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I am submitting a dissertation written by Cheryl D. Thomasson entitled, “An Investigation into Predictors of Middle School Mathematics Achievement as measured by the Georgia Criterion-Referenced Competency Tests.” I have examined the final electronic copy of this dissertation and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Education, with a major in Learning and Leadership.

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AN INVESTIGATION INTO PREDICTORS OF
MIDDLE SCHOOL MATHEMATICS ACHIEVEMENT AS MEASURED BY THE
GEORGIA CRITERION-REFERENCED COMPETENCY TESTS

A Dissertation
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Cheryl Thomasson
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DEDICATION

This dissertation is dedicated to my late parents,

James and Mary Thomasson.

I wish you could have called me Doctor.
Acknowledgments

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Abstract

The purpose of this study was to locate variables from 2006 and 2007 Georgia Criterion-Referenced Competency Test (CRCT) that could predict mathematics performance on the 2008 CRCT for a cohort of 449 students in two middle schools in Murray County in north Georgia. The student population was 80% Caucasian, 17% Hispanic, and 3% other. It was hypothesized that the predictors would be influenced by the high level of students eligible for free or reduced lunch. Logistic regression was applied to three data sets, all students, students from Bagley and Gladden Middle Schools. Sixth-grade CRCT mathematics percent correct was the only predictor common to all three groups. The northernmost middle school shared the other two predictors with all students, seventh-grade mathematics scaled score and seventh-grade science performance. The other middle school had only one more predictor, seventh-grade geometry percent correct. The probability of correctly identifying students’ performances as either pass or fail ranged from 50% to 69%. The logit was used to test the model on the 2009 CRCT data, and it was deduced that the performance of students could be predicted correctly as much as 71.6% of the time. It was concluded that student performance could be predicted for the eighth-grade mathematics CRCT. Analyses should be continued to locate predictors for subsequent cohorts.
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CHAPTER ONE

OVERVIEW OF THE STUDY

Background to the Problem

In this age of accountability and data-driven intervention, some students continue to fall short on standardized tests. The Annual Measurable Objective (AMO) from the No Child Left Behind (NCLB) of 2001 (Public Law 107-110) legislation proposed that 100% of students will meet or exceed standards in all subject areas by 2013-2014. Criteria were set for three academic areas, Reading, English, and Mathematics. The United States Department of Education (USDOE) published a list of what percentage of students must meet or exceed standards on a state standardized test. The percentage was the same for each state, but states could choose which test would be used. The AMO started at a low percentage which will incrementally increase through the year 2014 where it tops out at a 100% pass rate for all students. As implied by the title of the NCLB legislation, accountability became standard operating procedure for all school systems placing responsibility upon each school, system and state to ensure that all students received an adequate and equitable education (U.S. Department of Education, Office of Civil Rights, 2004).

NCLB required that each state set high academic standards and measured student achievement of those standards with a testing program that assessed students at third, fifth, eighth and one grade in high school with the same instrument. The State Department of Education and the Governor's Office of Student Achievement in Georgia developed the Single Statewide Accountability System (SSAS), State Board Rule 160-7-1-.01, to collect, analyze and report educational accountability of federal and state
guidelines. Components of this rule were designed to insure that rewards and consequences were identical for all Georgia Schools, both Title I and non-Title I. The state of Georgia used its Criterion-Referenced Competency Tests (CRCT) for grades one through eight to report accountability measures to the USDOE for No Child Left Behind. In 2008, the AMO goal for mathematics in grades one through eight was that 59.5% of all students in the United States would meet or exceed standards on a state-administered exam. CRCT results for eighth-graders in Georgia showed that 69% in 2005, 78% in 2006 and 81% in 2007 met or exceeded standards on the mathematics portion of the CRCT (Georgia Department of Education, n.d.). Using an assumption that progression follows simple linear growth, approximately 84% of Georgia eighth-grade students should have met or exceeded standards on the 2008 CRCT. Regrettably, the actual overall pass rate for eighth-grade students in Georgia in 2008 was 60% (Georgia Department of Education, n.d.). Kathy Cox (2008), State Superintendent of Georgia, explained that this large drop in percent passing was most likely due to a change in curriculum from Quality Core Curriculum to Georgia Performance Standards. The new mathematics curriculum, now in place in Georgia and developed by educators from Georgia and members of the National Council of Teachers of Mathematics, was more rigorous and expected students to learn mathematics using performance tasks.

These data were bleak reminders that educators had yet to find the right combination of standards-based instructional strategies to foster success in mathematics in the middle grades. This researcher was optimistic that all students could be successful on state standardized tests given educational opportunities based in data-driven practices with effective formative assessment.
Statement of the Problem

The percentage of eighth-grade students passing the mathematics portion of the Georgia CRCT in Murray County located in North Georgia was dismal for the first three years of the implementation of the Georgia Performance Standards. In 2005, the first year of testing, only 66% met standards, 74% in 2006, and 78% in 2007 (Georgia Department of Education, n.d.). The Georgia State Board of Education policy 160-4-2-.11, Promotion, Placement, and Retention, stated that no eighth-grade students shall be promoted to ninth grade unless they achieve grade level on the main administration or make-up administration of the CRCT in mathematics. There were provisions in the policy for parents to appeal retention of a student. The principal is required to convene a placement committee to review the student’s records. In most cases, parents do appeal retention, and students are promoted to ninth grade. Ideally, all students should perform on grade level, but the data that have been presented show that this was not the case.

Purpose

In a society where getting an adequate and equitable education had been challenged by the federal government with NCLB, it was imperative that school systems provided a valid and reliable curriculum to all of its students. Since the 1983 report, A Nation at Risk, the United States had encouraged stronger science and mathematics programs nationwide. The best indicators of the results of this initiative had been the National Assessment of Educational Progress (NAEP) and the Third International Mathematics and Science Study (TIMSS) (U.S. Department of Education, National Center for Education Statistics, 2001). The only reliable indicator for the success of students in Murray County was the Georgia Criterion-Referenced Competency Test given
annually in the spring. The purpose of this study was to determine if any relationships exist between the eighth-grade CRCT mathematics portion and the independent variables associated with the standardized test data of 2006 sixth-grade and 2007 seventh-grade CRCT assessments.

Main Research Questions

This researcher attempted to identify predictors for mathematics success using the following research questions.

Question 1

Were there variables in the 2006 and 2007 CRCT tests that were predictive of performance on the mathematics portion of the eighth grade CRCT? The most likely predictors were sixth grade and seventh grade CRCT scores on the mathematics test. For this research question, one of the potential variables was prompted by research that proposed that as socioeconomic status increases, student achievement increases (Sirin, 2005; Coladarci, 2006). Therefore, one factor that could have an effect on mathematics performance for Murray County eighth graders was poverty. The measure of poverty in this study was the student’s status of either free or reduced lunch. Using this definition, 71% of the students in Murray County schools came from poverty. Some have written that one of the implicit goals of the No Child Left Behind Act was to provide students of low socioeconomic status an equal educational opportunity and thus a future of better paying jobs (Anyon & Greene, 2007; Piché, 2007). If this goal can be achieved through the initiatives of NCLB, poverty may no longer be an indicator for low student achievement. Another factor that could have affected mathematics performance was gender. Geist and King (2008) wrote that boys and girls have an equal aptitude in
mathematics, but because mathematics curriculum is not differentiated to the differences in learning styles of gender, girls begin to lose interest in competitive problem solving as early as the fourth grade. The last factor that was explored was the effect of ethnicity on mathematics performance. Indirectly, ethnic differences in Murray County actually warranted a much deeper investigation into a child’s education. The largest ethnic group in Murray County was Caucasian, whose parents, grandparents and great grandparents had lived there all of their lives. The second largest group was Hispanic, whose parents had moved to Murray County in the last 10 years. The National Council of Teachers of Mathematics (NCTM) contends that all students can succeed in complex mathematics, but children from an ethnically diverse background are usually placed in low-track learning programs in public schools (Woodward & Brown, 2006).

**Question 2**

Did the identified predictors for mathematics performance for eighth grade students in 2008 also predict with certainty mathematics performance for eighth grade students in 2009? Limitations on teacher assignment could influence the prediction on this question. Since teachers had taught the same standards in eighth-grade mathematics and had differentiated instruction for all populations, all students should have had the same level of instruction to promote similar achievement results among the population. Nevertheless, Marzano (2003, pp. 71-75) found that students, who had an effective teacher, outgained students with an ineffective teacher by an effect size of 0.35 in reading and an effect size of 0.48 in mathematics. One factor that would be examined in this research would be to what amount of certainty the 2009 mathematics performance could be predicted. Since the current method used to select students for remediation was
This researcher hoped for at least a 67% certainty for identifying students who might struggle in eighth-grade mathematics.

**Methodology**

For this study, the dependent variable was eighth-grade mathematics performance level on the 2008 CRCT. To probe the data from the 2006 and 2007 CRCT for potential predictors of eighth-grade CRCT mathematics performance, the 30 variables available for consideration were:

- Four variables of demographic data: ethnicity, socioeconomic status, gender and school location;
- Six variables of reading scores: scaled scores, performance level and percent correct for sixth and seventh grades on the CRCT;
- Six variables of mathematics scores: scaled scores, performance level and percent correct for sixth and seventh grades on the CRCT;
- Eight variables of mathematics domains: percent correct in numbers and operations, in algebra, in geometry, and in data analysis and probability for sixth and seventh grades on the CRCT; and
- Six variables of science scores: scaled scores, performance level and percent correct for sixth and seventh grades on the CRCT.

These data were analyzed using logistic regression to determine what combination of independent variables could be used to predict future student success. If a significant relationship were found within these variables, educators perhaps would have a reliable predictor or predictors that could be used to identify rising eighth-grade students who may not be successful on the upcoming mathematics portion of the eighth-grade CRCT.
Research on socioeconomically disadvantaged youth and mathematics achievement (Goddard, 2003; Hadley, 2005) led this researcher to hypothesize that as socioeconomic status increased, mathematics achievement would increase, and as reading level on the CRCT increased, mathematics achievement would increase. The veracity of this study was to be tested on data collected from the 2009 administration of the CRCT.

**Rationale for the Study**

When only 78% of students in Murray County passed the mathematics portion of the 2007 Georgia CRCT, educators recognized the need for reliable predictors for identifying students who could be unsuccessful on this test. This trend of low percentages of students passing the mathematics CRCT not only put Murray County in danger of failing to meet the AMO and its middle schools not meeting the AYP prescribed by the USDOE but put students at risk of more low scores in mathematics in high school. If identified predictors were used to select students, educators in Murray County could develop early intervention plans to remediate students so that they could reach grade level success on the state test.

The mission of Murray County Schools was to instill within its students the desire to learn, to graduate from high school, and to become productive citizens. This study and its results may provide a successful likelihood that these students could reach their dreams of graduating from high school and becoming productive citizens. Hansen and Toso (2007) found that students begin to think about dropping out of school in elementary school. Other researchers have reported that retaining a student does not always increase academic success and can contribute to low self-esteem and the potential of becoming a dropout (Bowman, 2005; Holmes, 2006; Penna & Tallerico, 2005; Piklo &
Educators in Murray County were aware of the need for students to be successful and continued to search for ways to successfully target students who were at risk for failure.

**Significance of the Study**

The study was conducted in Murray County where educators were still searching for answers to poor scores on state standardized test scores in mathematics. Administrators in this county had completed at least six book studies that had led to a change in instructional practices. Murray County was committed to the Response to Intervention (RTI) framework by which students were assessed, taught and/or remediated on a timeline that would have the most impact on their learning (DuFour, Dufour, Eaker & Karhanek, 2004; Reeves, 2006). It was found that some researchers (Confrey, 2006; Schmoker, 2006) suggested narrowing the curriculum to allow students to put their knowledge to practice and capitalize on literacy, which should give students an edge on state assessments. Others (Wiggins & McTighe, 1998) believed that schoolwork can be designed so that it was interesting, meaningful and rigorous, especially when it does not center on worksheets and lecture. Having students assess their own work with rubrics or other useful tools had been lauded by many as a means to expose students’ conceptual understandings of their own work (Marzano, Pickering & Pollock, 2001; Schmoker, 2006; Stiggins & Chappuis, 2008; Wiggins & McTighe, 1998).

Summarizing the work of hundreds of researchers, Marzano, Pickering and Pollock (2001) appealed to educators to accept that the educational process was like a science, and instruction could be improved by collecting data, analyzing it and using the results to guide differentiated instruction for individuals or small groups. In a 2008
publication by the National Mathematics Advisory Council (NMAC), mathematicians wrote that for most of the twentieth century, a large number of mathematical specialists practiced in the United States and raised the quality of its engineering, science, medicine and financial leadership beyond all other countries in the world. Bahr (2008) agreed with the NMAC, but said that if substantial and sustained changes were not realized in education, the United States would surrender that claim. This claim was refuted (Roshcelle, Singleton, Sabelli, Pea & Bransford, 2008), when researchers reported that no experiment had undisputedly proven that an improvement in students’ mathematical achievement had resulted in any society’s economic gain.

Whether educators should change instructional practices, embrace the science of education or encourage substantive changes in mathematical education, it was evident that students across the United States were not mastering mathematics. In Georgia, data had shown that a large number of students were unsuccessful on the mathematics portion of the state’s standardized test, the CRCT. Furthermore, when students were promoted without performing on grade level, there were positive and negative implications. If teachers in the ninth grade did not recognize deficiencies of these students and remediate them, the students might never reach grade level and might continue to experience failure. However, with remediation and differentiated instruction, students could catch up to grade level and have success in high school. If the appeal process for eighth-grade retention did not exist, the local school system would bear the burden of having approximately 25 sixteen-year old or older teens in a middle school setting per year, which would make it difficult when planning teacher allotments and school funding.
If this study could identify a variable or set of variables with a significant relationship for identifying low performance on the CRCT, teachers and administrators could not only identify students at risk of performing poorly but could customize instructional practices for probable improvement in CRCT testing for those students throughout the entire school year.

**Definition of Terms**

Adaptive Control of Thought (ACT) – A theory of cognition developed by John Anderson, Carnegie Mellon University. It had been revised to ACT-R with the addition of the term, rational. This theory of human cognition had been used to develop Carnegie Learning’s Cognitive Tutors.

Annual Measurable Objective (AMO) – An incremental scale defined by each state used to measure continuous and substantial improvement for schools under the No Child Left Behind Act of 2001.

Georgia Criterion-Referenced Competency Test (CRCT) – A standardized test implemented in 2000 designed to measure how well students acquired the skills and knowledge described in the Georgia Performance Standards (GPS).

Georgia Performance Standards – The state curriculum adopted by the State Board of Education in 2005 that was grounded in what students should know and be able to do.

Georgia Quality Core Curriculum – The state curriculum brought into being by the Quality Basic Education Act in 1985. I was replaced by the Georgia Performance Standards in 2005.

Odds Ratio – The odds ratio was the natural log base, e, to the exponent, b, where b = the parameter estimate. In SPSS it was called Exp(B) and may have a value less than one, a
value equal to one, or a value larger than one. If Exp(B) > 1.0, the independent variable increased the odds event. An Exp(b) = 1.0, the independent variable had no effect. If Exp(b) < 1.0, then the independent variable decreased the odds (event) (SPSS Statistics 17.0 Tutorial).

Performance Level – The cut scores on the Georgia Criterion-Referenced Competency Test was divided into three categories, Does Not Meet, Meets and Exceeds. These three categories are labeled Performance Level 1 (PL1), Performance Level 2 (PL2), and Performance Level 3 (PL3), respectively.

STEM – This acronym stood for science, technology, engineering and mathematics and was usually used in higher education to describe faculty or degree programs.

**Theoretical and Conceptual Framework**

When investigating the process of learning mathematics, constructivism and cognitive learning theories stood out among the bases for many theories. John Anderson and his colleagues at Carnegie Mellon University first developed ACT in 1976 (Budiu, 2009). ACT was grounded in three types of memory, declarative, procedural and working. Declarative is the memory of facts, procedural memory facilitates remembrance of skills or cognitive operations and the working memory interchanges short-term items into long-term, usable memory items and appears to be home to many processes important to learning (Ormrod, 2004, p. 200). ACT proposed that knowledge begins in the declarative memory and is developed into procedural knowledge by making inferences from existing facts. Carnegie Learning, a company established from the researchers of mathematics learning at Carnegie Mellon University, developed a program called the Cognitive Tutor ® that provided research-based tutoring programs. Carnegie
Learning also developed course-specific learning resources for Louisiana, Chicago, Los Angeles, Miami, Kentucky and Georgia educational associations.

Another prominent theory of mathematical learning is the Gestalt Theory developed between 1923 and 1975. In *The Characteristics of Mathematics Creativity*, Sriraman (2004) asked whether the Gestalt Theory of mathematics creativity still applied today. He described numerous approaches to the study of creativity in mathematics. The Gestalt Theory fell within the psychodynamic approach which says that creativity arises from the tension between conscious reality and unconscious drives. He interviewed five mathematics faculty members from a mid-western university; four of these had been professional mathematicians for thirty years. He concluded that the Gestalt model was still applicable today because when these mathematicians worked to solve problems they often showed characteristics of mathematics creativity when they put the problem aside after a stalemate with it and returned to the problem later only to make progress right away. In his conclusion, he suggested that if contemporary models of creativity were created from work such as his, teachers could recognize mathematical creativity in students in the classroom.

Brain research had stimulated educational researchers to link learning to specific types of instruction. Educators and authors had written that teaching is now a combination of the art and science of teaching; and that by evaluating the complexities of biological, social and curricular needs of students led to more enjoyment for both educator and student. Some predict that it will not be unrealistic to expect educators and brain researchers to identify specific instructional strategies that can be prescribed for different types of learners (Rockwell, 2008; Willis, 2009). Baylor (2005) stated that most
teachers use the teacher-centered instructivist model. However, the student-centered constructivist model was particularly beneficial to meaningful learning and deeper understanding of mathematics. If the Carnegie ACT model and the Gestalt Theory of creativity are combined, the model that emerged stated clearly that mathematics should be taught using a constructivist approach capitalizing on the creativity of the unconscious mind. For this model to be successful, teachers must deliver instruction from a like perspective. They must allow students to explore deeper understanding of worthwhile, grade-level appropriate material while being guided by a teacher who believed in the constructivist model (Leatherman, 2007). Further, Leatherman stressed that teachers must develop each child as a learner in a community described by Vygotsky’s social constructivist theory, a community in which knowledge was shaped through interactions within an environment rich in inquiry and discovery.

Assumptions

As with any study, there were assumptions:

1. The population under investigation received consistent instruction using Georgia Performance Standards throughout their sixth, seventh, and eighth grades.

2. The students in the study had the capacity to perform adequately on the CRCT.

3. The CRCT was an appropriate instrument for measuring mathematics achievement of middle school students in Georgia.

4. Students were diligent in doing as well as possible on the Georgia CRCT.

5. Teachers maintained fidelity to best practices when delivering a curriculum.
Limitations of the Study

The following conditions would limit the scope of the study:

1. The researcher had no control in assigning teachers to students over the three-year period.
2. Teachers may not have taught the same mathematics course for all of the three-year study.
3. At least one among the cadre of teachers in these cohorts was ineffective.
4. The middle schools in this study were representative of all middle schools in north Georgia.

Delimitations of the Study

1. The study was limited to CRCT data reported for a cohort of students entering sixth grade in 2006 and exiting eighth grade in 2008.
2. The population under investigation was limited to one public school district in North Georgia.

Due to low standardized test scores, this researcher probed the available data and hoped to find one or more predictors of success on the Georgia eighth-grade mathematics test. Mathematical theories generally followed the constructivist’s view that young learners needed to be guided to explore and develop their own depth of knowledge.
CHAPTER TWO

LITERATURE REVIEW

Introduction

Much has been written about the lack of achievement in mathematics for students in the United States. Bracey (2004) described the results from the Third International Mathematics and Science Study (TIMSS) conducted in 1995, concluding that fourth graders in the United States ranked 11th while eighth graders ranked 27th compared to the same grade level students from other countries. The National Math Advisory Panel (2008) reported that American students are not expected to succeed at the same level as international students, and students entering colleges are taking more remedial courses in mathematics. Within the report, National Assessment of Educational Progress (NAEP) data showed that 32% of American students are at or above the proficient level in Grade 8, but only 23% are proficient at Grade 12. The NAEP assessment is the only “nationally representative and continuing assessment of what America's students know and can do in various subject areas (National Center for Education Statistics, 2009, ¶ 1).” The assessment is essentially unchanged from year to year, which gives researchers at the National Center for Education Statistics data sufficient for a measurement of student progress over time.

Blank and Langesen (2005) and Lowell and Salzman (2007) disagree with these data. They report that the numbers of students taking more rigorous courses such as Chemistry, Calculus and fourth-year mathematics increased significantly between 1990 and 2004. In 1990, 45% of students took chemistry while in 2004 it was 60%. The number of students taking fourth-year math rose from 29% to 72% in 2004. While these
two views each can provide supportive data, statistics on students requiring remedial college courses may be a better indicator of students’ conceptual understandings of mathematics. The percentage of students that enroll in college remedial courses across the nation is reported to be from 25% to 40% (Bahr, 2008). Furthermore, other nations are improving science, math, and engineering education more aggressively than the United States (Lowell & Salzman, 2007). In addition, the total direct and indirect cost annually of college remedial programs is estimated at $1 to $2 billion. A United States Department of Education report by Adelman (2006) emphatically avows that the greatest predictor of attaining a bachelor’s degree is the successful completion of Algebra II or a higher math course in high school.

The No Child Left Behind Act of 2001 (Public Law 107-110) requires all states to collect, track and improve standardized test scores in order to close the gap while providing adequate education for underachieving and under-served populations as well as providing a safe and equitable environment so that all students finish high school. Identified groups in Georgia for NCLB reporting are all students, African-American, Hispanic, Caucasian, English Language Learners (Low English Proficiency), multi-racial, Asian/Pacific Islander, American Indian/Alaskan, Students with Disabilities (SWD), and Economically Disadvantaged. Because of this differentiated accountability, educational practitioners have begun to search for factors that have significant influence on student achievement.

**Poverty**

Students living in poverty have been at the center of many studies in recent years and are targeted by NCLB under Title I. It has been reported that students from high
poverty had lower mathematics achievement (Hadley, 2005; Goddard, 2003), but Sirin (2005) concluded that there were a multitude of variables influencing the relationship between socioeconomic status (SES) and achievement. One of those factors, he explained, was the fact that low SES students most likely attend poor school districts. This combination may explain some low achievement scores, but many districts have reported success with children of poverty (Blanton, 2005; Cunningham, 2004; Picucci, Brownson, Kahlert, & Sobel, 2004; Taylor, 2005). Researchers have found that in order for high poverty schools to be successful, teachers must be highly qualified for the students they will teach. Some systems pay incentives to hire successful, highly qualified teachers who commit to teach in high-poverty schools (Machtinger, 2007). The challenges are great for children of poverty. Many times they come to school unprepared to learn from either hunger, lack of sleep, low hygienic practices, or abuse. Provisions from NCLB in the form of Title I funds have helped poor school districts close this preparedness gap; however, the likelihood of students attending Title I schools of reaching 100% proficiency is questionable (Walker & Mohammed, 2008). Those provisions include but are not limited to improving the feeding program, offering remedial education, implementing early intervention reading programs, and providing supplemental funding to systems to provide a large amount of resources for these students. The literature supports the claim that students who attend schools with a low socioeconomic status achieve lower than students in higher economic areas (Malaspina and Rimm-Kaufman, 2008) and that ethnicity is linked to socioeconomic status (Gootenboer, 2007).
English Language Learners

According to the United States Census Bureau (U.S. Department of Education, National Center for Education Statistics, 2008), the population of non-English speakers will continue to rise. In 1990 students whose first language was not English made up 14% of school aged children over five. From 1979 to 2006 the United States saw a 20% increase of school-age children ages 5 to 17 who do not speak English at home. It is estimated that by 2050 Hispanics will represent 29% or nearly one-third of the population of the United States (Hispanic Population, 2009). English Language Learners (ELL), as they are called in Georgia, are surpassed in mathematics by students who are proficient in English. For kindergarten students in public schools in 1999, about 12% had low English proficiency and half of those students lived in poverty and their mothers had not completed high school. These children must not only overcome the language and cultural barriers, but must master the same standards in reading, mathematics, science and social studies that English speakers have to master.

Vocabulary knowledge has been recognized as a predictor of substantial reading comprehension by many reading researchers (Braze, Tabor, Shankweiler, & Mencl, 2007; Cunningham & Stanovich, 1990; and Ransby & Swanson, 2003). It is now being intensely considered as an integral part of thinking mathematically. Chen and Li (2008) wrote that students proficient in more than one language were better math students than their monolingual peers, but ELL students are handicapped by the lack of mathematics vocabulary especially in word problems. When collecting data on Australian Vietnamese-speaking students, Clarkson (2007) found that bilingual students switch between both of their languages to problem solve in the early years, which may give them
more confidence in their math performance. The developers of the Georgia Performance Standards included vocabulary words in each lesson for all content areas including mathematics to encourage all students to participate in discussions and to verbalize their understanding of mathematical concepts.

**Culture**

Along with English deficiencies come cultural differences which pose learning problems for newcomers to the educational system of the United States. It has long been stated that mathematics is a universal language (Nasir, Hand, & Taylor, 2008) and that all students should understand numeracy regardless of cultural backgrounds. Other researchers say that minorities, particularly those of poverty, lose their cultural identity in public school and that teachers in the classroom maintain a certain bias toward Western culture even for African Americans (Tyler, et. al., 2008). The importance of self-efficacy cannot be discarded. Self-efficacy, the belief that any task can be performed at an acceptable level, has been defined as a means by which students motivate themselves toward a goal. Children are influenced by their parents, who naturally pass on the practices of their culture. Logically, a child will develop a personal self-efficacy (or lack thereof) greatly influenced by his parents’ culture. Mistretta (2004) showed that most parents suffer personal anxiety when attempting to assist their students in mathematics in grades 1 through 8 at home. If that student is then immersed into a new culture where the values or ideals of teachers and other students are vastly different, his self-efficacy is threatened and he could lose his motivation or confidence toward success. A high-quality organizational culture can provide the stability needed for students and teachers to believe in what the organization is doing and the part that they play in that organization.
The relationship that forms between a teacher with high self-efficacy and a student with the same has been shown to affect student achievement in a positive way. Some students suffer from test anxiety, which has been found to affect student performance. Students who think they are prepared for a subject have less anxiety than those who feel less prepared, and self-efficacy for the completion of math problems accounts for the major variance in mathematical performance (Shores and Shannon, 2007).

**Educational Equity**

The matter of equity in education has solicited countless articles and a myriad of hypotheses regarding race, social justice, demographics, background and pedagogy (Berry, 2005). Woodward and Brown (2006), investigating a central tenet of the National Council of Teachers of Mathematics (NCTM) Standards that all students can succeed in complex mathematics, compared two pedagogical methods for delivering a rigorous mathematics curriculum to students with learning disabilities in reading. They found that an intervention group gained more with a curriculum in which concepts were embedded in problem-solving activities than a comparison group did with the guided-practice curriculum. The tenet bears some truth, but what barriers related to equality block student success? Grootenboer and Hemmings (2007) wrote that dominant ethnic groups outperform minority groups in school. Thompson (2004) found that over 90% of parents of African American and Latino students planned for their students to attend college. The majority of parents regardless of their ethnicity intends for their children to do well in school and believe that they receive an equal education. Researchers disagree about whether all students get an equal education. Hill-Jackson, Sewell and Waters (2007) did
action research on the multi-cultural nature of white teachers due to their teacher education. The group of white teachers called resistors expressed hesitancy to teaching children of color or from urban areas, which exposed either their lack of self-efficacy or their mono-cultural background. If teachers do not have a belief that all students, especially those of color or a different ethnicity, can learn, then all students are not getting equal opportunities in education. Moreover, a teacher must have an awareness of a student’s culture to understand the needs that the student has (Kauffman, Conroy, Gardner & Oswald, 2008).

**Students with Disabilities**

Students with disabilities (SWD) have various barriers to success. Nonetheless, they deserve an equitable education. Often the education that these students receive looks different from traditional pedagogy. Frequently, additional teachers are present and a less rigorous curriculum is delivered. Success is measured using a guiding document called an Individual Education Plan (IEP). Inclusion has become an accepted model in classrooms with SWD, but has posed several barriers to success. It has been found that teachers are not fully trained to collaborate with inclusion teachers, deliver specific difficult content, modify instruction for all special needs students, and overcome the wide range of proficiency among students (DeSimone & Parmar, 2006).

**Early Education**

Cognitive development and academic achievement have been linked to early childhood experiences with family as well as high-quality child care (Downer, 2006). Children of poverty are less likely to be enrolled in high-quality child care and miss out on stimulating learning opportunities in the home (Magnuson, Meyers, Ruhm, &
English and Watters (2005) wrote that the primary school is where students should not only begin to differentiate between experiential knowledge and skill knowledge but should know how to use each one to solve problems. They also state that low performance is due to educational practices that lack rigor and high-quality learning experiences. Research by Bobis, Clarke, Clarke, Thomas, Wright, Young-Loveridge, et al. (2005) has shown that children begin to think mathematically prior to attending public school and that early intervention can close disparity gaps that may have existed for some children since entering school. Preschools that offer learning centers have been shown to prepare students with skills in both reading and math that carry over into the spring of the first grade (Magnuson, Meyers, Ruhm, & Waldfogel, 2004). When teachers received instruction to increase their capacity of teaching mathematics to young children, they recognized they should guide young learners to discover mathematics. Chard (2008) placed the failure of young students to understand mathematics squarely on the shoulders of teachers and curriculum developers for not recognizing that a key predictor of a child’s difficulty in mathematics later in school is a failure to develop a number sense. When children do not master learning materials, they are frequently retained in the same grade for another school year. Hong & Raudenbush (2005) found that if kindergarteners are retained they fall farther behind. He concluded that at-risk children who were promoted seemed to have a better chance to succeed.

Gender

The question of gender bias also arises in a study such as this. A New Jersey study by DeClerico (2002) showed that girls' scores in mathematics significantly increased from fourth to eighth grade, and in 2003 Bevil indicated that a group of middle
school students' scores increased when they were exposed to a mathematics curriculum which included real-world applications. These applications are often gender biased. Additionally, in 2002 Zittleman and Sadker uncovered gender stereotypes in teacher education textbooks concluding that teachers leaving teacher preparation programs may not be up to the challenge of dealing with gender equity in the workplace. In a similar study in 2007 Grootenboer and Hemmings reported that males surpassed females in mathematical performance. In the higher education arena, researchers discovered that females have lower placement scores in mathematics (Donovan & Wheland, 2008), and that attracting females to achieve a STEM degree is influenced by their educational success in mathematics as far back as the fifth grade (Nicholls, Wolfe, Besterfield-Sacre, Shuman, & Larpkiattaworn, 2007).

**Instructional Practices**

By far instructional practices (Bodovski & Farkas, 2007; Haas, 2005), teacher quality (Heck, 2007) and school culture (Feldman & Matjasko, 2005; Lee & Wong, 2004; Maninger & Powell, 2007; Okpala, Bell & Tuprah, 2007) have dominated the literature over the past three years. Curriculum directors, test coordinators, administrators and teachers now receive data in electronic form instead of paper copies and have learned to analyze data quickly using spreadsheet software. It is common practice for a teacher to give a benchmark test, get instant results and adjust instruction within one class period. This has allowed school staffs to focus on student weaknesses and to organize flexible groups for instruction or intervention.

Many researchers seek clues that will unlock the barriers to increased achievement for all students. The literature seems to imply that it is a combination of
variables. Whatever those variables are, it is critical that educators continue to believe that all students can learn given the most effective opportunity.
CHAPTER THREE
MATERIALS AND METHODS

Setting

The setting for this research was the Murray County Public Schools (MCPS). Murray County is located in extreme North Georgia with the northern county line bordering Tennessee. The school district had six elementary schools, two middle schools, one high school and one alternative academy. It was a rural district with a student population of 7,888 from pre-kindergarten to twelfth. The system student population was composed of 80% Caucasian, 17% Hispanic, 1% African American and 1% multiracial. Approximately 71% of students received either a free or a reduced-price lunch.

Population and Sample

The sample for the research consisted of 449 Murray County middle school students, 225 males and 224 females, who formed a cohort starting in the sixth grade at two separate middle schools in the fall of 2005 and completed eighth grade in the spring of 2008. This group of students was named Cohort I. Gladden Middle School was located inside the city limits of Chatsworth, the largest municipality of Murray County. Sixty-four percent of this school’s students were economically disadvantaged and 3% were identified as ELL. Bagley Middle School was located in the northern rural area with 62% economically disadvantaged students and 4% ELL. The students, who made up this cohort, attended the same middle school from sixth grade through eighth grade. Each middle school had one counselor and one school nurse. This study used 30 independent variables of socioeconomic status, gender, ethnicity, school location, CRCT
mathematics scaled scores, performance level and percent correct, percent correct in four domains of mathematics, CRCT reading scaled scores, performance level and percent correct, and CRCT science scaled scores, performance level and percent correct in sixth and seventh grades. The dependent variable was the performance level in mathematics on the eighth grade CRCT.

**Research Design and Procedure**

This study was conducted in two phases. In the first phase 2006 and 2007 CRCT scores for Cohort I was analyzed using logistic regression to test the causal relationship between the 30 independent variables and the dependent variable. A relationship significant enough to be a predictor for future student success was being sought. In the second phase, the predictor equation was tested on the next cohort of eighth graders from this county, who would take the 2009 CRCT. If a predictor(s) emerged from the data, the district would use similar analyses to select students for intensive intervention before the CRCT. The model would be tested after the administration of the 2008-2009 CRCT to determine its predictive accuracy.

**Research Questions and Related Composite Null Hypotheses**

1. Did variables exit in the 2006 and 2007 CRCT tests that were predictive of performance on the mathematics portion of the eighth grade CRCT for all students? The following null hypotheses related to demographic variables and performance on the 2008 eighth-grade mathematics CRCT among the students composing Cohort I:

   \[ H_0 \] 1.1: There was no difference in the performance on the mathematics portion of the 2008 eighth-grade CRCT based on location of school.
$H_0$ 1.2: There was no difference in the performance on the mathematics portion of the 2008 eighth-grade CRCT based on gender.

$H_0$ 1.3: There was no difference in the performance on the mathematics portion of the 2008 eighth-grade CRCT based on ethnicity.

$H_0$ 1.4: There was no difference in the performance on the mathematics portion of the 2008 eighth-grade CRCT based on socioeconomic status.

2 Did the identified predictors for mathematics performance for eighth-grade students in 2008 also predict mathematics performance for eighth-grade students in 2009?

**Statistical Method**

Since this study examined the causal comparative relationship between the numerous variables present in the data from standardized test results, a bivariate correlation technique, specifically the Pearson product-moment correlation coefficient ($r$), was the method chosen for the screening aspect of the study. Statistical Package for the Social Sciences (SPSS) 17.0 returned a matrix that listed each Pearson $r$ for the pairs tested. The strongest Pearson $r$’s were examined as potential positive or negative relationships, thus provided variables to the logistic regression analysis, which was the main statistical technique employed. ANOVA was used to test the differences between all groups within the demographic data and the potential predictors.

**Institutional Review Board (IRB)**

Permission was obtained from the superintendent of Murray County Schools and from the Institutional Review Board at The University of Tennessee at Chattanooga (UTC) to obtain and review standardized tests scores of students in the school system. All identifying numbers or codes were removed by the Director of Student Services
before this researcher received the data files. Data for students who moved or transferred were deleted from the file.

**Data Collection and Recording**

The results of the CRCT were received from the Georgia Department of Education (GaDOE) in a spreadsheet format. The data required for the study was obtained from the Murray County Schools Director of Student Services. Student names, teacher names and identifying numbers were removed from the file.
CHAPTER FOUR

FINDINGS AND DATA

Introduction

The search for variables for predicting eighth-grade performance on the mathematics portion of the Georgia CRCT led to two research questions. The first question asked which variables in the 2006 or 2007 CRCT were predictive of low performance on the 2008 eighth-grade mathematics portion of the CRCT. The second research question asked if the predictors discovered in the 2006 and 2007 CRCT could also predict mathematics performance on the 2009 eighth-grade mathematics CRCT.

A combination of descriptive statistics, bivariate correlation, ANOVA, logistic regression and crosstabulation was used to analyze the data collected for this study. The descriptive statistics described the demographics of the sample and compared the means and standard deviations of student performance on CRCT mathematics scaled scores. ANOVA tests were run to locate any statistically significant differences between group performance on the eighth-grade mathematics CRCT with respect to location of school, gender, ethnicity and SES. Logistic regression was chosen as the method to find predictors because there were thirty independent variables that had potential to be predictors for performance on the eighth-grade mathematics CRCT. Crosstabulation was used to determine how well predicted pass/fail scores compared to observed pass/fail scores for differing separation or cut values used to separate predicted pass and fail scores.

Logistic regression has been accepted as maximizing the variance explained when the effect of more than one independent variable determined a dichotomous outcome.
The logistic regression model did not assume a linear relationship between the independent variables and dependent variable and did not require normally distributed variables like a linear regression model. Logistic regression ranked the relative importance of independent variables. The effect of predictor variables was explained in terms of the probability of an event either happening or not happening, thus the dichotomy.

For this research the students’ performance levels on the eighth-grade CRCT were transformed into a dichotomy where zero equaled any cut score below 800 (PL1 = Does Not Meet) and one equaled any cut score above 800 (PL2 = Meets and PL3 = Exceeds). Following use of the logistic regression procedure to build the “best fitting” model, crosstabulation was used as a confirmatory test to identify what frequency of students would be predicted by the logit to score above or below 800 on the eighth-grade math CRCT compared to the frequency of student who actually scored above or below 800 on the 2009 CRCT. Because this researcher wanted to identify students who would need remediation due to a weak score on the mathematics CRCT, the cut value that returned the highest percentage of low or failing scores was selected. By varying the cut value, the frequency of students falling either above or below the cut value would change. It may be desirable to use a different cut value to allow researchers to investigate either higher or lower frequencies of scores depending on the intent of the prediction.

**Logistic Regression**

Logistic regression was performed using SPSS 17.0. Stepwise logistic regression is available in several ways including forward and backward methods. This researcher used the forward stepwise process, which added one variable at a time into the model in
order to build the most predictive model until the addition of a new variable showed a measure of change from the previous fit not to be significant. The measure of change was determined once a Chi-square, $\chi^2$, less than .001 was generated by the statistics. When that occurred, the iterations stopped and a table called Variables in the Equation was generated. A Model Summary table was also displayed listing two pseudo R-squares, Cox and Snell’s $R^2$ and Nagelkerke’s $R^2$.

These pseudo $R^2$'s are likened to $R$, a Pearson product-moment correlation coefficient between two variables in a linear combination (SPSS Statistics 17.0 Tutorial). Although $R$-squared ($R^2$) was not directly meaningful in logistic regression, the pseudo $R^2$ gave a measure of the relative strength of the fit of the predictive model. For instance, if $R = 0.8291$ then $R^2 = 0.6874$ and indicates that 68% of the variance of the independent variable could be attributed to the combination of the independent variables.

Since in logistic regression, a direct equivalent to $R^2$ does not exist, several pseudo R-squares have been defined by theorists. Two statistically related pseudo $R$-squares used in this study were Cox and Snell’s $R^2$ and Nagelkerke’s $R^2$ which explain how much variability could be accounted for in the model. Since the plot resulting from logistic regression was not linear, these pseudo $R$-squares were used with caution (Garson, 2010; Logistic regression, 2010).

The log odds of an event occurring were called a logit which is symbolized by $z$ in a logistic regression equation. The logit is simply defined as the natural log ($\ln$) of the event occurring or not occurring. The logistic equation is written as $z = b_0 + b_1X_1 + b_2X_2 + \ldots + b_nX_n$:

- where $z$ was the log odds of the dependent variable or $\ln(\text{odds(event)})$,
\*b_0 was the constant generated after the iterations, \\
\*b_1, b_2, through b_n were logistic regression coefficients for each predictor, and \\
\*X_1 to X_n represent independent variables into which values could be substituted.

Since z was also equal to the natural log of the probability of the event occurring divided by the probability of the event not occurring, the probability of the event occurring was written as P(event) = \text{Exp}(z)/(1 + \text{Exp}(z)). A student was predicted to pass if the probability generated from the choices used as independent variables was greater than some identifying score of pass and fail, called the cut value, and predicted to fail if the probability was less than the cut value. To answer the first research question regarding predictors for the 2008 mathematics CRCT, three cut values were tested (p = 0.50, p = 0.55 and p = 0.45). If p = 0.50 was used for the cut score, and P(event) was less than 0.50, it would be predicted that the student would fail. Conversely, if P(event) was greater than 0.50, it would be predicted that the student would pass. A researcher would choose which cut value to use relative to the need for identification of participants. For instance, if the intention of the researcher was to identify students who needed special intervention or review prior to a high-stakes test, the researcher could select the cut value that gave the largest number of students who would be predicted to score below or slightly above a passing score. That was the case for this researcher in this study.

To test the reliability of using the same predictors for the 2009 mathematics CRCT, Crosstabulation (Crosstabs), a statistical procedure that forms two-way and/or multi-way tables, was used. Crosstabs on predicted pass/fail versus observed pass/fail were run based on cut values of p = 0.45, p = 0.50 and p = 0.55 to check for relative fit of the model. The frequency of correct predictions generated in a crosstabulation table gave
the researcher an idea of which cut value would best suit the outcomes when applying the predictors from the 2008 student data to the 2009 student data.

**Participants**

**All Students – Descriptive Statistics**

To investigate predictors of eighth-grade mathematics achievement in Murray County Schools, students who took the Georgia CRCT assessments in both 2006 and 2007 were selected and called Cohort I. The information was tabulated in a spreadsheet and imported into SPSS. Demographic data, obtained from the CRCT, showed that the sample consisted of 449 students; 224 were female and 225 were male. There were six categories of ethnicity: 0.2% Asian \( (n = 1) \), 0.5% African-American \( (n = 2) \), 16.5% Hispanic \( (n = 74) \), 81.7% Caucasian \( (n = 367) \) and 1.1% Multi-racial \( (n = 5) \). A free or reduced lunch code was used to determine socioeconomic status (SES). Students who received no assistance for lunch payment made up 39.4% \( (n = 177) \) with 60.6% \( (n = 272) \) of the students in the study either receive a free lunch or have a reduced rate.

A total of 30 different quantitative measures were selected as independent variables to be analyzed using Logistic Regression in SPSS. Gender, ethnicity, and SES were the three nominal measures and reading scaled scores and CRCT mathematics scaled scores, performance level and percent correct, percent correct in four domains of mathematics, CRCT reading scaled scores, performance level and percent correct, and CRCT science scaled scores, performance level and percent correct in sixth and seventh grades were the ordinal measures. The dependent variable was the performance level in mathematics on the eighth grade CRCT, which was coded as a zero for students scoring below 800 on the test and a one for students scoring 800 or above on the tests. A
summary of the performance of students in Cohort I on the 2008 CRCT Mathematics
disaggregated by school location, gender, ethnicity and SES is found in Table 1. The 800
scaled score was the cut score or dividing point between Does Not Meet and Meets
performance criteria. The data in Table 1 indicated that the average of the scaled scores
of all students was above the cut score for Does not Meet in 2006 (M = 808.70), 2007 (M
=817.17) and 2008 (M = 802.30). The standard deviations (σ_{Total2006} = 25.3, σ_{Total2007} =
25.1, and σ_{Total2008} = 27.541) suggested a large amount of variability of scores around the
mean also there was homogeneity of variance. The only two groups of students showing
a mean less than 800 in those three years were African American (n = 2) and low SES (n
= 272) students.

Table 1. Performance on CRCT Mathematics for all Students (M and SD)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>Mean(SD)</td>
<td>Mean(SD)</td>
<td>Mean(SD)</td>
</tr>
<tr>
<td>School</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bagley Middle School</td>
<td>287</td>
<td>809.01(26.8)</td>
<td>819.33(25.3)</td>
</tr>
<tr>
<td>Gladden Middle School</td>
<td>162</td>
<td>808.15(22.5)</td>
<td>813.33(24.2)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>224</td>
<td>809.58(23.4)</td>
<td>817.75(23.2)</td>
</tr>
<tr>
<td>Male</td>
<td>225</td>
<td>807.84(27.1)</td>
<td>816.60(26.9)</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>1</td>
<td>873.00(0)</td>
<td>923.00(0)</td>
</tr>
<tr>
<td>African American</td>
<td>2</td>
<td>795.00(1.4)</td>
<td>808.50(9.2)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>74</td>
<td>805.73(19.8)</td>
<td>817.28(20.4)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>367</td>
<td>808.99(26.0)</td>
<td>816.73(25.1)</td>
</tr>
<tr>
<td>Multi-racial</td>
<td>5</td>
<td>824.40(25.3)</td>
<td>830.20(43.1)</td>
</tr>
<tr>
<td>SES Status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paying full price for lunch</td>
<td>177</td>
<td>815.95(27.2)</td>
<td>822.38(26.3)</td>
</tr>
<tr>
<td>Free or reduced lunch</td>
<td>272</td>
<td>803.99(22.8)</td>
<td>813.78(23.7)</td>
</tr>
</tbody>
</table>
The testing division of the Georgia DOE reported the CRCT test scores as scaled scores. The maximum achievable score was not the same for all subject areas but ranged between 918 and 950. The testing division also determined the cut scores for the three Performance Levels on the CRCT. PL3 (Exceeds) was assigned to scaled scores from 850 higher, PL2 (Meets) was assigned from 800 to below 850, and PL1 (Does Not Meet) was assigned to any score below 800. Means and standard deviations for the percentage of questions students answered correctly for Cohort I in 2006 and 2007 CRCT were tabulated in Table 2. The scores for sixth grade in 2006 and seventh grade in 2007 were obtained from an electronic spreadsheet in the testing office files of the Murray County Schools.

Table 2. Mean and SD for CRCT Data for Cohort I in 2006 and 2007

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>M% (SD)</td>
</tr>
<tr>
<td>Reading</td>
<td>449</td>
<td>71 (16.1)</td>
</tr>
<tr>
<td>Mathematics</td>
<td>449</td>
<td>56 (16.7)</td>
</tr>
<tr>
<td>Numbers and Operations</td>
<td>449</td>
<td>62 (23.8)</td>
</tr>
<tr>
<td>Geometry</td>
<td>449</td>
<td>57 (18.6)</td>
</tr>
<tr>
<td>Algebra</td>
<td>449</td>
<td>53 (19.7)</td>
</tr>
<tr>
<td>Statistics</td>
<td>449</td>
<td>57 (20.5)</td>
</tr>
</tbody>
</table>

A bivariate correlation, Pearson r, with eighth-grade Mathematics scaled scores from the 2008 CRCT being the dependent variable, found that several independent variables showed a correlation with the dependent variable. Primary quantitative data used in the Pearson r along with eighth-grade mathematics scaled scores were the reading
scaled scores, mathematics scaled scores, mathematics percent correct from the raw scores for the following subtests: numbers and operations, geometry, statistics, science scaled scores and science percent correct.

Upon investigation of the correlation coefficients, the analysis revealed that a large number of variables showed moderate to strong direct relationships. Gender, ethnicity and SES were included in these analyses. Of all of the variables weighed against gender, ethnicity and SES on both the Pearson $r$ and the Spearman’s rho ($\rho$), none of them had even a moderate relationship with respect to these variables. The results from these analyses performed using SPSS 17.0 software are given in Table 3. Sixth-grade CRCT percent correct of all mathematics questions was most highly correlated with sixth grade CRCT numbers and operations (NO) ($r = 0.801, p < .01$) sixth-grade CRCT algebra ($r = 0.908, p < .01$). Seventh-grade CRCT percent correct of all mathematics questions most highly correlated with seventh-grade CRCT numbers and operations (NO) ($r = 0.843, p < .01$), seventh-grade CRCT algebra ($r = 0.928, p < .01$) and seventh-grade CRCT geometry ($r = 0.802, p < .01$).

<table>
<thead>
<tr>
<th>Variable Label</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 6th Math %</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. 6th NO %</td>
<td>.801**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. 6th Alg %</td>
<td>.908**</td>
<td>.696**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. 6th Sci %</td>
<td>.682**</td>
<td>.570**</td>
<td>.617**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. 7th Math %</td>
<td>.752**</td>
<td>.635**</td>
<td>.698**</td>
<td>.641**</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. 7th NO %</td>
<td>.690**</td>
<td>.594**</td>
<td>.661**</td>
<td>.580**</td>
<td>.843**</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>7. 7th Alg %</td>
<td>.700**</td>
<td>.595**</td>
<td>.639**</td>
<td>.587**</td>
<td>.928**</td>
<td>.711**</td>
<td>1.00</td>
</tr>
</tbody>
</table>
One way analysis of variance (ANOVA) was used to analyze the performance of students categorized by school location, ethnicity, gender and socioeconomic status on each of the following independent variables: sixth-grade mathematics percent correct, sixth-grade numbers and operations percent correct, sixth-grade algebra percent correct, seventh-grade mathematics percent correct, seventh-grade numbers and operations percent correct, and seventh-grade algebra percent correct. A significant difference occurred between the performance of students from the different schools on seventh-grade mathematics scaled score \( (F_{(1,447)} = 5.996, p = .015) \), seventh-grade numbers and operations \( (F_{(1,447)} = 4.819, p = .029) \), and seventh-grade algebra \( (F_{(1,447)} = 9.806, p = .002) \). There was also a significant difference between the performance of students based on socioeconomic status on sixth-grade mathematics percent correct \( (F_{(1,447)} = 5.344, p = .021) \), sixth-grade number and operations \( (F_{(1,447)} = 8.166, p = .004) \), and sixth-grade algebra \( (F_{(1,447)} = 12.490, p = .000) \). ANOVA was also used to test for any differences in performance on the 2008 eighth-grade Mathematics CRCT by students at different school locations, gender and ethnicity. The results \( (F_{(1,447)} = .003, p > .05) \) noted no difference in students’ scores between schools and no difference in scores based on gender \( (F_{(1,447)} = 1.101, p > .05) \), but did show a difference within ethnic groups \( (F_{(1,447)} = 8.143, p < .05) \). When the means of the scaled scored on the 2008 eighth-grade mathematics CRCT were compared by ANOVA, the differences were not significant \( (F_{(1,447)} = 1.663, p = .198) \) and the null hypothesis was retained. Student data were split into the two respective schools in preparation for further analysis.
All Students – Logistic Regression Analysis

Logistic regression was applied to determine what variables would best predict success defined here by Performance Levels (PL) where PL3 and PL2 represented success and PL1 represented failure on the 2008 eighth-grade mathematics CRCT for Murray County Students. The Performance Levels for eighth-grade mathematics were converted to only two values of zero for PL1 and one for PL2 and PL3 to convert this data into a dichotomy, a requirement for logistic regression. Eighth-grade CRCT Mathematics Proficiency Level was used as the dependent variable. The independent variables were reading scaled scores and percent correct, mathematics scaled scores and percent correct, percentage correct for the domains of number and operations, geometry, algebra, statistics, science scaled score and science percent correct. The logistic regression was tabulated by iteration and a list of significant predictors was produced at each step of the iteration. In this case it was the Forward Stepwise process. In the Forward Step process, the program will put in one variable at a time until it finds the one with the greatest potential of prediction. That variable remained in the program while other variables were inserted in steps. SPSS generated tables at each step indicating how each new independent variable showed contribution to a better logistic fit. When no significant change occurred in the predictive value, the iterations stopped. When this process was used on all student data, logistic regression stopped after Step 3, generating a table, the Model Summary Table, that contained the variables that contributed most to a predictive model called a logit.

In addition to the statistical model displayed by the Model Summary Table, two pseudo $R$-squares, Cox and Snell $R^2 = .369$ and Nagelkerker $R^2 = .492$ were given. It
must be understood that these numbers attempt to mimic R-squared in multiple linear regression, thus the name, pseudo. In multiple linear regression, $R^2$ was the percentage of the variation in the dependent variable that can contribute to the variation of the combined predictor variables (Hinkle, Wiersma, & Jurs, 2003, pp. 472-483). A dichotomy was used in Logistic Regression; therefore, the prediction would have a variance between the dichotomy or a 50-50 split with some potential skewedness that can be used to analyze the variance. The pseudo $R$-squared values are not accepted by all researchers as having predictive value, rather measure strength of association. Nonetheless, these pseudo $R$-squared values have been considered with caution in this research. Cox and Snell $R^2$ implicated that 37% of the predictions of whether student passed or failed the eighth-grade Mathematics CRCT were predicted correctly and Nagelkerker $R^2$ showed a correct prediction 49% of the time. The next table generated was the Classification Table which evaluated the accuracy of the model. The model predicted correctly that 82.4% the students would perform at PL1 that 80.3% of the students would perform at PL2 and that overall 81.3% of the cases were predicted correctly. Statistically, this indicated that the model that was generated by the data could predict accurately what would happen to 81.3% of the students on this test. The final data output from SPSS was called Variables in the Equation; Table 4 is a tabulation of these results. The first column lists the variables that were chosen by the analysis to be the best predictors, $b$ column represents the estimated log odds ratio and is used as the logistic regression coefficients, Standard Error is the standard deviation of the sampling distribution associated with the estimation method, $p$ denotes statistical significant and
the Odds Ratio or Exp(b) indicates by its quantity the general effect an independent variable has on the dependent variable.

*Table 4. Logistic Regression Predictors for All Students in Cohort I*

<table>
<thead>
<tr>
<th></th>
<th>b</th>
<th>Standard Error</th>
<th>p</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 3</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6th Mathematics percent correct</td>
<td>.075</td>
<td>.013</td>
<td>.000</td>
<td>1.078</td>
</tr>
<tr>
<td>7th Mathematics scaled score</td>
<td>.033</td>
<td>.009</td>
<td>.000</td>
<td>1.034</td>
</tr>
<tr>
<td>7th Science Performance Level</td>
<td>.622</td>
<td>.240</td>
<td>.010</td>
<td>1.863</td>
</tr>
<tr>
<td>Constant</td>
<td>-32.482</td>
<td>7.158</td>
<td>.000</td>
<td>.000</td>
</tr>
</tbody>
</table>

Note: Final values after iterations stopped.

When these b values were inserted into the logit, $z = b_0 + b_1X_1 + b_2X_2 + b_3X_3$, the log odds ($z$) were generated and then converted to the probability of passing or failing the eighth-grade Mathematics CRCT using $P(\text{event}) = \frac{\text{Exp}(z)}{1 + \text{Exp}(z)}$. A student was predicted to pass if the probability generated was greater than a selected cut value and predicted to fail if the probability was less than the cut value. In this study three cut values were tested ($p = 0.50$, $p = 0.55$ and $p = 0.45$) and reported by predicted pass/fail percentages using crosstabulation. Cross-tabulation analysis, sometimes called contingency table analysis, confirmed the functionality of the predictors from the 2008 eighth-grade mathematics CRCT data and the logistic regression model to predict the performance of students for Cohort II using data from the 2009 eighth-grade mathematics CRCT. Table 5 tabulates the results of crosstabulation for each cut value for all students. From these analyses, it was known which students scored below proficiency or in PL1, and it was known which students scored at or above proficiency in PL2 and PL3. In the
first table, the model correctly predicted that 82 students would score PL1 (fail).

Therefore, 82 of the 127 students 64.6% of students predicted to fail did fail. From cross tabulation, the total percentage of passing or failing can be determined by $(82 + 177)/374 \times 100$ or 69.3%; because out of 374 students, 82 were predicted to fail and did fail and 177 were predicted to pass and did pass. The same method was used for a cut value of $p = .55$ revealing that $91/127 \times 100$ or 71.6% of students predicted to fail, did fail, and $(91 + 164)/374 \times 100$ or 68.2% of students passing or failing were predicted correctly. For the cut value of .45, 59.1% of students predicted to fail, did fail, and 69.3% of students passing or failing were predicted correctly.

**Table 5. Classification Table (Crosstabulation) for all Students in Cohort I**

<table>
<thead>
<tr>
<th>Cut value</th>
<th>Fail</th>
<th>Pass</th>
<th>Total</th>
<th>Fail</th>
<th>Pass</th>
<th>Total</th>
<th>Fail</th>
<th>Pass</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>.50</td>
<td>82</td>
<td>70</td>
<td>152</td>
<td>75</td>
<td>63</td>
<td>174</td>
<td>91</td>
<td>83</td>
<td>174</td>
</tr>
<tr>
<td>.45</td>
<td>45</td>
<td>177</td>
<td>222</td>
<td>52</td>
<td>184</td>
<td>200</td>
<td>36</td>
<td>164</td>
<td>200</td>
</tr>
<tr>
<td>.55</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Bagley Middle School Students – Descriptive Statistics**

Bagley Middle School was located in a rural area of Murray County and housed sixth, seventh and eighth grades. Bagley Middle School students made up 63.9% (n = 287) of the total sample (n = 449). Of the 287 students, 144 (50.1%) were girls and 143 (49.8%) were boys and 169 (58.9%) received a free or reduced lunch. Ninety-eight percent of the population was made up of Caucasians (n = 227, 79.1%) and Hispanics (n = 56, 19.5%). The rest of the population consisted of Asian (n = 1, 0.3%), Black (n = 1,
0.3%) and Multi-racial (n = 2, 0.7%). These 287 students began the sixth grade in 2005-2006 and completed their seventh and eighth grades at Bagley Middle School.

When the 2006, 2007 and 2008 CRCT data were analyzed by males and females compared year by year in the area of mathematics, it was found that more males scored PL1 (Did Not Meet) \( n_{\text{males}} = 59; n_{\text{females}} = 44 \), more females scored PL2 (Met) \( n_{\text{males}} = 68; n_{\text{females}} = 91 \) and more males scored PL3 (Exceeded) \( n_{\text{males}} = 16; n_{\text{females}} = 9 \) on the 2006 sixth-grade mathematics CRCT. That pattern was repeated on the 2007 seventh-grade mathematics CRCT but numbers were closer together for males and females. On the 2008 eighth-grade mathematics CRCT, 49% of the students scored in PL1. More females scored PL1 \( n_{\text{males}} = 68; n_{\text{females}} = 73 \), an equal number of males and females scored PL2, and more males scored PL3 \( n_{\text{males}} = 13; n_{\text{females}} = 7 \). The sample size was low and statistically shows no significant difference on 8th grade CRCT mathematics on a t-test. However, from a practitioner’s standpoint, these numbers were important and will be discussed later.

These findings were supported by Zittleman and Sadker (2002) who described that the gender bias prevalent in teacher education texts as well as textbooks written for students in K-12 education could have an effect on achievement between the genders. In 2008 Geist and King recommended a standards-based approach for boys, who generally use deductive reasoning, and girls, who use inductive reasoning, equal opportunities to solve the problem and to discuss the different ways they did it.

Further investigation into the data showed that on all CRCT tests for Cohort I, students of low socioeconomic status scored lower than their counterparts who pay full price for a lunch. As discussed earlier, students of poverty are not likely to reach 100%
proficiency in a curriculum (Walker & Mohammed, 2008). Of the students who pay full price for lunch, an overwhelming percentage of them exceeded proficiency compared to students who receive free or reduced-price lunch on sixth-grade reading, sixth-grade science, seventh-grade mathematics, seventh-grade reading, eighth-grade reading and eighth-grade science. In fact, they outscored the students on free or reduced-price lunch on seven of seven CRCT tests given in 2006, 2007 and 2008. In most cases the number of non-paying students exceeded the free and reduced lunch students by more than one and one half times.

**Bagley Middle School – Logistic Regression Analysis**

The same tests used to analyze the data for all students were used on the data for Bagley Middle School students. Likewise the results were reported in the same manner. Eighth-grade CRCT Mathematics Proficiency Level was used as the dependent variable. The independent variables were reading scaled scores and percent correct, mathematics scaled scores and percent correct, percentage correct for the domains of numbers and operations, geometry, algebra, statistics and science scaled score and percent correct.

The SPSS 17.0 forward stepwise process of logistic regression generated its final report after Step 3. The Model Summary Table yielded two pseudo R-square’s, Cox and Snell $R^2 = .396$ and Nagelkerker $R^2 = .52$. Since these are pseudo $R^2$ values, it can be loosely interpreted to mean that the pass fail predictions of the model share variance with actual results in the amounts of 39.6% and 52%. Thus the model generated can be assumed to be predictive of whether a student will pass or fail the eighth-grade Mathematics CRCT. The data output, Variables in the Equation table, is displayed in Table 6.
Table 6. Logistic Regression Predictors for Bagley Middle School Students in Cohort I

<table>
<thead>
<tr>
<th>Step 3</th>
<th>b</th>
<th>Standard Error</th>
<th>p</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>6th Math percent correct</td>
<td>.069</td>
<td>.015</td>
<td>.000</td>
<td>1.072</td>
</tr>
<tr>
<td>7th Mathematics scaled score</td>
<td>.027</td>
<td>.012</td>
<td>.027</td>
<td>1.028</td>
</tr>
<tr>
<td>7th Science scaled score</td>
<td>.018</td>
<td>.008</td>
<td>.035</td>
<td>1.018</td>
</tr>
<tr>
<td>Constant</td>
<td>-40.352</td>
<td>8.83</td>
<td>.000</td>
<td>.000</td>
</tr>
</tbody>
</table>

Note: Iterations stopped at Step 3.

When the b values were inserted into the logit, \( z = b_0 + b_1X_1 + b_2X_2 + b_3X_3 \), the log odds (\( z \)) were generated and then converted to the probability of passing or failing the eighth-grade Mathematics CRCT using \( P(\text{event}) = \frac{\text{Exp}(z)}{1 + \text{Exp}(z)} \). A student was predicted to pass if the probability generated was greater than the cut value and predicted to fail if the probability was less than the cut value. The cut value is a strategically selected value selected by this researcher. In the final analysis, it is the researcher’s decision to choose which cut value will return the group of students for whom intervention would be most advantageous. Table 7 shows the results of cross tabulation for all students when \( p = .50 \), \( p = .45 \) and \( p = .55 \). For a cut value of .50, these data confirmed that 40 of 75 students or 53.3% of students predicted to fail, did fail; and that of 223 students, 40 students failed that were predicted to and 116 passed that were predicted to for 70.0% of passing or failing being predicted correctly. Likewise, for a cut value of .45, 49.3% of students predicted to fail, did fail and 72.2% students of passing or failing were predicted correctly. Those same percentages for a cut value of .55 were 57.3% of students correctly predicted to fail and 69.5% of students’ performance levels predicted correctly. When testing the accuracy of the model, the Classification Table reported that 82.3% of failures were predicted correctly, 80.8% of passing were predicted
correctly, and 81.5% overall were predicted correctly with a cut value of 0.50, indicating that the model fits the data, and the researcher may use the equation with confidence.

This researcher is most interested in identifying students who have the greatest potential to fail; therefore, the cut value of 0.55 was chosen for this study.

Table 7. Crosstabulation for Bagley Middle School Students in Cohort I

<table>
<thead>
<tr>
<th></th>
<th>PL 8th Grade Math CRCT Cut value = .50</th>
<th>PL 8th Grade Math CRCT Cut value = .45</th>
<th>PL 8th Grade Math CRCT Cut value = .55</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fail Pass Total</td>
<td>Fail Pass Total</td>
<td>Fail Pass Total</td>
</tr>
<tr>
<td>Fail</td>
<td>40 32 72</td>
<td>37 24 61</td>
<td>43 36 79</td>
</tr>
<tr>
<td>Pass</td>
<td>35 116 151</td>
<td>38 124 162</td>
<td>32 112 144</td>
</tr>
<tr>
<td>Count</td>
<td>75 148 223</td>
<td>75 148 223</td>
<td>75 148 223</td>
</tr>
</tbody>
</table>

Gladden Middle School Students – Descriptive Statistics

Gladden Middle School was located in the city of Chatsworth, Georgia, and housed sixth, seventh and eighth grades. Gladden Middle School students represented 36.1% (n = 162) of the total sample (n = 449). Of the 162 students, 80 (49.4%) are girls and 82 (50.6%) are boys; 103 students (63.6%) received a free or reduced lunch. Ninety-eight percent of the population was made up of Caucasians (n = 140, 86.4%) and Hispanics (n = 18, 11.1%). The remainder of the population consisted of Black (n = 1, 0.6%) and Multi-racial (n = 3, 1.9%). These 162 students began the sixth grade in 2005-2006 and completed seventh and eighth grades at Gladden Middle School.

When the 2006, 2007 and 2008 CRCT data were disaggregated by gender and by all subject areas of Reading, English, Mathematics, and Science, it was found that more females scored in PL3 (Exceeds) in both seventh-grade and eighth-grade mathematics
while males outscored females on sixth, seventh and eighth grade CRCT science tests. Geist & King (2008) found that getting back to the basics with standards-based curriculum and instruction has benefited males over females. The data from Gladden Middle School showed a higher percentage of males scoring Does Not Meet (PL1) in every subject tested on the 2006, 2007 and 2008 CRCT. Whereas these are small sample sizes, to the practitioner these data are important when planning strategies to improve instruction for all students. Further discussion will appear later on these findings. Students at Gladden Middle School exhibited a slight difference in performance between the genders from Bagley Middle School. It was shown that at Bagley boys had better success in scoring at the Exceeds (PL3) level on state tests. That gap did not exist at Gladden. In fact females appeared to score more Meets and Exceeds than did boys. Further investigation into gender distribution and teacher assignment could expose factors that could have given such different results.

Also at Gladden Middle School students who received a free or reduced lunch achieved Did Not Meet on different content areas of state tests more often than their counterparts who paid full price for a lunch. Additionally, a higher percentage of students who paid full price scored in Meets and Exceeds on every state CRCT test given. The difference was especially noteworthy in sixth-grade science where 85% of paying students passed compared to 70% of free and reduced students passing. In eighth-grade science, 80% of paying students passed while 69% of free and reduced students passed. As discussed earlier, students of poverty are not likely to reach 100% proficiency in a curriculum (Walker & Mohammed, 2008). Of the students who paid full price, an overwhelming percentage of them scored advanced proficiency compared to students...
who received free or reduced-price lunch on sixth-grade reading, sixth-grade science, seventh-grade mathematics, seventh-grade reading, eighth-grade reading and eighth-grade science. Indeed, these students outscored students of free and reduced status on seven of seven CRCT tests given in 2006, 2007 and 2008. In most cases the number of paying students exceeded the free and reduced by more than one and one half times.

**Gladden Middle School Student – Logistic Regression Analysis**

The method used for Gladden Middle School was identical to the method for Bagley Middle School. The 2008 eighth-grade mathematics performance level of the CRCT was the dependent variable. The independent variables used for Gladden Middle School analysis were the same variables that were used for Bagley Middle School. The forward stepwise process of logistic regression returned two independent variables as statistically reliable predictors. The Model Summary Table in SPSS logistic regression yielded Cox and Snell $R^2 = .438$ and Nagelkerker $R^2 = .584$ which can be interpreted that roughly 44% and 58% of the variance in predicted scores can be attributed to the model, on whether or not a student will pass or fail the eighth-grade Mathematics CRCT. The Classification Table returned the values of 87.5% and 82.9% with a cut value of 0.50, indicating that this model fits the data well. The final data output from SPSS is given in Table 8 and listed the predictor variables and constant along with their statistical properties. The logit predicted future odds when these coefficients from the iterations were used in the prediction equation.
Table 8. Logistic Regression Predictors for Gladden Middle School Students in Cohort I

<table>
<thead>
<tr>
<th>Step 2</th>
<th>$b$</th>
<th>Standard Error</th>
<th>$p$</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>6th Math percent correct</td>
<td>.115</td>
<td>.021</td>
<td>.000</td>
<td>1.121</td>
</tr>
<tr>
<td>7th Geo percent correct</td>
<td>.045</td>
<td>.015</td>
<td>.002</td>
<td>1.046</td>
</tr>
<tr>
<td>Constant</td>
<td>-9.156</td>
<td>1.388</td>
<td>.000</td>
<td>.000</td>
</tr>
</tbody>
</table>

Note: Iterations stopped after Step 2.

As described earlier, once the value for $z$ is obtained from the logit, $z = b_0 + b_1 X_1 + b_2 X_2$, it is then converted to the probability that an event will happen using $P \text{ (event)} = \frac{\text{Exp}(z)}{1 + \text{Exp}(z)}$. In this study, the event would either have a probability greater than the cut value or a probability less than the cut value. Table 9 gives the results of cross tabulation for all students when $p = .50$, $p = .45$ and $p = .55$. For a cut value of .50, these data confirmed that 29 of 52 students or 55.8% of students predicted to fail did fail; and that of 151 students, 29 students predicted to failed did fail and 73 passed that were predicted to pass ending with 67.5% performance of passing or failing being predicted correctly. Likewise, for a cut value of .45, 50.0% of students predicted to fail, did fail and 66.2% students of passing or failing were predicted correctly. Those same percentages for a cut value of .55 were 63.5% of students correctly predicted to fail and 68.9% of students’ performance levels predicted correctly. When testing the accuracy of the model, the Classification matrix reported that 87.5% of failures were predicted correctly, 82.9% of passing were predicted correctly, and 85.2% overall were predicted correctly, indicating that the model fits the data, and the researcher may use the equation with confidence. In this case, the cut value of 0.55 was chosen since this researcher is
most interested in identifying students who have a greater potential of not meeting standards.

Table 9. Classification Table (Crosstabulation) for Gladden Middle School Students in Cohort I

<table>
<thead>
<tr>
<th></th>
<th>PL 8th Grade Math CRCT</th>
<th></th>
<th>PL 8th Grade Math CRCT</th>
<th></th>
<th>PL 8th Grade Math CRCT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fail</td>
<td>Pass</td>
<td>Total</td>
<td>Fail</td>
<td>Pass</td>
</tr>
<tr>
<td>Fail</td>
<td>29</td>
<td>26</td>
<td>55</td>
<td>26</td>
<td>25</td>
</tr>
<tr>
<td>Pass</td>
<td>23</td>
<td>73</td>
<td>96</td>
<td>26</td>
<td>74</td>
</tr>
<tr>
<td>Count</td>
<td>52</td>
<td>99</td>
<td>151</td>
<td>52</td>
<td>99</td>
</tr>
</tbody>
</table>

Confirmation of Model

Demographics

The first research question of this study was to determine if there were variables among the data for the cohort of students entering sixth grade in 2006 and completing eighth grade in 2008, Cohort I, which could predict performance on the eighth-grade Mathematics CRCT. The second research question asked if those same predictors would be viable for the next cohort of students entering sixth grade in 2007 and completing eighth grade in 2009, henceforth called Cohort II. In order to check the reliability of the predictors, the same data were collected and analyzed using identical statistical methods for the second cohort.

Demographic data for Cohort II is given in Table 10. When this data is compared to the same data for Cohort I, there is little difference. For all students in Cohort I and Cohort II respectively, there were 449 to 374 students, 49.9% to 48.7% females, 50.1% to 51.3% males, 0.2% to 0% Asian, 0.5% to 0.5% African American, 16.5% to 15.5%
Hispanic, 81.7% to 83.2% Caucasian, 1.1% to 1.1% multiracial, and 60.6% to 61.0% free or reduced lunch students.

*Table 10. Demographic Statistics for Cohort II*

<table>
<thead>
<tr>
<th></th>
<th>All students</th>
<th></th>
<th>Bagley Middle</th>
<th></th>
<th>Gladden Middle</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>182</td>
<td>48.7</td>
<td>109</td>
<td>48.8</td>
<td>73</td>
<td>48.3</td>
</tr>
<tr>
<td>Male</td>
<td>192</td>
<td>51.3</td>
<td>114</td>
<td>51.1</td>
<td>78</td>
<td>51.7</td>
</tr>
<tr>
<td>SES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free lunch</td>
<td>228</td>
<td>61.0</td>
<td>131</td>
<td>58.7</td>
<td>97</td>
<td>64.2</td>
</tr>
<tr>
<td>Full pay</td>
<td>146</td>
<td>39.0</td>
<td>92</td>
<td>41.3</td>
<td>54</td>
<td>35.8</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>2</td>
<td>.5</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>.7</td>
</tr>
<tr>
<td>Hispanic</td>
<td>58</td>
<td>15.5</td>
<td>38</td>
<td>17.0</td>
<td>20</td>
<td>13.2</td>
</tr>
<tr>
<td>Caucasian</td>
<td>311</td>
<td>83.2</td>
<td>183</td>
<td>82.1</td>
<td>128</td>
<td>84.8</td>
</tr>
<tr>
<td>Multi-racial</td>
<td>4</td>
<td>1.1</td>
<td>2</td>
<td>.9</td>
<td>2</td>
<td>1.3</td>
</tr>
<tr>
<td>Total</td>
<td>374</td>
<td></td>
<td>223</td>
<td></td>
<td>151</td>
<td></td>
</tr>
</tbody>
</table>

As tabulated in Table 11, the means and standards deviations for student performance on the eighth-grade CRCT in 2008 for Cohort I and in 2009 for Cohort II are relatively comparable. These statistics tell the researcher that the two groups, Cohort I and Cohort II, are very similar in demographic data and in test performance on the eighth-grade mathematics CRCT. The reliability of using the predictors for Cohort II will be confirmed using Crosstabulation.
Cohort I Predictors vs. Cohort II Data

A recap of the predictors specified by logistic regression analyses of Cohort I by all students, Bagley Middle School students and by Gladden Middle School students is found in Table 12.
Table 12. Predictors for 2008 Mathematics CRCT Performance Level

<table>
<thead>
<tr>
<th></th>
<th>All Students</th>
<th>Bagley Middle</th>
<th>Gladden Middle</th>
</tr>
</thead>
<tbody>
<tr>
<td>6th Grade Mathematics percent correct</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>7th Grade Mathematics scaled score</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>6th Grade Science performance level</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>7th Grade Geometry percent correct</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

A cross-tabulation gives you a basic picture of how two variables inter-relate and can be performed in SPSS. In this study the researcher was investigating how the predictors generated from logistic regression inter-related or predicted whether or not students would fall into the category of Does Not Meet or the category of Meets. These categories were the dichotomy, zero for Does Not Meet and one for Meets, required by logistic regression. Because this researcher wanted to discover how the predictors from Cohort I related to the data for Cohort II, crosstabs had to be used. The general predictions were either failed or passed. Three cut values were deliberately chosen, $p = .45$, $p = .50$, and $p = .55$. When $p = .50$ was selected and values generated from the logit for each student were compared in a crosstabs table, those probabilities with a value of 0.50 or less would be predicted to fail. That prediction would be compared to see if those students actually did fail. When the cut value was changed in the crosstab analysis, the same principle applied. Crosstabulation data given in Table 13 confirmed that 56.1% of students who Did Not Meet on the 2009 eighth-grade mathematics CRCT could be correctly predicted using a cut value of $p = 0.45$, that 64.6% of students who Did Not Meet on the 2009 eighth-grade mathematics CRCT could be correctly predicted using a cut value of $p = .50$, and 71.7% of students who Did Not Meet could be correctly
predicted using a cut value of $p = .55$. A researcher must choose which of the probabilities will give the most useful information. In this case, the practitioner who wished to liberally choose students for remediation would use a cut value of $p = .45$ because it correctly predicted that 91 students would fail. That was the largest group correctly predicted to fail of the three cut values since a cut value of $p = .50$ predicted 82 student outcomes correctly and a cut value of $p = .55$ predicted 75 student outcomes correctly.

*Table 13. Crosstabulation for All Students in Cohort II*

<table>
<thead>
<tr>
<th></th>
<th>PL 8th Grade Math CRCT</th>
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<th>PL 8th Grade Math CRCT</th>
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<td>Cut value = .50</td>
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<td>Fail</td>
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<td>Fail</td>
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<td>Fail</td>
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<td>Pass</td>
<td>45</td>
<td>177</td>
<td>222</td>
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<td>164</td>
</tr>
<tr>
<td>Count</td>
<td>127</td>
<td>247</td>
<td>374</td>
<td>127</td>
<td>247</td>
</tr>
</tbody>
</table>

**Summary of Crosstabulation**

There was little doubt that the variables selected through the process of logistic regression, calculation of odds and crosstabulation gave the researcher enough evidence to accept the model for predicting student performance on the eighth-grade mathematics CRCT. When $p = .55$ and the model was tested on all students on the 2009 CRCT Mathematics, it correctly predicted 71.7% of students would fail. Gladden Middle School data fit the model somewhat better than the Bagley Middle School data. At $p = .55$, 63.5% of Gladden’s and 57.3% of Bagley’s performance could be predicted. This solid data gave educators a valid method for identifying students who needed reinforcement before the test.
Results of Research Questions and Data Analyses

The results of the statistical tests run on the main research questions and the null hypotheses will be presented in the follow section. Because the main purpose of the study was to locate predictors for future cohorts of students, it was important to the researcher to know if there was a statistical difference in the mathematics performance by students based on their gender, ethnicity and socioeconomic status. The null hypotheses, therefore, were based on these factors.

Research Question #1

Primary Research Question #1: Were there variables in the 2006 and 2007 CRCT tests that were predictive of performance on the mathematics portion of the eighth-grade CRCT?

The processes of logistic regression, odds prediction and crosstabulation were used to answer this question. It was found that a set of predictors emerged from the 2006 and 2007 CRCT data. Those predictors were listed in Table 12. Four hypotheses were tested for research question one using one-way ANOVA for differences in performance with respect to the independent nominal variables, school location, gender, ethnicity and socioeconomic status.

Four hypotheses were tested for research question one using one-way ANOVA for differences in performance with respect to the independent nominal variables, school location, gender, ethnicity and socioeconomic status.

Null Hypothesis #1.1: There was no difference in the performance on the mathematics portion of the 2008 eighth-grade CRCT for all students based on school location.
The results of the one-way ANOVA, $F_{(1,447)} = .003, p = .960$ demonstrated no significant difference in the 2008 CRCT eighth-grade Mathematics Scaled Score based on school location. The null hypothesis was not rejected ($F_{(1,448)} = .960 < F_{cv} = 3.84$).

**Null Hypothesis #1.2:** There was no difference in the performance on the mathematics portion of the 2008 eighth-grade CRCT based on gender for all students.

The results of the one-way ANOVA, $F_{(1,447)} = 1.101, p = .295$ did not indicate a significant difference in the 2008 CRCT Eighth-Grade Mathematics Scaled Score based on gender. The null hypothesis was not rejected ($F_{(1,448)} = 1.101 < F_{cv} = 3.84$).

**Null Hypothesis #1.3:** There was no difference in the performance on the mathematics portion of the 2008 eighth-grade CRCT based on ethnicity.

The one-way ANOVA results, $F_{(1,444)} = 2.573; p = .037$, showed no significant differences in the performance of the ethnic groups on the 2008 CRCT Eighth-Grade Mathematics Scaled Score. The null hypothesis was not rejected ($F_{(1,444)} = 2.573 < F_{cv} = 3.84$).

**Null Hypothesis #1.4:** There was no difference in the performance on the mathematics portion of the 2008 eighth-grade CRCT based on socioeconomic status (SES).

ANOVA results for this null hypothesis, $F_{(1,447)} = 8.143; p = .005$, showed a significant difference relative to socioeconomic status in performance on the 2008 CRCT Eighth-Grade Mathematics Scaled Score. The 177 students paying full price for lunch had a mean scaled score of 808.86 with a SD = 29.424. Student on free and reduced lunch had a mean scaled score of 799.33 with a SD = 25.869. The null hypothesis was rejected ($F_{(1,444)} = 8.143 > F_{cv} = 3.84$).
Research Question #2

*Primary Research Question #2:* Did the identified predictors for mathematics performance for eighth-grade students in 2008 also predict mathematics performance for eighth-grade students in 2009?

This question was answered by the crosstabulation method using SPSS 17.0. Once the predictors were identified, the data from Cohort II were inserted into the logit which had been derived from Cohort I data. Recalling the discussion of the logit, when the data and constants were inserted into the variables, the logit equation, \( z = b_0 + b_1X_1 + b_2X_2 + b_3X_3 \), gave the solution, \( z \). Inserting \( z \) into \( P(\text{event}) = \frac{\text{Exp}(z)}{1 + \text{Exp}(z)} \) gave the probability that an event would or would not occur. In this research \( P(\text{event}) \) equaled a number between zero and one, the dichotomy required by logistic regression. In the dichotomy, zero represented Does Not Meet and one represented Meets. In crosstabulation calculations different cut values can be used to define the midpoint or median between zero (Does Not Meet) and one (Meets). Mathematically, 0.50 would be the median between zero and one. However, 0.50 did not have to be the median and this researcher varied the median to explore the outcome of the numbers of correctly predicted results. One of the reasons for this research was to identify students who had potential to be unsuccessful on an upcoming CRCT mathematics test. Once those students were known, administrators and teachers could select with statistical certainty which students would need remediation before the test.

Crosstabulation calculations were run on all three groups, all students, Bagley Middle School students and Gladden Middle School students. The logit from Cohort I 2006-2007-2008 data gave acceptable results for all three groups of students. By varying
the cut values, this researcher found that the largest percentage of student performances correctly predicted were 71.7% for all students, 57.3% for Bagley Middle School, and 63.5% for Gladden Middle School.

**Summary**

The focus of the research was to find potential predictors for performance on the eighth-grade mathematics CRCT. There were 30 independent variables weighed against the dependent variable. The setting was in the two middle schools, Bagley and Gladden, in Murray County, Georgia. The sample size for 2008 was 449 students with 81.7% Caucasian, 16.5% Hispanic and 60.6% free or reduced lunch status. In 2009 the sample size was 374 students with 83.7% Caucasian, 15.5% Hispanic, and 60.9% free or reduced lunch status.

Logistic regression was used to find the predictors. The first stage of the analysis included all students followed by an individual study for Bagley and Gladden Middle Schools. The predictors for all students were sixth-grade mathematics percent correct, seventh-grade mathematics scaled score, and sixth-grade science performance level. The predictors for Bagley Middle School were the same as for all students. Gladden Middle School had different predictors, sixth-grade mathematics percent correct and seventh-grade geometry percent correct.

Confirmatory tests analyzed the predictors against the 2007 and 2008 to predict performance on the 2009 mathematics CRCT for Cohort II. Crosstabulations confirmed the accuracy of the model when it was coded with a cut value equal to 0.55 and it correctly predicted that 71.7% would score Does Not Meet (PL1) in mathematics on the 2009 CRCT Cohort II.
CHAPTER FIVE
FINDINGS, DISCUSSION, CONCLUSIONS, RECOMMENDATIONS

Purpose of the Study

Chapter five was a summary of the research and findings of this study. The purpose of this study was to determine if a statistical relationship, significant enough to predict performance on future eighth-grade mathematics CRCT in Murray County Schools, existed between the 2008 eighth-grade CRCT mathematics portion and its independent variables. Poor student achievement at all grade levels had prompted this study to assist Murray County educators in selecting which students might need reinforcement or remediation before taking state standardized tests.

Demographic statistics of Murray County Schools described a population composed primarily of impoverished (71% free and/or reduced-price lunch), Caucasian children living in a county with no higher educational institution and a culture that had for many years had little value for education. Embed into that scenario a Hispanic population of 1,340 (17%) with approximately 450 (5.7%) who received language acquisition assistance with Title III monies. At the time of the study, the culture was changing, but barriers still existed for some children.

Literature Overview

A review of the literature revealed numerous studies that provided insight into the barriers that populations similar to Murray County’s routinely face when taking state standardized assessments such as the Georgia CRCT. Data from the 2009 National Assessment of Educational Progress (NAEP) revealed that students lose nine percentage points of proficiency between eighth grade and twelfth grade (National Center for
Education Statistic, 2009, ¶ 1). Of the students entering college, it was estimated that 25% to 40% take remedial courses. Murray County statistics were no different. Of the high school graduates from Murray County in 2007 who attend college the following fall, 53.1% of them were required to take remedial courses. For 2008 graduates the percentage was 61.9%. Consequently, this researcher targeted literature that reported information relevant to mathematics performance with specific focus on a variety of parameters that were indicative of the population of students found in Murray County Schools.

At the time of this research, approximately 71% of students attending Murray County Schools were receiving a free or reduced-price lunch. It can be inferred from the literature that these students would have less mathematics success than the students paying full price for lunch (Hadley, 2005; Goddard, 2003). Sirin (2005) warned that there are a multitude of variables influencing the relationship between socioeconomic status (SES) and achievement. Some school systems with high poverty have reported success (Blantan, 2005; Cunningham, 2004; Picucci, Brownson, Kahlert, & Sobel, 2004; Taylor, 2005). This literature provided insight that Murray County educators should be prepared to face the low achievement levels of their students. However, this writer was troubled by the implications that foretelling an educator to expect low achievement from any group of students may result in just that. Students should never be able to sense that their teachers will accept less from them just because of what researchers have said. The research does not say that these students cannot learn, and educators cannot allow a self-fulfilling prophesy to prove that students of poverty cannot achieve success in
mathematics. An environment of learning must be made available to break the barriers created by poverty or any other barrier that may impede achievement.

ELL students, students new to the United States needing language acquisition assistance, made up about 3% of the population of Murray County Schools. These children face several of the risk factors that are indicators of low performance in schools. They have low proficiency of the English language, they live in poverty and their mothers have not completed high school (Hispanic Population, 2009). In mathematics, these students were handicapped by the lack of understanding of mathematics vocabulary, a necessary component of thinking mathematically. Their needs were great, but statistical studies such as this one can provide foundational strategies for targeting the root cause for low achievement, which could ultimately close some of the gaps for them.

Culture plays an important role in a child’s social development. In the diverse populations that exist in the United States today, educators often fail to recognize the gaps created by different cultural backgrounds. Research tells us that diverse populations that also come from poverty can lose their cultural identity when immersed into a classroom where a bias may exist toward a Western culture (Tyler, et. al., 2008). When the culture of a school is vastly different from the social culture a child relates to, self-efficacy is threatened and academic achievement can suffer (Roney, Coleman, & Schlichting, 2007). Murray County’s student population only has two large groups of learners, Caucasians and Hispanics. This study did not find huge gaps in achievement between these two groups, which may be an indicator that Murray County educators provide all students with classroom experiences where no bias was apparent.
Researchers have tried for many years to discern why there are achievement
differences between boys and girls. Zittleman and Sadker (2002) laid some of the blame
onto gender stereotypes found in textbooks used for teacher preparation programs.
Nichols, et al. (2007) linked the shortage of female STEM faculty to a lack of self-
efficacy toward mathematics beginning in the fifth grade. Again, Murray County
educators appeared to be providing equal access to the curriculum to boys and girls.

The onus for creating a risk-free, equitable learning environment for all students
rests on the shoulders of every educator. Many researchers have found that barriers to
achievement may come from racial differences, social injustices, dominant ethnic groups,
and teacher attitude to minorities (Grootenboer & Hemmings, 2007; Hill-Jackson, Sewell
& Waters, 2007; Kauffman, Conroy, Gardner & Oswald, 2008). Students with
disabilities face not only barriers related to culture and equity barriers but they have
learning disabilities and behavior disorders that impede their ability to learn at the same
pace as other students. To help close the gap for these students, practitioners have placed
two teachers in a classroom, called inclusion, to provide immediate one-on-one
reinforcement to students with disabilities (DeSimone & Parmar, 2006). Friend and Pope
(2005) wrote that inclusion is a belief system that all students belong to the learning
community. No matter what type of students are seen by a teacher, the quality of
instruction and assessment plays a major role in the success of a classroom or a school.

Most researchers (Chard, 2008; Downer, 2006; English & Watters, 2005;
Magnuson, Meyers, Ruhm, & Waldfogel, 2004) agreed that cognitive development and
academic achievement begin in the years before kindergarten. Ongoing brain research
promises to unlock biological pathways that can lead to individualized strategies for
different learners (Rockwell, 2008; Willis, 2009). An environment filled with a variety of experiences including exploration, challenges, basic curriculum and tactile tasks grant vital opportunities for early development especially for children from poverty. When students are not challenged with rigorous and high-quality learning, they will exhibit low performance and low success.

The educational process is a daunting task especially when all of the potential barriers are identified. It behooves those who work in education to believe that all students can learn when the right barriers are removed and a culture of equity, discovery and rigor are freely available.

**Methodology**

**Population and Sample**

The setting for this research was Murray County Public School (MCPS) in extreme North Georgia. The school district had six elementary schools, two middle schools, one high school and one alternative academy, all Title I schools with 71% of students receiving a free or reduced-price lunch. The student population of this rural county was 7,888 from pre-kindergarten to twelfth in 2008 and composed of 80% Caucasian, 17% Hispanic, 1% African American and 1% multiracial.

The sample for the 2008 research consisted of 449 students, 225 males and 224 females, Murray County middle school students who formed a cohort starting in the sixth grade within two separate middle schools in the fall of 2005 and completing eighth grade in the spring of 2008. Gladden Middle School’s population was 64% economically disadvantaged, and Bagley Middle School’s population was 62% economically disadvantaged.
Data Analysis

Ex post facto or causal comparative design was used to identify predictors for mathematics performance on the 2008 CRCT from 2006 and 2007 CRCT assessments. Statistical analyses were applied to 30 independent variables collected from the 2006 sixth-grade CRCT and 2007 seventh-grade CRCT. Those variables were socioeconomic status, gender, ethnicity, school location, CRCT mathematics scaled scores, performance level and percent correct, percent correct in four domains of mathematics, CRCT reading scaled scores, performance level and percent correct, and CRCT science scaled scores, performance level and percent correct in sixth and seventh grades. The dependent variable was the performance level in mathematics on the eighth grade CRCT.

This study was conducted in two phases. In the first phase, independent variables from the 2006 and 2007 CRCT data for the 449 students of Cohort I were entered into SPSS 17.0, and logistic regression was used to find predictors of performance on the dependent variable, eighth-grade CRCT mathematics performance level. Once predictors had been found and a logit was used to find the probability of passing or failing, the predictor equation was tested against the data for 374 students of Cohort II.

Findings and Discussion

The need to find genuine predictors that could guide Murray County educators to implement effective interventions toward student success was the driving force behind this entire exercise. Students deserved the best opportunities to receive a valid education in public schools. When the analyses were completed and predictors emerged, this researcher breathed a sigh of relief to know that now the important work of serving students could begin.
Before logistic regression could search for predictors, descriptive statistics were used to check for differences in how the individual components of the population scored on the 2008 eighth-grade CRCT mathematics test. In general, the students and demographic groups showed little differences. This detail is very informative to the instructional leaders of Murray County. It was apparent that even though there was a relatively wide diverse group of learners in Murray County, teachers and school staff members did not appear to be showing any bias toward students relative to ethnicity, gender and socioeconomic status. Since this sample showed a great deal of homogeneity, the logistic regression could give feasible predictors.

The first research question asked whether there variables in the 2006 and 2007 CRCT tests that were predictive of performance on the mathematics portion of the eighth grade CRCT in 2008 for all students. The means and standard deviations of the variables found in the 2006 and 2007 data from the CRCT were given in Table 1. These data confirmed for the researcher that scores in mathematics were weak in those two years. The cut score for meeting standards on mathematics on the CRCT was 800. The sixth-grade students scored lower in 2006 (M = 809) on the sixth-grade test than they did in 2007 (M = 817) on the seventh-grade test. Administrators expected those mean scores to be closer to 850. An especially weak domain was Algebra. When Spearman’s rho was applied there were some strong correlations between several of the mathematics variables with an especially high correlation between 2007 seventh-grade mathematics percent correct and 2007 seventh-grade Algebra percent correct. Based on the data output, there were predictors for performance in mathematics on the eighth-grade CRCT. Additionally, when the null hypotheses were checked using a one-way ANOVA, it was
found that there was no difference in the performance on the mathematics portion of the 2008 eighth-grade CRCT based on which school the student attended. That was good information for Murray County Schools. It said that both middle schools were delivering the same level of instruction, differentiation and assessment. It was also a good indicator that students could move within the district and receive consistent instruction in mathematics. There was also no difference in the performance on the mathematics portion of the 2008 eighth-grade CRCT based on gender when the data for all students were analyzed. However, when the data were analyzed for the schools independently, it showed that females at Gladden Middle School performed better than males and the converse was true at Bagley Middle School. Continued studies in the matter would be needed to uncover any bias toward either gender at the two middle schools. It can be noted that Gladden Middle School has had female leadership for the last six years and that Bagley Middle School has had male leadership for its entire history except for one six month period. The performance between ethnic groups showed no difference in performance on the mathematics portion of the 2008 eighth-grade CRCT.

Null hypothesis #1.4, which tested for differences in mathematics performance between socioeconomic groups, was the only one rejected since \( F \) exceeded \( F_{cv} \). The mean scaled score for students paying full price was 806.86 while the mean scaled score for students on free or reduced lunch was 799.33. Generally speaking, this indicated that students from low SES scored on average lower than students from a higher SES in Murray County. This information should be conveyed to all classroom teachers. More importantly, additional ANOVA testing should be performed on earlier grade level
CRCT data to pinpoint the origin of this difference so that the gap between socioeconomic groups can be closed before students reach eighth grade.

Further analyses established that sixth-grade mathematics percent correct, seventh-grade mathematics scaled score and seventh-grade science performance level were the three statistical predictors identified for all students when logistic regression was used. The probability of the model was found to accurately forecast performance at 37% and 49% by two independent tests and at 69.3% by crosstabulation. When the same method was applied to Bagley Middle School data, three predictors emerged: sixth-grade mathematics percent correct, seventh-grade mathematics scaled score and seventh-grade science scaled score. The model generated from these data fit the data very well predicting performance correctly at 82.3%, 80.8% and 81.5%. Gladden Middle School data returned only two predictors, sixth-grade mathematics percent correct and seventh-grade geometry percent correct with a 55.8% probability of predicting failures correctly. These results were warmly received and led to confirmation analyses on the 2009 data. For future students these data can now be an early indicator of potential success or failure in eighth-grade CRCT mathematics.

The second research question sought to check the reliability of the predictors found in the 2008 data against mathematics performance for eighth-grade students in 2009? When the 2009 data were inserted into the model, it was found that the model predicted 64.6% of the students who failed correctly. This was much better information than simply using descriptive statistics or disaggregated data to presume which students could fail the test.
Conclusions

The primary goal for this research was to find reliable predictors for performance on eighth-grade mathematics CRCT for future cohorts of students in Murray County Schools.

1. Upon performing statistical analysis on 2006 and 2007 CRCT data for all students in the two Murray County middle schools, three predictors for mathematics performance emerged. They were sixth-grade mathematics percent correct, seventh-grade mathematics scaled score and seventh-grade science performance level. The sixth-grade mathematics percent correct predictor gives administrators and teachers in Murray County middle schools an early indicator of weak eighth-grade mathematics performance. Administrators must assign students who answered a low percentage of questions correctly in sixth-grade mathematics to teachers who could monitor their progress in seventh grade mathematics and plan effective interventions to strengthen those students’ understanding of mathematics. If the interventions worked, those students would score above a PL1 on the seventh-grade mathematics CRCT. If those same students score in PL1 in seventh-grade mathematics, it could mean that the chosen interventions were not effective and it was now time for other diagnostic assessments to pinpoint individual student needs. Check points and strategies for this process could be developed and tested in the first two to three years following this study.

2. In addition to the predictors for all students, each middle school had its own. The predictors for mathematics performance on the 2008 CRCT found in the 2006 and 2007 CRCT data for students at Bagley Middle School were sixth-grade mathematics
percent correct, seventh-grade mathematics scaled score and seventh-grade science scaled score. The first two predictors at Bagley Middle School were consistent with the findings for all students. This indicates that these predictors could be very helpful in selecting students for interventions or extra instruction in mathematics. This fact validated the importance of providing a list of students who scored poorly on this component of the sixth-grade mathematics CRCT to the seventh-grade mathematics teachers. They could then plan appropriate lessons for delivering the curriculum with an added component of closing the gap on the weaknesses shown for these students on the sixth-grade mathematics test.

3. Two predictors for mathematics performance on the 2008 CRCT emerged from the 2006 and 2007 CRCT data for students at Gladden Middle School, sixth-grade mathematics percent correct and seventh-grade geometry percent correct. Gladden Middle School was more limited on its predictors than Bagley Middle School and may have limited success selecting the right students for intervention. Fortunately, the sixth-grade mathematics percent correct showed up in all three sets of data: all students, Bagley Middle School and Gladden Middle School. The administrators and teachers from both schools could plan interventions together and monitor progress toward improving mathematics scores for these students. However, since the sixth-grade mathematics percent correct component appeared as a predictor for all sets of students, it was important to ascertain that sixth-grade teachers were included in any collaborative meetings so that they could provide insight into potential barriers not visible to seventh-grade teachers.
The second goal for this research was to test the predictors found for Cohort I data on the 2009 CRCT for Cohort II. When the predictors for all students which emerged from the 2008 data were applied to Cohort II student data for 2009, performance on the eighth-grade mathematics 2009 CRCT was correctly predicted at most for 68.2% of the students. Using the same statistical methods for each middle school, analysis showed that mathematics performance for 70.0% of the students in Cohort II at Bagley Middle School and 66.2% of the students in Cohort II at Gladden Middle School could be predicted correctly. Other percentages were found as explained in Chapter 4; however, for this study the researcher chose the crosstabulation that gave the highest percentage. Because this study was the first of its kind in this county, this would be a starting place. As other studies are conducted and administrators apply these methods to future data, different crosstabs may be used. As for the outcome of this study, administrators will be elated that they can be confident, at least to the percentage reported from these findings, in their selection of students who will receive remediation and interventions in seventh and eighth grade mathematics.

**Implications for the Study**

Armed with this information, Murray County administrators could have predicted which students had potential to struggle to meet expectations on the 2009 eighth-grade CRCT mathematics test with 50 to 70% accuracy. This would have been very beneficial and better than their current method where teachers referred students for remediation based primarily upon performance in class and on locally-prepared benchmarks. A student’s success on the eighth-grade test was vital, but a student’s readiness to enter high school on grade level in mathematics was much more important. Table 9 gives a recap of
the predictors generated by the statistics. It validated that sixth-grade mathematics was a predictor for all students combined plus both middle schools individually. Even though this statistic was not the only one, it appeared to be a consistent predictor for all students. It could be used after sixth grade to begin the process of selecting students for remediation before the seventh-grade test.

There was a significant difference in students who received a free or reduced lunch and students who paid full price for lunch and the way they scored on the 2008 eighth-grade mathematics CRCT. Since approximately 71% of students in Murray County were identified on free and reduced lunch, educators needed to consider this population when analyzing data and providing interventions. The education provided to these students, as with all students, should have the same high expectations (Picucci, Brownson, Kahlert, & Sobel, 2004), so effective interventions would give them a chance at equitable educational outcomes. This researcher intended to use this identical method to formulate predictors for students in subgroups such as ELL and students with disabilities. These students lag behind other students daily without immediate intervention or special attention from the teacher. With these tools, educators can know more precisely which subject to assist students in for greater success and better self-efficacy.

All instructional leaders in a school system should learn how to run and interpret the statistical tests that predict with some certainty which students will need additional remediation and intervention prior to taking state standardized tests. With statistical software such as SPSS 17.0, it would be simple to recalculate predictors every two to three years for all subjects and for different subgroups of students. Equipped with such
tools, educators would soon recognize these numerical patterns much like the meteorologist uses weather patterns to make weather forecasts.

This study was one of the first of its kind to be performed in Murray County Schools. It will, undoubtedly, lead to increased student achievement. With professional development opportunities and practice any educator could repeat this study.

It is the goal of this researcher to give every student an equal chance at daily success, yearly progress toward mastery and lifelong fulfillment in an occupation chosen by the student not his/her achievement record in school. The process described in this study can be one step toward equalizing education for all.

**Recommendations for Murray County Schools**

Murray County Schools has seen some success in the past two years, but the limit of their potential has not been met. In order for Murray County Schools to use the findings of this study and increase opportunities for more students to have success, the following recommendations are suggested:

- All practices for classroom instruction and intervention should be authenticated by statistical analyses so that all students receive an equitable education in Murray County Schools. Because simplified statistical packages such as SPSS 17.0 are available, Murray County leaders should become proficient with statistical software and should be able to perform the most common statistical tests used in educational studies.

- Adequate staff development opportunities should be provided for building-level administrators and teachers on how to use software similar to SPSS 17.0 to make decisions for increasing student achievement. In the past in Murray County, most decisions were made by simply looking at the performance level. The practice at the
time of this writing was for administrators and teachers to delve into individual scores
on domains from standardized tests as well as local benchmark tests. In the future,
administrators and teachers should begin to utilize statistical packages such as SPSS
17.0 which gives analyses that are substantiated by statistics.

- Central-level and building-level administrators should monitor activities proposed by
  instructional leaders to ensure that all practitioners in Murray County Schools are
  implementing the current required curriculum and using the results from statistical
  analysis.

- Individuals should be employed or current employees could be trained to disaggregate
data, run statistical analyses on state standardized tests and formulate predictors for all
students and for students identified for the subgroups of English Language Learners
and students with disabilities. Until all intervention is customized for the individual
learner, the work of educators is not complete. Having statisticians on staff can
increase the validity of decision-making when it comes to developing interventions and
making improvements in instruction.

**Recommendations for Further Study**

It has been suggested previously that these kinds of analyses should be performed
on all data results from state standardized tests. This study searched for predictors in
achievement in eighth-grade mathematics. The study looked only at sixth and seventh-
grade data to predict eighth-grade success. Earlier data could be examined to predict
weaknesses for students before they reach fourth or fifth grade. Ultimately, students
reach high school where thoughts of giving up or dropping out are constantly on their
minds. If educators could isolate problems areas for students in the early grades, it would help to make school a learning environment for all students.

All administrators should remain current on the latest brain research especially if that research unveils major breakthroughs that provide physiological explanations for substantiated findings like some revealed by this researcher.

Student success has often been linked to the effectiveness of the teacher. Additional analyses should be performed on teacher combinations over a three-year period in order to find combinations that were not productive for students. If combinations are found, those educators should engage in staff development that would lead to improved instructional practices.
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APPENDICES
Appendix A

ABBREVIATIONS AND ACRONYMS

ACT       Adaptive Control of Thought
AMO       Annual Measurable Objective
ANOVA     ANalysis Of VAriance
AYP       Annual Yearly Progress
CRCT      Criterion-Reference Competency Test
ELL       English Language Learner
IEP       Individual Education Plan
GaDOE     Georgia Department of Education
MCPS      Murray County Public Schools
NAEP      National Assessment of Educational Progress
NCLB      No Child Left Behind Act
NCTM      National Council of Teachers of Mathematics
NMAC      National Mathematics Advisory Council
OLS       Ordinary least squares
PL        Performance Level
RTI       Response to Intervention
SES       Socioeconomic status
SPSS      Statistical Package for the Social Sciences
SSAS      Single Statewide Accountability System
SS        Scaled score
SWD       Students with disabilities
Appendix B

IRB Approval (University of Chattanooga)

MEMORANDUM

TO: Cheryl Thomasson
Dr. Hinsdale Bernard

FROM: Lindsay Pardue, Director of Research Integrity
M. D. Roblyer, IRB Committee Chair

DATE: July 29, 2009

SUBJECT: IRB Application # 09-104: An Investigation into Predictors of Middle School Mathematics Achievement as Measured by the Georgia Criterion-Referenced Competency Tests

The IRB Committee Chair has reviewed and approved your application and assigned you the IRB number listed above. You must include the following approval statement on research materials seen by participants and used in research reports:

The Institutional Review Board of the University of Tennessee at Chattanooga (FWA00004149) has approved this research project # 09-104.

Since your project has been deemed exempt, there is no further action needed on this proposal unless there is a significant change in the project that would require a new review. Changes that affect risk to human subjects would necessitate a new application to the IRB committee immediately.

Please remember to contact the IRB Committee immediately and submit a new project proposal for review if significant changes occur in your research design or in any instruments used in conducting the study. You should also contact the IRB Committee immediately if you encounter any adverse effects during your project that pose a risk to your subjects.

For any additional information, please consult our web page http://www.utc.edu/irb or email us at: instrb@utc.edu.

Best wishes for a successful research project.
VITA

Cheryl Thomasson gained a secretarial certification in 1971 at Draughon’s Business College and worked as a payroll clerk. She was employed in 1975 at the Paducah Union Carbide Gaseous Diffusion plant as a chemical operator and supervisor. She received an Associate of Science from Chattanooga State Technical College in 1981 and a Bachelor of Arts in Biology from the University of Tennessee at Chattanooga in 1986. She was employed by Cobb County Schools in Georgia in 1987 and taught Chemistry, Physical Science, Astronomy, and Meteorology at Lassiter High School in Marietta, Georgia, for twelve years.

She earned a Master of Science Education from West Georgia College in 1996. In 1999 she accepted a teaching position with Walker County Schools and taught Chemistry, Physical Science and Physics for four years at Ridgeland High School in Rossville, Georgia. She earned her Specialist of Education in Instructional Technology from the University of Tennessee at Chattanooga in 2004.

She was named the Science Implementation Coordinator for Region I for the Georgia Department of Education in 2004. In 2005 she was accepted into Cohort I of the University of Tennessee at Chattanooga’s doctoral program in Leadership and Learning. One year later she accepted a position with Murray County Schools as the Director of Secondary Education. In 2008 she retired with 27 years of service from the United States Naval Reserves as a Navy Corpsman Chief. She graduated with her doctorate on December 18, 2010.