the cooperating schools nor the researcher controlled student attendance in any manner. Student transition in and out of the schools and classes was a common occurrence in the system, and only students who were enrolled in two semesters of the sixth-grade year within a school in the cooperating system had their scores analyzed for the purposes of the study. While the researcher worked in one of the schools that was studied and still works in the school system, the researcher did not teach any of the sixth grade students and provided no direct instruction to any of the students who participated in the study. The four schools were free to schedule the course as necessary to meet this minimum criterion but were flexible within their site scheduling. This was a limitation within the study as the data were ex-post facto.

The validity of the CRCT was examined in addition to the reliability. Validity was evident from an assessment presented by the Georgia Department of Education for both the 2008 and 2009 CRCT tests (Georgia Department, 2008; Georgia Department, 2009). Content validity was established through a process of field-testing questions on the CRCT, checking error or bias against those questions and through a thorough development process where Georgia educators were used (Wallace, n.d.). Riverside Publishing Company presented statistical properties where testing questions were observed and controlled to ensure validity (Cook, 2008) as well as presenting standard measurement of error and error bands for student scores for all years (Georgia Department, 2011b). Other threats to validity were present and controlled for within

statistical analysis and participant selection (Kazdin, 2003).

Students' perception about math could have impacted student achievement on the 2009 math CRCT. Since it was noted in many studies that student self-efficacy and motivation were threats to internal validity (McConney & Perry (2010), Benner and Hatch (2009), Larwin (2010), Risser (2010), Ward et al. (2010), Carbonaro (2005), Mason and McFeetors (2007), Hannula (2006), Maloney, Waechter, Risko, and Fugelsang (2012), Nosek and Smyth (2011) Rudolph, Lambert, Clark and Kurlakowsky (2001), Weber (2008), Frye (2010), Ball and Forzani (2010), Risser (2010) Carbonaro (2005), Bahr (2009), Carmichael and Taylor (2005), Hannula (2006), they are similarly threats in this study as well. Student learning styles (while not seen very much in the review of literature) could also impact student achievement. While this study controlled for the variables of treatment and demographics, these are important to note for external validity (Kazdin, 2003). Future research could possible focus in these areas as they may affect student success.

Lastly, reporting all other aspects of the academic lives of the participants involved would be the most beneficial and intuitive for the study, especially in regards to data analysis. Reporting students' critical thinking abilities would have been extremely important, as that information from students would have guided the researcher to formulate a plan for data disaggregation. Gathering such information was not possible for this study. The test data did not allow for analyzing student ability, ability at the students' current grade level, self-efficacy, motivation, nor any other descriptive factors at the time when the students were tested. These factors limited this study, as the students' ability existed solely in the form of the past CRCT mathematics scores.

## **Implications and Recommendations**

As stated in the previous chapter, there are many questions that this study raises as to why the analysis showed what it did. Remediation and intervention for students should be sought for students that need more assistance. The importance for more studies to help close this gap in high-stakes testing was that the results varied. In some studies (including this one), a statistical difference existed between control and experimental groups, while other studies did not show those differences between groups. Subgroups sometimes showed that they were affected by an intervention.

This study found that overall, there was not a statistically significant difference between the treatment group and the control group on the 2009 math CRCT. Self-efficacy, as found by several research studies (Bandura, 1986; Bandura, 1989, Bandura & Bussey, 2004; Bandura, Barbaranelli, Caprara, & Pastorelli, 2001; Zimmerman, Bandura, & Martinez-Pons, 1992), may have attributed to the students within the remediation math class not achieving as high on their sixth grade CRCT math assessment as compared to the control populations' mean. The research suggested that motivation was a possible factor for those at-risk students in the remediation class, as they realized their weaknesses in math and then did not perform well (Bahr, 2009; Carbonaro, 2005; Frye, 2010; Weber, 2008).

The female gender subgroup was shown to have had statistically significant improvements in the intervention math course as compared to males receiving treatment and against females in the control population. Reasons for this, as determined in the study, are unclear. Perhaps specific individuals had been targeted during instruction (Weber, 2008), and possibly those subgroups noticed marked improvement in math

scores during the sixth grade year and therefore performed better on the sixth grade CRCT (Mathis, 2010). More specific subgroup research is warranted.

Few studies were identified that specifically targeted math CRCT intervention for middle-grades students (Cole, 2008; Maxwell, 2010; Travis, 2008). The variables that exist in public education today are so varied that just a few studies have focused on middle-grades math intervention for the CRCT and are not enough to draw strong conclusions. The demographics are so different for schools trying to achieve an acceptable status for AYP that many studies, with varying demographics, need to be conducted. The relationships between variables are so vast that it might not be possible to isolate one remediation that has shown to be beneficial. To make a statement that one strategy works is not scientifically sound. The aim should always be for student achievement.

It may have been possible that a Type I Error was created in falsely rejecting the null hypothesis. However, the possibility is slim considering the power analysis of 0.483 (Howell, 2008). Improvements from individual to individual who were in that intervention class may have been higher as compared to the previous four years of CRCT math testing, indicating that the class did help individuals. Furthermore, if a change in motivation or self-efficacy with regards to math achievement or mathematical practice in school occurred for those students in the math remediation class, then further improvements in subsequent years may have occurred; more research with those cohort data would be required.

More research in these areas is critical for the improvement in high-stakes testing for middle-grades students. Research from the cooperating school system is needed before such large and expensive endeavors, such as an intervention class, are undertaken.

Research focused on student demographics, motivation, and even critical thinking ability might guide the system toward supported methods of remediation for at-risk students.

## **Conclusion**

No significant difference was seen between overall remediation math class scores for students and control group scores on the sixth grade CRCT in the 2008 – 2009 school years for the cooperating school system and for SES or ethnicity, but was seen for the female gender subgroup. Those data suggest that future research should be aimed at varying demographics for the purposes of either supporting or refuting the findings in this and other similar studies, specifically gender-specific testing.

Test scores are necessary for tracking the educational ability of a student, school, school system, and state (Georgia Department, 2011a). The pressure placed on teachers and school leaders for students to perform well on such assessments might cause better research to be brought forth. This researcher hopes that careful analysis is taken in the future by those individuals not only for the purpose of intervention for at-risk students, but for the success of students overall. Meeting AYP for the NCLB requirements is important. Serving students is just as important, however. Educators are accountable to students, as it is their responsibility to help raise students as God desires (Proverbs 22:6 [NKJV]), whether that means finding good and specific methods for remediation or teaching a student to be a good person regardless of high-stakes testing requirements.

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