GIFTED LEARNERS AND MATHEMATICAL ACHIEVEMENT: AN ANALYSIS OF GIFTED INSTRUCTIONAL MODELS

by
Lezley Barker Anderson
Liberty University

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

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ABSTRACT

The purpose of this causal-comparative study was to examine whether differences exist in the mathematics achievement of fifth grade gifted students based on the instructional delivery model used for mathematics instruction, cluster or collaborative, as defined by the Georgia Department of Education. The content area of mathematics, an area susceptible to underachievement among gifted learners, was investigated using archival data from a sample of 67 participants from rural Southwest Georgia over three academic years. The STAR Math assessment and the Georgia Criterion-Referenced Competency Test (CRCT): Math assessments were used to measure overall mathematics achievement. The subscales on the CRCT were used to measure mathematical proficiency in numbers and operations, measurement, geometry, algebra, and data analysis. A one-way analysis of variance (ANOVA) was used on the data from the STAR Math assessment to analyze mathematics achievement. A multivariate analysis of variance (MANOVA) was used on the scale score data from the CRCT to analyze overall mathematics achievement. Results from the ANOVA on the STAR Math assessment data revealed no significant difference between comparison groups. Results from MANOVA on the CRCT revealed a significant main effect difference on overall mathematics achievement between comparison groups. The posthoc pairwise comparisons revealed significant differences on the subscales of geometry and algebra. No significant differences were found on the subscales of numbers and operations, measurement, and data analysis and probability. Suggestions for further experimental research are included.

Keywords: gifted education, gifted instructional delivery models, gifted underachievement, gifted education in Georgia, collaborative instructional model
Dedication

This dissertation is dedicated to my mother, Gail Barker, and my husband, Wiley Anderson. My mother taught me through example what it means to truly be an educator devoted to meeting the needs of diverse learners. My husband taught me through example what it means to be patient and thankful for all of God’s blessings and trials. I love you both dearly and hope I have made you proud. Thank you for your guidance and grace.
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List of Abbreviations

Adequate Yearly Progress (AYP)
Analysis of Variance (ANOVA)
Annual Measurable Objective (AMO)
Criterion-Referenced Competency Test (CRCT)
Full-Time Equivalent (FTE)
Georgia Association for Gifted Children (GAGC)
Georgia Department of Education (GaDOE)
Georgia Professional Standards Commission (GaPSC)
Gifted and Talented (GT)
Local Education Agency (LEA)
Multivariate Analysis of Variance (MANOVA)
National Assessment of Educational Progress (NAEP)
National Association for Gifted Children (NAGC)
National Commission on Excellence in Education (NCEE)
National Council of Teachers of Mathematics (NCTM)
No Child Left Behind (NCLB)
Organization for Economic and Cooperation Development (OECD)
Regional Educational Service Agency (RESA)
Science, Technology, Engineering, and Mathematics (STEM)
Statistical Package for the Social Sciences (SPSS)
United States Department of Education (USDOE)
CHAPTER ONE: INTRODUCTION

Giftedness has been characterized as the embodiment and exhibition of traits and manifestations of above average aptitude, creative abilities and talents, and task commitment or motivation (Georgia Department of Education, 2012e; Reis, 2005; Renzulli, 1978). The concept of giftedness is in constant development (Gates, 2010), with changes necessary as research investigates and addresses deficiencies and misconceptions. A substantial body of research can be found regarding the foundational principles behind providing education tailored to the needs of gifted students (Mitchell, 2010; Reis & Renzulli, 2009, 2010; Renzulli, 2011).

Alerted to the problem of a national crisis in education in 1983 via the report *A Nation at Risk* (National Commission on Excellence in Education), education researchers have been focused on mathematics achievement in search of best practices for years in an attempt to restore the nation’s previously held position of superiority in global society. Mathematics achievement once again became a national priority with the emphasis on accountability brought about from the No Child Left Behind Act of 2001 (NCLB). In addition to references in the report and the act to deficiencies in mathematics achievement, both federal documents referenced gifted education as well. In the report, gifted achievement was shown to be less than mediocre with students not meeting their potential. In the act, funding was made available to assist in researching best practices in gifted education. However, academic underachievement among gifted students continues to be reported at epidemic proportions (Figg, Rogers, McCormick, & Low, 2012; Winner, 2000), with estimates of up to 50% of gifted students not meeting their academic potential (Morisano & Shore, 2010). Further, experts agree that underachievement
among gifted students in mathematics can be purposeful (O’Boyle, 2008), selective (Figg et al., 2012), due to a lack of appropriate curriculum development (McAllister & Plourde, 2008), and/or due to a lack of motivation or proper level of challenge (Morisano & Shore, 2010; Phillips, 2008).

Research is continually being conducted regarding best practices in gifted education for identification procedures (Gates, 2010; King, Kosleski, & Landsdowne, 2009; Kornilov, Tan, Elliott, Sternberg, & Grigorenko, 2012), program development (Briggs, Reis, & Sullivan, 2008), curriculum development and implementation (Hockett, 2009), instructional methods (Powers, 2008), and a myriad of other topics (Brulles, Saunders, & Cohn, 2010; Foust & Booker, 2007; French, Walker, & Shore, 2011; Housand & Reis, 2008; Lee, Olszewski-Kubilius, & Thomson, 2012; Mingus & Grassl, 1999; Shaunessy, 2007). As the concept of giftedness develops and best practices are identified, there have been numerous studies regarding curriculum delivery models (Adelson, McCoach, & Gavin, 2012; Gavin, Casa, Adelson, Carroll, & Sheffield, 2009; Hockett, 2009; Shawer, Gilmore, & Banks-Joseph, 2008), instructional service models (Beecher, 2010; Eddles-Hirsch, Vialle, Rogers, & McCormick, 2010; Field, 2010), and clustering models (Brulles et al., 2010; Pierce et al., 2011; Teemant, Wink, & Tyra, 2011); however, there has been little, if any, research comparing the differences between clustering models for instructional services in elementary schools as defined by the Georgia Department of Education (GaDOE) (2012e). More research is needed to better understand the impact and effect of the instructional model used to deliver mathematics instruction to gifted learners to determine best practices for enhancing academic achievement and developing interventions for reversing underachievement. The purpose
of this study is to compare the differences between the cluster and collaborative gifted instructional models as defined by the GaDOE on the mathematics achievement of fifth grade gifted students. This chapter will present relevant background information regarding current research and practices in gifted education including those in the state of Georgia, the problem and purpose statements, significance of the study, research questions and corresponding hypotheses, identification of variables, definitions, and research summary.

**Background**

**Research and Practices in Gifted Education**

Gifted education is provided for students identified as having superior aptitude in areas such as motivation, creativity, mental ability, and achievement (Litster & Roberts, 2011). Renzulli (1977) has developed a theory regarding the conception of giftedness, which provides three broad definitions of gifted traits that overlap to identify persons with gifted tendencies. This theory allows for characteristics to be refined over time. Renzulli (2012) stated,

> Giftedness is not viewed as an absolute or fixed state of being (i.e., you have it or you do not have it). Rather, it is viewed as a developmental set of behaviors that can be applied to problem-solving situations. Varying kinds and degrees of gifted behaviors can be developed and displayed in certain people, at certain times, and under certain circumstances. (p. 153)

Other theorists have developed conceptions of giftedness, and research continues to validate current theories. The traits agreed upon by most theorists regarding giftedness
include above-average creativity, motivation, and mental ability. For this study, Renzulli’s theory will be used.

Renzulli (2012) and others have worked to develop curriculum models and instructional strategies to cultivate the exhibition of traits in gifted learners. Among strategies found, clustering of students to receive gifted instruction is very common. Clustering is the grouping of homogenous students to receive services, which can constitute the whole group or a smaller group within a greater heterogeneous environment. The empirical support for clustering has proven its efficacy (Brulles et al., 2010; Pierce et al., 2011; Schroth & Helfer, 2009; Taylor, 2007). The concept of clustering students based on ability is often grounded in Vygotsky’s (1978) sociocultural theory (Koshy, Ernest, & Casey, 2009; Shabani, Khatib, & Ebadi, 2010; Smagorinsky, 2007). Vygotsky’s theory proposes providing learning environments wherein students interact in a social setting and gain knowledge through cultural assimilation. In the social context, peers learn from one another. This theory provides that one’s zone of proximal development allows the completion of tasks independently at the lower end of the zone and with the help of a more capable peer at the higher end. In gifted education this allows gifted learners to work in general education classes with their age peers on tasks with their ability peers. The two theories, Renzulli’s (1977) theory of giftedness and Vygotsky’s (1978) sociocultural theory, intersect to provide the necessity for clustering gifted students for instruction tailored to meet their needs.

Current research includes studies to investigate instructional practices targeting achievement gains in gifted learners through curriculum development (Pierce et al., 2011), curriculum compacting (Linn-Cohen & Hertzog, 2007), acceleration (Lee,
Olszewski-Kubilius, & Peternel, 2010; Steenbergen-Hu & Moon, 2011), enrichment (Linn-Cohen & Hertzog, 2007), learning styles (Slack & Norwich, 2007; Yildirim, Acar, Bull, & Sevinc, 2008), teacher perceptions (Elhoweris, 2008; McCoach & Siegle, 2007), professional development (Maynes, Julien-Schultz, & Dunn, 2010; Teement, Wink & Tyra, 2011), and instructional models (VanTassel-Baska & Brown, 2007). These studies provide empirical evidence that gifted students perform best when clustered to receive instruction and when instruction is tailored to meet their needs. Tailoring mathematics instruction to meet the unique needs of gifted learners can develop students with mathematical promise, promote mathematical courage, and assist learners in realizing mathematical potential (Leikin, 2011).

Although studies have been conducted regarding gifted instructional models, including cluster models (Brulles et al., 2010; Pierce et al., 2011) and instructional practices for gifted students in the area of mathematics (Koshy et al., 2009), no study has been uncovered in the review of present literature that determined the effects of a full academic year’s scope and sequence of mathematics curriculum instruction planned by gifted-endorsed teachers, known as gifted specialists, and implemented by general education teachers. This study intended to build upon previous research to extend the existing knowledge in the area of gifted instructional models by determining whether a difference exists in mathematics achievement of gifted learners based on the model of instruction implemented, cluster or collaborative as defined by the GaDOE (2012a).

**Gifted Education in Georgia**

In 1958, the state of Georgia was the first to pass legislation recognizing the need for gifted education (H.R. 246) and subsequent funding for development of programs to
meet the needs of gifted learners. Once gifted education became mandated for all schools in the state, policies were established for program implementation. As a result, the GaDOE created a policy manual with guidelines and requirements for program implementation (GaDOE, Georgia Association for Gifted Children, n. d.). Included in the policy are definitions of what constitutes gifted education, how it can be implemented, including the instructional models used at all grade levels, and the corresponding structures for program funding based on the instructional models. The funding structure allocates additional funds per pupil for segments of instruction tailored for gifted students (GaDOE, 2012e). These segments must be tailored for a cluster of gifted students by a teacher with gifted endorsement on his/her teacher certification (GaDOE, 2012a).

A gifted endorsement requires a teacher to obtain additional professional development in the area of gifted education (Georgia Professional Standards Commission, 2012). This professional development provides training in characteristics, assessment, strategies and materials, and program and curriculum development specialized for gifted learners. The presence or absence of a gifted endorsement on an educator’s certification is the distinguishing factor between the elementary level instructional models defined in Georgia’s gifted education policy and the role of the gifted education specialist in the instructional process within those models (GaDOE, 2012e).

In the cluster model, the teacher providing instruction has obtained additional training specialized in meeting the needs of gifted learners; therefore, the direct instruction to clusters of gifted learners is provided by a gifted-endorsed teacher.
(GaDOE, 2012e). Two segments of the instructional day served through the cluster model can be claimed for additional funding through the funding structure allowed by the state of Georgia (GaDOE, 2012a). In the collaborative model, the teacher planning lessons has obtained additional training specialized in meeting the needs of gifted learners. This teacher plans lessons and collaborates with the general education teacher delivering the actual face-to-face instruction to provide for the unique needs of the gifted learner (GaDOE, 2012e). Therefore, the gifted-endorsed teacher provides indirect service to clusters of gifted learners through the collaborative model. Six segments of the instructional day served through the collaborative model can be claimed for additional funding through the funding structure allowed by the state of Georgia (GaDOE, 2012a). The funding structure is disproportional in its allowance of segments to be funded per model. This is counterintuitive when considering the nature of the instruction, whether direct or indirect, and the level of expertise gifted specialists obtain when procuring a gifted endorsement. Substantiation of current practices is warranted.

Renzulli’s (1977, 2012) theory of giftedness indicates that giftedness can be developed and refined over time, and an enriching environment can stimulate gifted traits and encourage achievement. Further, Vygotsky’s (1978) sociocultural theory indicates that students develop in a cultural context and within a zone of proximal development wherein they learn more challenging concepts with the help of more capable peers. The social context and collaboration with peers encourages achievement. Considering the GaDOE’s requirement of gifted-endorsed teachers to engage in intensive professional learning specialized to meeting the educational needs of gifted learners, the cluster model is more conducive to providing an enriching environment to stimulate gifted traits in a
cultural context. This implies that the cluster model when compared to the collaborative model may result in higher student achievement among gifted learners. Therefore, mathematics instruction in the cluster model can be expected to increase mathematics achievement among gifted learners.

**Problem Statement**

The current body of research includes studies to validate the practices of clustering students (Brulles et al., 2010; Pierce et al., 2011; Teement et al., 2011), as prescribed by Vygotsky’s (1978) theory and studies to validate the practices of tailoring instruction to develop the traits of giftedness (Field, 2010; Kanevsky, 2011; Reis & Renzulli, 2010), as prescribed by Renzulli’s (1977, 2011, 2012) theory. The problem is underachievement in mathematics is pervasive and gifted underachievement in general is at epidemic proportions (Figg et al., 2012; Morisano & Shore, 2010). Teachers need to know best practices for addressing gifted underachievement in mathematics in order to address current trends in education (Leikin, 2011).

Using the instructional models approved for implementation in elementary gifted education in Georgia, this study sought to build upon existing research to address the content area of concern for underachievement, mathematics. Studies exist validating the practice of tailoring instruction to meet the mathematical needs of gifted students (McAllister & Plourde, 2008; O’Boyle, 2008). It has been proven with positive correlation that professional development of teachers increases student achievement of gifted learners (Azano et al., 2011); however, a paucity of studies exists to validate the implementation of the GaDOE’s collaborative instructional model for elementary grades, which requires no professional development of the direct instruction provider. Therefore,
using archival data from assessments given to gifted learners receiving gifted education services through one of the instructional models, cluster or collaborative, for the content area of mathematics, this study was designed to address this gap in the body of knowledge.

**Purpose Statement**

The purpose of this causal comparative study is to determine if the gifted education instructional model used to give mathematics instruction showed a difference in the mathematics achievement of fifth grade students at an elementary school in Southwest Georgia when comparing the cluster and collaborative models. The independent variable was the gifted instructional model used to deliver mathematics instruction to clusters of gifted students in groups of no more than eight in a general classroom setting and had two levels. The first level of the independent variable was the cluster gifted instructional model that was given by a teacher with a gifted endorsement on his/her teacher certification, meaning he/she has received specialized training for gifted learners and gave direct instruction to clusters of gifted students. The second level of the independent variable was the collaborative gifted instructional model that was given by a general education teacher who has collaborated with a gifted-endorsed teacher who planned the lesson thereby giving indirect service to clusters of no more than eight gifted students.

The dependent variable was generally defined as mathematics achievement, a continuous variable reported as the scale scores measured by the STAR Math assessment (Renaissance Learning, 2009) and the Georgia Criterion-Referenced Competency Test (CRCT): Grade 5 Math assessment (GaDOE, 2010c, 2011d, 2012d). The researcher
compared the scores on these assessments for students served in the cluster model to students served in the collaborative model.

The covariate was generally defined as previous mathematics achievement, a continuous variable reported as the scale score as measured by the STAR Math assessment pretest, (Renaissance Learning, 2009) and the Georgia CRCT: Grade 4 Math assessment (GaDOE, 2009c, 2010b, 2011c).

**Significance of the Study**

The findings of this study provided empirical data to gifted education providers and program implementers regarding the significance of the differences between the cluster and collaborative gifted instructional models as defined by the GaDOE on the mathematics achievement of fifth graders. The results also gave evidence concerning whether further studies should be conducted to determine if the cluster gifted instructional model yields significantly different student achievement in mathematics, as the principles of Vygotsky’s (1978) sociocultural theory and Renzulli’s (2012) theory of the conception of giftedness would converge to suggest.

Examining ways to reverse mathematics underachievement among gifted learners and determining best practices in gifted education is vital to addressing the unique needs of gifted learners and ensuring the provision for social capital (Renzulli, 2012) in the future. As Jarrell and Borland (1990) noted, it is imperative that all conceptions of giftedness be given rigorous testing before using them to guide instruction. Insomuch, Figg, Rogers, McCormick, and Low (2012) empirically tested Delisle’s theory of underachievement among gifted students (as cited in Figg et al., 2012, p. 54). The current study is situated among others here to help gifted education program
implementers determine if providing an environment where gifted traits are fostered actually shows an increase in student achievement in mathematics, as Renzulli’s theory of giftedness suggests. Further, McAllister and Plourde (2008) defined mathematically gifted students and specified that a differentiated curriculum is needed for success in a regular classroom. Leikin (2011) agreed and presented a review of studies with corresponding findings and suggestions for future research, including, “In the [sic] light of the debate on ability grouping the following question demands careful and systematic investigation: What type of ability grouping is the most effective for mathematically gifted students?” (p. 180). As suggested by McAllister and Plourde and in response to Leikin’s admonishment, this study also helps gifted education specialists determine if there is evidence to suggest clustering gifted students for direct mathematics instruction from a gifted education specialist trained to differentiate curriculum for gifted learners really promotes student achievement within a social context as Vygotsky’s (1978) sociocultural theory implies. Due to the pre-experimental nature of the causal comparative design, at the very least this study is significant in collecting information for a more systematic experimental study (Campbell & Stanley, 1963).

**Research Questions**

The following research questions were examined in the study.

**Research Question One:** What is the difference in mathematics achievement as measured by the STAR Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement?
Research Question Two: What is the difference in mathematics achievement as measured by the CRCT Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement?

Null Hypotheses

The following null hypotheses were provided for the study.

Null hypothesis corresponding with Research Question One:

\( H_{01} \): There is no statistically significant difference in mathematics achievement as measured by the STAR Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement.

Null hypotheses corresponding with Research Question Two:

\( H_{02} \): There is no statistically significant difference in overall mathematics achievement as measured by the CRCT Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement.

\( H_{03} \): There is no statistically significant difference in mathematical competency in numbers and operations as measured by the CRCT Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement.
cluster instructional model while controlling for previous mathematics achievement.

H_{04}: There is no statistically significant difference in mathematical competency in measurement as measured by the CRCT Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement.

H_{05}: There is no statistically significant difference in mathematical competency in geometry as measured by the CRCT Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement.

H_{06}: There is no statistically significant difference in mathematical competency in algebra as measured by the CRCT Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement.

H_{07}: There is no statistically significant difference in mathematical competency in data analysis and probability as measured by the CRCT Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement.
Identification of Variables

The independent variable in this study is operationally defined as the gifted instructional model used to teach fifth grade mathematics wherein instruction is given to clusters of no more than eight students identified as gifted within a regular classroom setting. There are two levels of this variable, the cluster model and the collaborative model. Through the cluster model, direct instruction is given by a teacher with a gifted endorsement on his/her teacher certification (GaDOE, 2012a). Through the collaborative model indirect instructional service is given by a gifted-endorsed teacher. In the collaborative model, the gifted-endorsed teacher plans instruction and collaborates with the general education teacher who delivers the instruction (GaDOE).

The dependent variable in this study is operationally defined as the mathematics achievement of gifted students as measured by the STAR Math assessment (Renaissance Learning, 2009) scale score and the CRCT Math assessment (GaDOE, 2009c, 2010b, 2010c, 2011c, 2011d, 2012d) scale score and subscale scores. This continuous variable is a numerical measure reported on each assessment separately. The STAR Math assessment is a computer adaptive software that assesses “general math achievement within 54 skill sets in four broad domains: numbers and operations, algebra, geometry and measurement, [and] data analysis, statistics, and probability” (Renaissance Learning, 2012a, p. 49) using selected response. In order to establish equality of groups, data from the STAR Math assessment pretest was examined as a covariate known as previous achievement in data analysis. The CRCT Math assessment is a criterion-referenced test designed to assess student mastery of the Georgia Performance Mathematics Standards. This assessment uses selected response to assess achievement in five domains: numbers
and operations, measurement, geometry, algebra, and data analysis and probability and provides a composite scale score and subscale scores for each domain (GaDOE, 2012c). The five domains on the CRCT Math assessment are known as subscales that are also dependent variables in this study. The subscales assess mathematical competency and are numerical measures. In order to establish equality of groups, data from the previous academic year’s CRCT Math assessment was examined as a covariate known as previous achievement in data analysis.

**Definitions of Terms**

*Advanced Content Gifted Instructional Model:* The model of gifted instruction planned and delivered by a gifted-endorsed teacher to a cluster of gifted students in a homogeneous setting with other high-ability learners. Instructional strategies, tasks, and lesson plans are modified to meet the specific needs of gifted learners to include higher order thinking skills and enrichment beyond the typical curriculum requirements (GaDOE, 2012a).

*Algebra:* The domain specific to the fourth and fifth grade Georgia Performance Standards for mathematics referring to proficiency in understanding and the ability of representing mathematical relationships to solve problems. The progression from using expressions representing mathematical relationships between quantities to expressions using variables (GaDOE, 2009b, p. 25 & 31). Competency in this domain is measured with the algebra subscale on the Georgia CRCT Math assessment.

*Cluster Gifted Instructional Model:* The model of gifted instruction planned and delivered by a gifted-endorsed teacher to a cluster of gifted students in a regular
classroom setting (GaDOE, 2012e). Instructional strategies and tasks are modified to meet the specific needs of gifted learners (GaDOE).

**Collaborative Gifted Instructional Model:** The model of gifted instruction planned by a gifted-endorsed teacher and delivered by a general education teacher (GaDOE, 2012e). The model requires extensive documentation of fidelity of implementation and requires the gifted-endorsed and general education teachers to meet to collaborate regarding the instruction to gifted students (GaDOE, 2012a). The students are served as a cluster in a regular classroom setting. Instructional strategies and tasks are modified to meet the specific needs of gifted learners (GaDOE, 2012e).

**Curriculum Model:** The model used to define content for instruction (VanTassel-Baska & Brown, 2007). This is in addition to and separate from the state-mandated curriculum.

**Georgia Criterion-Referenced Competency Test (CRCT):** An assessment required by law to be given at the end of each school year in the state of Georgia for grades 3 through 8 in all content areas. This assessment determines student achievement in domains matching those in the Georgia Performance Standards. Scale scores are reported along with corresponding performance levels which determine promotion or retention for the following school year (GaDOE, 2012c). Subscales are reported corresponding with the domains from the Georgia Performance Standards.

**Data Analysis and Probability:** The domain specific to the fourth and fifth grade Georgia Performance Standards for mathematics referring to proficiency in creating graphs through gathering and organizing data, comparing features of graphs, and interpreting data displayed in graphs (GaDOE, 2009b, p. 26 & 32). Competency in this domain is
measured with the data analysis and probability subscale on the Georgia CRCT Math assessment.

**Geometry:** The domain specific to the fourth and fifth grade Georgia Performance Standards for mathematics referring to proficiency in understanding and skill of building plane and solid geometric figures, and the ability to graph points on the coordinate plane (GaDOE, 2009b, p. 24 & 30). Competency in this domain is measured with the geometry subscale on the Georgia CRCT: Math assessment.

**Georgia Rural Elementary School:** The pseudonym used in this study for the setting.

**Georgia Rural School District:** The pseudonym used in this study for the school district in which the study is situated.

**Gifted Endorsement:** The addition of documentation on a teacher’s certificate issued through the Professional Standards Commission (Georgia Professional Standards Commission, 2012) to certify that a teacher has received additional training in the area of gifted education, specifically characteristics, assessment, strategies and materials, and program and curriculum development. This training is equivalent to approximately one year’s worth of classes beyond the requirements of general education teachers regarding gifted education. Teachers delivering the cluster and resource models and planning for the collaborative model must have this endorsement for the instructional segment to be coded in the student information system to receive additional funding for the following school year.

**Giftedness:** Traits possessed by students showing abilities beyond the levels of their peers in achievement, motivation, creativity, and mental ability. The GaDOE (2012f) defines a gifted student as one
who demonstrates a high degree of intellectual and/or creative ability(ies),
exhibits an exceptionally high degree of motivation, and/or excels in specific
academic fields, and who needs special instruction and/or special ancillary
services to achieve at levels commensurate with his or her ability(ies). (para. 2)

*Instructional Model:* The model used to deliver instruction. Instructional models reflect
program and policy requirements and integrate strategies designed for specific
instructional practices. In Georgia, there are four approved instructional models for
gifted education in elementary schools: cluster, collaborative, resource, and advanced
content (GaDOE, 2012a).

*Mathematics Achievement:* Gains in knowledge in the content area of mathematics by
students as measured by an outcome assessment (Koshy et al., 2009).

*Mathematical Competency:* The skills and knowledge acquired in a specific domain
described in the Georgia Performance Standards for Mathematics.

*Mathematics Curriculum:* The curriculum prescribed by the GaDOE (2008) for students
requiring mastery by the end of the grade level, known as the Georgia Performance
Standards. This curriculum is divided into five domains: numbers and operations,
measurement, geometry, algebra, and data analysis and probability. These domains
 correspond with the subscales on the CRCT and are consistent from fourth to fifth grades.

*Measurement:* The domain specific to the fourth and fifth grade Georgia Performance
Standards for mathematics referring to proficiency in measuring angles which progresses
to measuring capacity, volume of simple geometric solids, and area of geometric plane
figures. The progression from using metric and standard units of measurement to
proficiency in converting unit measures from one to another within a system (GaDOE,
2009b, p. 23 & 29). Competency in this domain is measured with the measurement subscale on the Georgia CRCT Math assessment.

*Numbers and Operations:* The domain specific to the fourth and fifth grade Georgia Performance Standards for mathematics referring to proficiency in understanding and using whole numbers to solve problems, showing mastery of the four basic operations and rounding. The progression from whole numbers continues to proficiency in understanding and using fractions and decimals to solve problems, showing mastery of using common fractions and decimals in computation (GaDOE, 2009b, p. 22 & 28). Competency in this domain is measured with the numbers and operations subscale on the Georgia CRCT Math assessment.

*Regional Educational Service Agency (RESA):* Service agencies with organizations of experts throughout the state of Georgia with the mission of meeting the professional development needs of Georgia educators (GaDOE, 2012g). These agencies are able to deliver the professional development necessary to receive a gifted endorsement.

*Resource Gifted Instructional Model:* The model of gifted instruction planned and delivered by a gifted-endorsed teacher to a cluster of gifted students in a pull-out setting. Instructional strategies, tasks, and lesson plans are modified to meet the specific needs of gifted learners to include higher order thinking skills and enrichment beyond the typical curriculum requirements (GaDOE, 2012a).

*STAR Math Assessment:* An assessment using adaptive technology to assign criterion and norm referenced scores to students’ performances in mathematics (Renaissance Learning, 2012c). This assessment measures mathematics achievement based on growth from pretest to posttest.
Zone of Proximal Development: The zone defined through Vygotsky’s (1978) sociocultural theory prescribing the range of a learner’s abilities. Tasks planned at the lower end of the zone can be completed accurately without assistance (Koshy et al., 2009). Tasks planned at the higher end of the zone can be completed accurately but require the assistance of an adult or more capable peer (Koshy et al.).

Research Summary

This study was conducted examining archival data using an ex-post facto design. Stebbins (2001) provided that exploratory research is appropriate when phenomena have not otherwise been researched or are in the broad nonspecialized stages of research. This area of gifted education research has a dearth of representation in the current body of knowledge; therefore, exploratory research is appropriate. Using this pre-experimental design was appropriate in this study because the independent variable was manipulated prior to the study and randomization of groups was not possible (Campbell & Stanley, 1963). Since archival data exists, possible causation of achievement differences can be made using statistical analysis (Gall, Gall, & Borg, 2007).

The participants were given the CRCT: Grade 4 Math (GaDOE, 2009c, 2010b, 2011c) assessment at the end of the previous academic year to measure levels of mathematical proficiency in the domains of numbers and operations, measurement, geometry, algebra, and data analysis and probability and overall mathematics achievement to establish prior knowledge. The participants were given the STAR Math (Renaissance Learning, 2009) assessment at the beginning of the fifth grade academic year as a pretest to measure prior knowledge in overall mathematics achievement. The comparison groups spent an equivalent amount of time receiving mathematics instruction
in the fifth grade curriculum prescribed by the Georgia Performance Standards following
the same sequence, but the gifted instructional model differed, that being either the
cluster or collaborative. At the end of the fifth grade academic year, the participants were
given the STAR Math assessment again as a posttest. In addition, the participants took
the CRCT: Grade 5 Math (GaDOE, 2010c, 2011d, 2012d) assessment to measure the
levels of mathematics competency regarding the fifth grade mathematics Georgia
Performance Standards in the domains of numbers and operations, measurement,
geometry, algebra, and data analysis and probability and overall mathematics
achievement (GaDOE, 2012c).

Prior achievement on both instruments was examined as a covariate to establish
equality of groups and control for the selection threat to validity in analyses to help attain
equivalent groups, which “provides a post hoc method of matching groups on such
variables as age, aptitude, prior education, socioeconomic class, or a measure of
performance” (Gall et al., 2007, p. 321). A one-way analysis of variance (ANOVA) was
used to analyze overall mathematics achievement on the posttest data from the STAR
Math assessment. A one-way multivariate analysis of variance (MANOVA) was used to
analyze overall mathematics achievement on the CRCT and posthoc pairwise
comparisons of the subscale scores were used to analyze mathematical competency in the
areas of numbers and operations, measurement, geometry, algebra, and data analysis and
probability.
CHAPTER TWO: REVIEW OF THE LITERATURE

In this chapter, discussion will be presented regarding the theoretical framework used in this study. A general overview of the challenges in gifted education will be offered, and the effect of underachievement on gifted learners’ performance in mathematics will portray the current body of knowledge. Examining how gifted education is provided in the state of Georgia, including how approaches in gifted education inform achievement in the instruction of mathematics, establishes the need for the present study.

Theoretical Framework

Renzulli’s Theory of Giftedness

The theory of giftedness includes the conception of gifted traits in various areas including characteristics and aptitudes manifesting in achievement, creativity, effort, motivation, and talent. Renzulli (1976, 1977, 1978, 1986, 1998, 2002, 2005, 2011, 2012) has developed a theory of giftedness over many years of research with a synthesis of four subtheories. Foundational to Renzulli’s theory is the recognition that

Giftedness is not a state of being, it is not fixed, and it does not reside in a chosen few over their lifetimes as a fixed entity. It is rather developmental – in some children and adults with high potential, at certain times, under certain circumstances, and with appropriate levels of support, time, effort, and personal investments and choices. (Reis & Renzulli, 2009, p. 235)

The first subtheory in the theory of giftedness is the three-ring conception of giftedness, which includes three overlapping areas in the middle of which gifted potential is
embodied. These three areas, or rings, are clusters of traits (Renzulli, 2011) including above average ability, task commitment, and creativity (see Figure 1).

In the above average ability cluster, traditional intellectual traits are seen as constant in general and specific domains (Renzulli, 2011). In the task commitment cluster, focused motivation is seen as consistent (Renzulli). In the creativity cluster, original approaches are common (Renzulli). These three rings of trait clusters converge to create the conception of giftedness, which Renzulli theorizes is an interaction of the traits that can be developed and displayed in different people at different times (p. 153).

The second of Renzulli’s (2012) subtheories in the theory of giftedness is the enrichment triad model, which is the prescribed stimulation of gifted traits to allow the convergence of the three rings of giftedness. This prescriptive environment provides activities that are investigative and creative in nature (Renzulli, 1977). Specifically, the activities should follow these guidelines:

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First, there is a personalization of the topic or problem—students are doing the work because they want to. Second, students are using methods of investigation or creative production that approximate the modus operandi of the practicing professional, even if the methodology is at a more junior level than that used by adult researchers, film makers, or business entrepreneurs. Third, the work is always geared toward the production of a product or service intended to have an impact on a particular audience. (Renzulli, 2012, p. 154)

The enrichment triad model is specifically regulatory about how the three types of enrichment should interact and flow from one to the other in order to optimize conditions for the convergence of the three rings or clusters described in the first subtheory (Renzulli, 2011).

Renzulli’s (2011) third subtheory in the theory of giftedness has been termed Operation Houndstooth (Renzulli, 2012). This subtheory acknowledges the potential of gifted education to promote social capital through intervention “to infuse into the overall process of schooling experiences that promote the Houndstooth components and that ultimately give highly able young people a sense of their responsibility to society at large” (Renzulli, 2012, p. 156). These components include “the development of wisdom and a satisfying lifestyle that are paralleled by concerns for diversity, balance, harmony, and proportion in all the choices and decisions that young people make in the process of maturing” (Renzulli, 2012, p. 156). Renzulli theorized that offering experiences for gifted students to realize the responsibility to society their giftedness inherently brings to them, they will learn to appreciate their abilities as they use them for the common good.
Closely related to the third subtheory, the final subtheory in Renzulli’s (2012) theory of giftedness, is known as executive functions, which is defined as “the ability to engage in novel situations that require planning, decision making, troubleshooting, and compassionate and ethical leadership that is not dependent on routine or well-rehearsed responses to challenging combinations of conditions” (p. 156). This subtheory suggests curricular experiences through which leadership traits can be developed to give students opportunities to grapple with situations in which their giftedness can be utilized to overcome problem solving experiences. This allows students to internalize leadership skills that can be used to promote change in greater society. Renzulli’s four subtheories combine to form the entirety of the theory of giftedness, which is predicated on the belief that giftedness is a combination of traits that can be developed using focused strategies and situational provisions (Reis & Renzulli, 2009 & 2010). Providing the framework for the current study, Renzulli’s theory is the basis for tailoring education to stimulate development of gifted traits, such as motivation, achievement, creativity, and talent, among gifted learners. These practices are provided in the settings of the gifted instructional models being studied.

**Vygotsky’s Sociocultural Theory**

Vygotsky (1978) pioneered the development of the sociocultural theory. This theory examines the basis for social contexts in cultural development. Specifically, Vygotsky theorized that children create cognitive tools to accept and understand cultural content. Contextualizing the theory in an instructional situation, Kozulin (2003) provided that “the situation of the multicultural classroom can thus be operationalized as a copresence of different systems of psychological tools, and educational integration as a
problem of acquisition by students…of new systems of psychological tools” (p. 16). Such tools can be general or more domain-specific (Kozulin). Providing this cultural context to develop cognitively is the basis for utilizing the theory in a classroom. In this framework, students are developed through situations of interaction with new skills they conceptualize as tools in their culture (Shabani et al., 2010). This awareness is cultivated through assimilation of meaning as cognitive processes become internalized (Smagorinsky, 2007). Internalization requires the ability to manipulate new skills within one’s potential (Kozulin). Vygotsky (1978) believed that such an internalization of “culturally produced sign systems brings about behavior transformations and forms the bridge between early and later forms of individual development” (p. 7). This provides the basis for the concept of the zone of proximal development.

The zone of proximal development is often cited in educational research and in studies as the sociocultural theory continues to develop over time (Louis, 2009). Vygotsky’s (1978) definition of the zone of proximal development is “the distance between the actual developmental level as determined by independent problem solving under adult guidance or in collaboration with more capable peers” (p. 86). This collaboration with peers is what Smagorinsky (2007) termed the social nature of learning, “the process is (at least) two way: people’s thinking shapes their physical and symbolic worlds and their engagement with those worlds in turn shapes how they (and others) think” (p. 62).

Employing the zone of proximal development as the basis for tailoring instructional practices for homogeneous ability grouped students supports another portion of the framework for the current study. Additionally, Vygotsky’s (1978) sociocultural
theory provides the impetus for offering a social learning environment in which gifted instruction is delivered to clusters of gifted students. As Young, Worrell, and Gabelko (2011) found, using the conceptions learned in social environments establishes the prior knowledge needed to scaffold more advanced mathematical concepts in future courses, with such prior knowledge providing a significant predictor for future mathematics achievement. Using Renzulli’s (Reis & Renzulli, 2009 & 2010) focused strategies for developing giftedness and situational provisions to create environments with enriching lessons where students are able to develop in social contexts allowing gifted learners to internalize new information, as Vygotsky’s (1978) conceptualization of cultural development suggests, an intersection of the two theories converge to provide the theoretical framework of this study.

**Gifted Education**

Instruction tailored to meet the needs of learners by grouping based upon ability dates back to 1868 (National Association for Gifted Children, 2008). Even then exceptionalities were seen by educators as needing extra attention for full development and prompting toward meeting potential. Gifted education is the specialized education tailored to meet needs of learners identified as having gifted traits. Such specialized instruction is often at a faster pace and a more rigorous depth of knowledge than its general education counterpart. Education of the gifted learner in a specialized program is not federally mandated, as is the case with special education. This, among many other issues, challenges the ability of educators to meet the unique needs of the gifted learner.
Challenges in Gifted Education

Challenges in gifted education begin with the very definition of the term \textit{giftedness}, as theorists and researchers vary on any one specific if even broad definition. Perhaps this inability of experts to agree on what it means to “be gifted,” exacerbates the misperceptions and misconceptions of general educators on the subject of who gifted learners are, what they can do and the specialized attention they need to fully develop their potential. Without a federal mandate to require gifted education, students with above-average abilities are not guaranteed an education commensurate with their needs. This is in bold contrast to students with disabilities, another group of students that also needs specialized attention in order to fully develop their potential, but for another reason, often due to incapacity or some difficulty causing a propensity toward deficiency in academic achievement that is beyond their control. These students are guaranteed an education specialized to meet those needs through federal mandate, the Individuals with Disabilities Education Act of 2004, along with which federal funding supports program implementation.

Beyond varied definitions of giftedness, inabilities of general education teachers to identify gifted learners, and insufficient public policies for educational provisions, other challenges faced by gifted education include the lack of professional development required of general education teachers to become familiar with the needs of gifted learners. Students with multiple intelligences or different learning styles pose challenges to teachers ill-equipped to meet their academic needs. Professional development is needed to teach educators how to focus student effort on mastery of objectives instead of on performance goals (Burney, 2008), which high ability learners are usually able to meet.
with ease and can therefore mask an underlying difficulty in mastering the depth of knowledge needed to truly master curricular standards. Determining ways to address these challenges is important to helping gifted students in the absence of federal assistance. Teachers need more evidence-based research to validate current interventions in order to provide best practices for addressing challenges in gifted education (Parker, Jordan, Kirk, Aspiranti, & Bain, 2010).

**Addressing Challenges in Gifted Education**

Providing a free and equitable education is the premise of the American public education system. Addressing the current challenges in the field of gifted education is crucial if meeting the needs of the highest-ability learners is to be considered equitable in comparison to their less able peers. Currently, the body of research in gifted education shows a myriad of definitions of giftedness. Determining one specific definition will most likely never happen; however, establishing one upon which to build an academic program is essential, especially in light of the development of identification procedures. Many states have responded to the lack in federal gifted education policy with state mandates and accompanying requirements for funding. In their analysis of five states’ gifted education policies, Brown, Avery, VanTassel-Baska, Worley, and Stanbaugh (2006), noted the challenges brought about from varied legislation due to state-level policies. For example, “the variance of policies makes national reform in gifted education less cohesive, comprehensive, and inclusive” (p. 12). This is important because “knowing what works and what does not is crucial for states in exercising both quality control of programs and services and developing new initiatives” (p. 22).
Nearly all of the challenges in gifted education can be addressed with professional development of educators, whether general educators or gifted education specialists. Using this platform, general educators can clarify misconceptions and recognize misperceptions regarding identification procedures, manifestations of gifted traits, and other academic and affective needs of gifted learners. Additionally, addressing curriculum development and instructional strategies can be conveyed through professional development opportunities. Specific needs for professional development have been addressed in the literature. Burney (2008) noted that professional development for teachers of gifted students should increase with the number of gifted students they serve. Such training provides the pedagogical foundation upon which to build and promotes the likelihood of modifying instructional practices to meet the needs of gifted learners (e.g., differentiated activities, enrichment exercises, expectations for mastery, and student engagement). Rogers (2007) suggested that the “obvious key to success lies in the comprehensiveness and efficacy of gifted education training provided to regular classroom and GT [gifted and talented] resource teachers” (p. 392). Specializing instruction to meet the needs of gifted learners is important for creating optimal conditions for academic achievement, otherwise they are just as susceptible as general education students to underachieve. The importance of professional development in how to provide such specialized instruction cannot be understated.

**Underachievement**

Underachievement is the lack of academic performance in comparison to mastery of standards and attainment of knowledge of content matter taught. There are many manifestations of general academic underachievement. Unfortunately, most learners’
underachievement is measured in cumulative comparisons and interventions are not made until subsequent academic years, creating further divides between same aged peers and personal potential. The problem of underachievement is not new and researchers and practitioners’ attempts to address it continue as the pervasive problem has manifested despite efforts to the contrary over time.

**A National Predicament**

The prosperity of the national public education system has been in peril for many years. As compared to the global society, the United States no longer ranks highest in any content area. In the 2011 report commissioned by the United States Department of Education (USDOE) from the National Center for Education Statistics entitled *The Condition of Education 2011* (Aud, et al., 2011), statistical analyses compared the mathematical literacy of students in the United States to their counterparts in 65 countries and other education systems including the world’s most advanced economies. Members of the systems include 34 countries in the Organization for Economic Cooperation and Development (OECD).

The average U.S. mathematics literacy score (487) in 2009 was lower than the average score of the 34 OECD countries (496). In comparison with students in all 64 other countries and education systems, students in the United States on average scored lower than students in 23 (17 OECD countries, 2 non-OECD countries, and 4 other education systems) and higher than students in 29 (5 OECD countries, 23 non-OECD countries, and 1 other education system). No measurable difference was found between the average U.S. mathematics literacy scores in
2009 (487) and 2003 (483)…. In both years, the U.S. average score was lower than the OECD average score. (p. 54)

These performances came after the 2008 report commissioned by the USDOE entitled Foundations for Success: The Final Report of the National Mathematics Advisory Panel noting that although most commentary regarding mathematics focused on economic competitiveness and well-being, it was not the only cause for concern (National Mathematics Advisory Panel). Even more fundamental was the issue of national security and the quality of life when considering the underperformance and lack of competitiveness brought about from the mathematical illiteracy of the nation (p. 1).

The trend of underperformance of American students in the area of mathematics has continued for some time and advancements to address the concerns stemming from it have made slight progression over many years of reporting statistical declines.

A Nation at Risk report. In 1983 the National Commission on Excellence in Education (NCEE) published its report entitled A Nation at Risk, culminating an 18-month investigation on the quality of education in the United States in ultimate response to concerns presented by the public at large. At that time, the Commission noted that the general public education system was mediocre, with low expectations and high levels of underachievement. The areas specifically noted with deficiencies included mathematics in all areas of the findings: content, expectations, time, and teaching. Notable even then was the lack of professional development of teachers to provide mathematics education. Further, there was also reference to inferior performance of gifted students and the disparity between the achievement of gifted learners on achievement assessments compared to academic performance in courses. The lack of professional development
was echoed again in the National Mathematics Advisory Panel’s final report (2008), using very similar verbiage regarding the lack of preparation educators have to provide adequate instruction in the area of mathematics. As a review of the progress made since the NCEE (1983) report, the USDOE published a report entitled *A Nation Accountable: Twenty-Five Years After A Nation at Risk* (2008). Disturbingly, the findings reported the nation was at greater risk than when the original report was published. Reference was again made to the importance of effective teachers and it was clearly noted that “we do not yet know as much as we would like about how to develop these great teachers or the best way to allocate our teaching resources to do the most good” (USDOE, 2008, p. 14). The USDOE also pointed out that accountability procedures brought about by the legislation of the No Child Left Behind Act of 2001 (NCLB) were beginning to serve the purpose of data collection for identifying and addressing weaknesses in student performance in general and schools in particular.

**No Child Left Behind Act.** The NCLB Act of 2001 reenacted the law providing equitable public education. Unlike reenactments before it, this version added an accountability piece that held states responsible for showing gains in academic achievement. A part of the focus of NCLB included the content area of mathematics. Research-based best practices were funded for implementation in schools and other funding sources were granted through the original legislation, including funding research in best practices for gifted education. Underachievement among all subgroups was highlighted and requirements for showing all students meet or exceed standards by 2014 were articulated.
One study followed kindergarten students through later grades and the findings from this large scale study, known as the Early Childhood Longitudinal Study, Kindergarten Class of 1998-1999, were reported in the National Center for Education Statistics (2007) report *The Condition of Education 2007*. The achievement scores in mathematics showed a large disparity based on concepts, with scores from 92 percent proficiency in multiplication and division to two percent proficiency in area and volume. Underscoring the need for attention to subgroups was the achievement gap between students living at or above the poverty distinction for all data collection points and those living in poverty for all of the collection points. For example, “84 percent of students who lived at or above the poverty threshold for all survey rounds demonstrated proficiency in place value compared with 45 percent of students who lived in poverty for all rounds” (p. 41). Unfortunately, this attention to subgroups did not encompass the subgroup of gifted learners. Therefore, longitudinal data for that subgroup is not available on the same scale. This is another example of the federal government’s lack of attention to the subgroup of gifted learners despite reports of its underachievement in *A Nation at Risk* (NCEE, 1983). Notably, the follow-up report, *A Nation Accountable* (USDOE, 2008), failed to discuss the subgroup of gifted students at all, although consideration was given to the subgroups of minorities, students with disabilities, and English language learners.

**Focused on Mathematics**

In response to underachievement in the specific content area of mathematics which was highlighted in the reports *A Nation at Risk* (NCEE, 1983) and *Foundations for Success* (National Mathematics Advisory Panel, 2008) and again in NCLB (2001),
various professional education groups established standards for curriculum and expectations for achievement to keep attention focused on the problem of underachievement in mathematics and to provide statistical analyses to follow achievement over time; once such organization is the National Council of Teachers of Mathematics (NCTM). NCTM provided standards (2000) considered rigorous and organized in six themes: equity, curriculum, teaching, learning, assessment, and technology. The standards are presented in grade bands which scaffold and interweave to spiral new and old concepts. Organizations such as NCTM and initiatives such as the release of the standards and the follow-up report *A Nation Accountable* (USDOE, 2008) continue to focus renewed attention on mathematics achievement.

**Measuring Achievement**

When accountability for academic achievement became a national focus due to the NCLB Act (2001), measurements of achievement were required to be in place for any state accepting federal funds for public schools. Therefore, a statewide common assessment was used to measure the gains in achievement in each content area on an annual basis. Certain requirements were specified along with the Act (NCLB). Each school had to demonstrate adequate yearly progress (AYP) on annual measurable objectives (AMOs). This measurement kept schools and districts accountable for ensuring curriculum was taught and sufficient amounts of progress were made in each content area each year. This information serves as the basis for the claims in the USDOE’s (2008) report, *A Nation Accountable*.

**Adequate yearly progress.** AYP determines whether schools show sufficient annual progress toward meeting the goal established in NCLB (2001) of having 100
percent of all student meeting or exceeding standards on the statewide accountability assessment by the year 2014. Other criteria determine whether a school meets or does not meet AYP in addition to the assessment data. It is important to note that AYP only required achievement in the content areas of reading/language arts and mathematics for the years leading from its enactment to 2012.

**Annual measureable objectives.** AMOs are specific goals for each content area developed to keep schools moving toward meeting 100 percent of all students meeting or exceeding standards on the statewide accountability assessment by the year 2014. These goals specify the achievement gains needed per content area each year in order to meet the ultimate requirement of 100 percent by the target year. If AMOs are not met, AYP is not met for the criteria of assessment data. Using accountability measures to address underachievement helped focus attention on the content areas of deficiency noted in *A Nation at Risk* (NCEE, 1983), which were also reported in *Foundations for Success* (National Mathematics Advisory Panel, 2008), and provided specific requirements to measure achievement.

Most recently a consortium of 45 states adopted rigorous standards to address the problem in failing performance that has been present for some time (Common Core State Standards, 2013). Known as the Common Core State Standards, the structure of the curriculum is similar to the grade banding of the NCTM standards as well as the embedded spiraled approach to concept presentation and review. The Common Core State Standards provide the first national standards comprehensive of all subject areas and grade levels. Though not all states have chosen to adopt this curriculum, this is the
beginning of a marked change in the curricular approach taken to address the national state of education.

With implementation of best practices identified using funds from federal mandates, there is a need for professional development that may seem to be a natural progression in order to instigate change; however, in all government documents reviewed, the lack of professional development of teachers has been noted. The challenge of developing as an effective educator takes time and is an ever changing process, one which must be supported with opportunities to advance in scholarship and pedagogical awareness. The Committee on Mathematics Learning established by the National Research Council noted in the executive summary of its report *Adding it Up: Helping Children Learn Mathematics* (2001) that

> Teachers’ professional development should be high quality, sustained, and systematically designed and deployed to help all students develop mathematical proficiency. Schools should support, as a central part of teachers’ work, engagement in sustained efforts to improve their mathematics instruction. This support requires the provision of time and resources. (p. 12)

Professional development must be a consistent part of implementation of change to ensure success. As teachers become more proficient in their knowledge of and confident in their abilities to deliver mathematical concepts, student achievement will surely be impacted. Such achievement will continue to be measured for accountability based on NCLB (2001).

With the adoption of common national standards, fair comparisons can be made when measuring achievement. However, until a national curriculum becomes commonly
implemented and assessed, the existing means of common assessment is the National Assessment of Educational Progress (NAEP). This is not a required assessment of all students; however it is required for the students to whom it is given and provides a cross-section of students in fourth, eighth, and twelfth grades across the nation between which comparisons can be made regarding national achievement. The most recent release of NAEP data from the National Center for Education Statistics regarding the 2011 administration of the assessment indicates that at the time they were assessed, the average scores for fourth and eighth graders were higher than all previous assessment years, with 82 percent of fourth graders performing at or above the basic proficiency level (USDOE, 2012). The basic proficiency level indicates that there is partial mastery of fundamental skills. For the same period, forty percent of fourth graders performed at or above proficient and seven percent at or above advanced (USDOE). The level of proficient indicates students are competent of challenging subject matter and the advanced level indicates superior performance (USDOE). The national focus on underachievement in mathematics will continue as states implement the new Common Core State Standards curriculum. As of now, the states still have varying forms, structures, sequences, and pace of curriculum and varying assessments to measure such. It is unknown the extent to which students underachieve; however, with a common assessment like NAEP, the states can compare achievement longitudinally with better constructs to the educational system.

**Underachievement in Gifted Education**

Underachievement in the general population of students is mirrored in the subgroup of gifted learners. Studies have been conducted to distinguish types of gifted underachievement and reasons for such behavior (Figg et al., 2012; O’Boyle, 2008;
Understanding what gifted underachievement looks like can help educators know what behaviors to target for intervention in the classroom.

Underachievement of Gifted Learners Defined

The underachievement of gifted learners is characterized as performance below their fullest potential. Although potential is an immeasurable capacity, when gifted learners do not perform as well as their innate ability allows or do not develop their giftedness to the fullest possibility, underachievement occurs. Often educators, with focus on accountability measures, perceive underachievement of gifted learners as their lack of performance on an assessment (i.e., scoring a proficiency level of meeting standards as opposed to what would be expected should full achievement be actualized, which would be exceeding standards). Since underachievement cannot be measured, achievement is the measurement used to determine if students perform commensurate with their abilities.

Measuring Achievement of Gifted Learners

Giftedness is often determined based on the performance outcome on an assessment or various assessments, based on the identification criteria being used. Mental ability is often assessed using intelligence assessments and gifted students usually represent the upper five percent of the scores on those assessments. Measuring achievement of gifted learners is important for establishing eligibility regarding inclusion in gifted service programs. Once gifted learners have been identified, baseline scores on mental ability assessments are used to compare performance in school with the established ability. This is how the NCEE used such findings in its report, noting that at
that time “over half the population of gifted students do not match their [sic] tested ability with comparable achievement in school” (1983, p. 11).

When AYP was established through NCLB (2001), subgroups of the greater student population were targeted with requirements for performance and tracked on an annual basis to ensure the needs of special groups were kept subjects of focus; however one special group missing from the subgroups is the gifted learner subgroup. While achievement can be measured using previous performance as a baseline, underachievement cannot be measured. Often the gifted learners whose underachievement goes unmeasured and unnoticed are those who are never identified as gifted. Sometimes unfavorable behavior masks giftedness and leads to the different types of underachievement among gifted learners. In contrast, when students are high achieving, they have a larger knowledge base and are able to make connections between new information and known schemata and are more easily motivated through interdisciplinary approaches (Linn-Cohen & Hertzog, 2007).

**Types of Underachievement of Gifted Learners**

One recent empirical study sought to validate previous qualitative studies regarding different types of underachievement among gifted learners (Figg et al., 2012). Though subsequent responses from other researchers (Flint & Ritchotte, 2012) noted that quantitatively validating types of underachievement was a use of time better spent in providing best practices known to be effective regardless of what empirical data was available to substantiate them, it is important to note that there are differences in types of underachievement in gifted learners. Without complicating the issue, teachers do need to know about these different types of underachievement so they can address classroom
practices that may cause them and behaviors that signify the probability that underachievement may occur.

**Purposeful underachievement.** Purposeful underachievement is that which is expressly committed because the gifted learner is aware of the difference in his/her ability compared to same-aged peers. Committing purposeful underachievement gives gifted learners control over how they look to their peers. This may be caused by a lack of self-esteem or in an attempt to fit in with their classmates without seeming to be the “know-it-all” of the class. Continued underachievement not only makes identification of gifted traits difficult, it also causes a decrease in achievement test scores including IQ (Morisano & Shore, 2010).

**Selective achievement.** Another type of underachievement among gifted learners is selective achievement. This occurs when students’ interest levels determine their engagement with tasks and ultimate performance overall. For example, when gifted learners are not given appropriately stimulating activities to foster their giftedness and challenge their development, boredom often leads to misbehavior and hastily finished work without concern for accuracy. Choosing not to engage in accurately performing or achieving to their fullest potential is the selective achievement of gifted learners.

**Reasons for Underachievement among Gifted Learners**

Various reasons can be found in the existing body of literature regarding underachievement of gifted learners. These range from responses to government mandates and lack thereof, teacher unawareness, and student choice. Others include ecological factors, gender factors, cultural factors, extreme creativity, and economic
factors (Morisano & Shore, 2010). Identifying and understanding the reasons for underachievement among gifted learners is key when examining its effects.

**Instructional attention lost due to No Child Left Behind Act.** When the NCLB (2001) legislation focused educational efforts on closing the achievement gaps of low performing students with their on-grade-level peers and provided funding to implement best practices targeting interventions on the lowest end of the achievement continuum, higher performing students were no longer the target of concern they became in the *A Nation at Risk* (NCEE, 1983) report. In other words, the achievement gap of concern brought about by NCLB became the segment of students performing below standards. There was no focus put on the subgroup of gifted students who were meeting standards although such performance may have represented underachievement since they should have been exceeding standards. In the report *A Nation Deceived: How Schools Hold Back America’s Brightest Students* (Colangelo, Assouline, & Gross, 2004), the authors noted the adverse effects of mandating adequacy without exploring options for moving gifted students forward has had on meeting their needs. McAllister and Plourde (2008) went so far as to report that NCLB was causing gifted learners to become sacrificed in the pursuit of adequacy. They showed how the instructional attention and subsequent program funding targeting the lowest performing students in response to the Act was a cause of underachievement among gifted learners. This sentiment was echoed by Burney (2008), providing that mixed ability classes with expectations on grade level are “less likely to have learning experiences that attend to their [that being gifted students’] more rapid rate of learning or greater capacity for information and complexity” (p. 135). The mission of the USDOE (2008) is “to promote student achievement and preparation for
global competitiveness by fostering educational excellence and ensuring equal access” (p. 20). Ensuring equal access for gifted students has not been demonstrated through the fluctuations of federal foci in education. Using the subgroup as a means for comparison to demonstrate underachievement then not requiring any form of accountability measures for ensuring efforts for addressing such is in absolute opposition of its own stated mission. Without federal consistency it is difficult for educators to know how to address underachievement among gifted learners.

**Lack of motivation.** In Renzulli’s (2012) theory of giftedness, task commitment is one area where focused motivation is seen as consistent. Motivation is “…the total engagement in an activity, which then becomes rewarding itself….experiences can then reinforce productivity, resulting in an increase in both confidence and competence” (Burney, 2008, p. 134). When there is a lack of this motivation, the conditions needed for gifted development are not optimal and underachievement can occur. Many factors can cause a lack of motivation, such as when students’ interests are not stimulated or relevance is not readily understood. Motivation can be stimulated extrinsically when intrinsic catalysts are absent or lacking. Morisano and Shore (2010) noted the suggestions from current research toward the effects of creating goals in gifted education for increasing motivation.

**Boredom from lack of challenge.** Gifted learners need constant stimulation and challenge in order to maintain high levels of development of their giftedness. McAllister and Plourde (2008) showed that gifted learners’ brains need this stimulation through challenging exercises and by using interests and abilities to promote engagement. Otherwise, sustained development and chemical make-up is not sufficient for learning to
occur (p. 40). Other brain-based research, such as that regarding mathematically gifted children, has shown that using multi-modal challenges helps motivate students to achieve through brain stimulation (O’Boyle, 2008, p. 184). This corresponds with Vygotsky’s (1978) zone of proximal development, wherein students should feel a challenge at the upper portion of the zone as they learn more and need the assistance of more capable peers or adults. Manifestations of inappropriate behaviors, which are often masks of gifted abilities, are in direct response to boredom from the lack of a suitable challenge, resulting in underachievement of gifted learners. In *A Nation Deceived*, Colangelo et al. (2004) address what they term “the boredom factor” (p. 16) as what becomes manifested in unmotivated adults who were once bright children but found school and academic stimulation too easy and lacked challenge. Understanding that boredom is indicative of insufficient challenge and is often manifested as misbehavior can help educators address underachievement among gifted learners.

**Negative effect of insufficient curriculum development.** When curriculum is not sufficiently developed to meet the needs of gifted learners (i.e., enrichment opportunities are purposeful and differentiation of tasks allowing students to see significant applications of content being learned), the effect is often negative and results in underachievement of gifted learners. Gifted traits must be constantly stimulated in order to fully develop. When gifted students are not given sufficient opportunities of frustration and challenge and they experience easy performance, though lack of mastery may be underlying, giftedness is not cultivated due to a lack of conditions where effort is needed to coach development of self-regulatory skills (Burney, 2008).
The level of differentiation is often insufficient in general curriculum development. Mixed-ability classrooms are successful in producing academic achievement to the extent that the educator is able to manage the grouping and has been trained to modify the curriculum. VanTassel-Baska and Brown (2007) analyzed the influence of curriculum development and found that teacher understanding of curriculum and instruction of gifted learners was the foundation upon which the field of gifted education is supported (p. 342). However, as Reis and Renzulli’s (2010) review of studies revealed, a lack of training in the pedagogy of gifted education leaves general education teachers ineffectively implementing strategies shown as optimal for gifted instruction, if any are used at all.

**Response to perceived expectations.** Gifted learners have reported that expectations put on them by peers, parents, teachers, and themselves cause them to underachieve (Morisano & Shore, 2010). Perfectionism, the fear that their best is ultimately insufficient, gender expectations and self-image can all be antecedents to underachievement in gifted learners as their response to perceived expectations. Performance anxiety, fear of failure, and inability to adjust socially can also be causes (Morisano & Shore).

**Effects of Underachievement of Gifted Learners**

Since there is no way to fully measure the loss of potential when gifted learners underachieve, it is impossible to fully measure the effects of such underachievement. However, some effects are seen in manifestations that affect society as a whole, not just the gifted learners underperforming. These effects give credence to the need for best practices in gifted education.
Loss of social capital. The third of Renzulli’s (2012) subtheories in the theory of giftedness, Operation Houndstooth, addresses the need for gifted education to promote social capital as interventions are made to help gifted learners recognize the societal responsibilities brought alongside high abilities. When students are not achieving to this point, there is a loss to our social capital. In the report, A Nation at Risk, the NCEE (1983) articulated the relationship between the education system and social capital.

Citizens know intuitively what some of the best economists have shown in their research, that education is one of the chief engines of a society's material well-being. They know, too, that education is the common bond of a pluralistic society and helps tie us to other cultures around the globe. Citizens also know in their bones that the safety of the United States depends principally on the wit, skill, and spirit of a self-confident people, today and tomorrow. It is, therefore, essential--especially in a period of long-term decline in educational achievement--for government at all levels to affirm its responsibility for nurturing the Nation's intellectual capital. (p. 17)

When gifted learners underachieve, social capital is lost. Colangelo et al. (2004) in A Nation Deceived reported that misconceptions regarding acceleration strategies for gifted learners cause underachievement and in so doing exacerbates the problem, noting that when we expect gifted learners to be held back to perform with their grade level peers, “the cost to our country, to our communities, and to our children is enormous (p. 3). Essentially, the apathetic lowering of standards from excellence to baseline competence lowers national standards, undermines motivation of gifted learners, and ultimately hurts the nation (Colangelo et al.).
Drop-outs. When gifted learners are not stimulated and experience habitual underachievement, it is not uncommon for them to drop out of high school. Though the social stigma of not completing school is unfavorable, drop-out rates among gifted learners have been shown to be commensurate with general education students and sometimes even at higher rates (Cloud, 2007; Phillips, 2008). As noted in *A Nation Accountable* (USDOE, 2008) in high schools with over 100 students, less than 60 percent of students enrolled as ninth graders are still enrolled as twelfth graders four years later. In a study of causes for gifted students dropping out of school, Renzulli and Park (2000) noted many reasons including jobs, pregnancy, and dislike for school. In the sample, they noted a five percent drop-out rate among the gifted students included in the study. When gifted learners underachieve for lengthy periods for various reasons, such as those previously listed, the high school experience is not held as important.

**Roles of Educators in Addressing Underachievement among Gifted Learners**

Educators fill the most important role, second possibly only to parents, in addressing underachievement among gifted learners. Teachers have the opportunity to offer lessons designed to stimulate motivation through relevance and interest to not only teach content-specific curriculum, but also to help gifted learners sustain high levels of achievement. It is crucial that administrators, general education teachers, and gifted specialists work together to develop environments most conducive to fostering achievement in gifted learners. Burney (2008) stated that “the concern then becomes whether or not the learning experiences and context provided are consistently modified to fully develop the gifted student” (p. 130). When underachievement occurs, there must be plans for interventions to reduce the rate of occurrence and reverse the habit. Vygotsky’s
(1978) sociocultural theory addresses purposeful underachievement with cultural learning opportunities within the zone of proximal development. While gifted students remain very aware of their abilities, their grouping with other like-ability peers helps relax the social constraints of the negative consequences of overachievement with same age peers. Researching other effective practices for such interventions is essential in meeting the needs of gifted learners.

In order to motivate gifted students to master concepts, as opposed to meet some performance objective which comes easily to highly able students, teachers must shift their focus from grades on an assignment to depth of knowledge. Through this paradigm shift, students begin to influence the motivation of one another toward meeting mastery goals as performance goals persuade competitive students to work harder (Pintrich, 2000). Teachers are meanwhile able to nurture the intrinsic value of effort, which is needed when difficult tasks pose challenges and possible failure (Burney, 2008). Gifted students are motivated by the value of a task when they are given the opportunity to choose. When this strategy is employed, students become intrinsically and extrinsically motivated. Renzulli’s (2012) second subtheory in the theory of giftedness, the enrichment triad model, is designed to provide an environment where students are stimulated through personalized activities. Relevance is addressed as the work is aimed at a goal of producing a good or service for an identified group with need (p. 154). The enrichment triad model specifically addresses selective achievement by combining students’ interests with opportunities to creatively express their achievement in response to environmental stimuli.
Other interventions designed to reverse gifted underachievement have been attempted and studied. These include working to improve self-esteem and self-efficacy, general psychological well-being, study skills and metacognitive skill development, acceleration, increasing motivation, and individualized goals or differentiation (Morisano & Shore, 2010, p. 251). Findings are mixed and suggestions include raising minimal expectations for all learners and developing gifted education programs designed to meet the unique needs of gifted trait development. In the report *A Nation Deceived: How Schools Hold Back America’s Brightest Students*, Colangelo et al. (2004) noted that acceleration can be offered in eighteen different ways to gifted children of all races, ages, and gender, across settings, and socioeconomic status served in private, public, and alternative schools. However, they noted that this type of intervention has not been historically implemented as it should. In fact, Colangelo et al. stated that

[acceleration] is strongly supported by decades of research, yet the policy implications of that research are ignored by the wider educational community.

That’s why we feel compelled to make clear the following: (1) the research on acceleration is expansive and consistent; and (2) we are not aware of any other educational practice that is so well researched, yet so rarely implemented. (p. 11)

In summary, it is clear that interventions exist to respond to underachievement among gifted learners; however the depth, breadth, and fidelity of such interventions are not always clear or consistent for best practices to be implemented by teachers of gifted students.
Gifted Education in Georgia

Gifted education services are mandated in the state of Georgia for any students identified as gifted using the state’s criteria. Program guidelines and policies include the approved models for implementation at all grade levels and the requirements per each model, along with the roles gifted education specialists fill. Prior to receiving general teacher certification, regardless of the grade levels, all educators in the state of Georgia must prove they have taken a course on exceptional children in which meeting the needs of students with disabilities is discussed at length to prepare the educator for identifying, teaching, disciplining, and understanding the development of and legislation protecting the rights of such students in their classrooms. Although gifted education is mandated in Georgia, there is no course required regarding meeting the needs of gifted learners in order to gain teacher certification. For narrative and clarification purposes, the terms regular education and general education are used interchangeably to describe education services not modified in any way.

Mandated Provision of Services

The state of Georgia was the first to recognize the need for gifted education with legislative mandate in 1958 (H.R. Res. 246), which became the foundation for provision of gifted services in all districts in the state, regardless of the number of students identified as gifted. This mandate continues to serve as the basis for the policy implemented by the GaDOE, which also requires gifted education through state board rules. These legislative actions not only commit funding to maintain programs, require multiple criteria for identification procedures, and rigorous program standards, they serve
as commitments to the public that gifted students will be served in the educational system in Georgia.

**Funding structure for program.** Funding structures ensure procurement of financial resources needed for continuing services for the following academic year. In the public education system of Georgia, educational services are compensated through a numeric equation which allocates funds acquired from taxation and other funding sources, such as federal funds (e.g., Title I), for the cost of educating a student for one academic year. An instructional day is divided into six segments. Each segment is funded as if it is in regular education taught by regular education teachers, not requiring any special programs or services. For each segment of the instructional day spent receiving special services or in special programs, additional funds are allocated to make up for the extra cost that these services encumber. This is known as the full-time equivalent (FTE) weight. All special programs have an FTE weight. The FTE weight is added to the base cost for each segment of instructional time to determine how much funding the services procure. For example, if a fifth grader is not gifted and does not require any special services or programs, the school receives funding for six segments of regular education. If a fifth grader is gifted and is served in the gifted program for four segments of the instructional day, the school receives funding for two segments at the regular education weight and four segments at the gifted FTE weight, which costs more to implement and is therefore worth more than the regular education segments. The extra subsidy is how the state is able to justify the mandate for implementing a gifted education program. The number of segments in the instructional day that can be claimed at the gifted FTE weight differs based on the instructional model used. Students must be
identified as gifted using the GaDOE (2012a) rules to receive funding for inclusion in a
gifted education model.

**Multiple-criteria identification.** After many years of research and development
(Krisel & Cowan, 1997), the Georgia gifted program employed multiple criteria for
identifying gifted learners as a requirement effective in 1997 through a State Board Rule.
Research in gifted education has shown that giftedness can be manifested as creativity,
above-average mental ability and/or achievement, above-average intelligence, talent, and
high levels of motivation and task commitment. Since there is no one-size-fits-all
definition of giftedness, there is no one assessment or measure to determine whether a
student is gifted. Therefore, the GaDOE adopted the following criteria for areas used in
identifying gifted learners: mental ability, achievement, creativity, and motivation. In
order for a student to qualify for program inclusion, he/she must have superior
performance on an indicator, usually an assessment determined by the school district or a
performance task, in three of the four areas. Specific guidance for satisfying each area is
provided through the GaDOE’s gifted education policy manual (GaDOE).

**Program standards.** Once students are identified as being gifted, they are taught
using program standards that are intended to enrich content curriculum standards. The
program standards are divided into five categories: assessment, curriculum planning and
instruction, learning environments, programming, and professional development. Under
these categories, the eight standards provide indicators for how the gifted education
program should be implemented to promote cognitive and affective growth (GaDOE &
GAGC, n.d.). These are the same for all grade levels and models. The Georgia program
standards are based on the six programming standards developed by the National
Association for Gifted Children (NAGC). The programming standards provided by the NAGC include student outcomes and evidence-based practices for the areas of learning and development, assessment, curriculum planning and instruction, learning environments, programming, and professional development (NAGC, 2010). The purposes of the programming standards are to: “assess, evaluate, and improve local plans and programming; plan curriculum; provide professional development; advocate; develop, improve, and evaluate state standards; approve gifted plans and programs and monitor for compliance with state regulations” (p. 4). Using the programming standards provided from the national organization and the GaDOE provide a framework for implementation protocols and expectations, along with examples of identified practices for meeting the standards. While the standards are important and should be used to guide program and lesson planning, the structure is not sufficient for use in curriculum implementation in isolation and should, therefore, be used to complement content curriculum standards to augment instructional delivery practices.

**Approved Models for Elementary Grades**

There are four instructional models for elementary grades in Georgia’s gifted education program with state-wide approval for implementation. The fifth instructional model requires additional approval prior to implementation. When effectuating the models, schools must follow the state’s guidelines carefully in order to receive and maintain funding. The guidelines include specifications per model regarding the role of the gifted specialist in the instructional environment, the structure of the lesson plans, the number of segments allowed to be claimed at the gifted FTE weight for funding, and ancillary information specific to models as needed. The role of the gifted education
specialist will be investigated more completely in the next section. For now, the other requirements of the elementary gifted instructional models in Georgia will be explored.

**Resource.** The resource model is the most common model for providing gifted education services in Georgia. In the resource model, students are served by a gifted education specialist in a pull-out setting in groups of 14-17. This is a setting separate from the general education classroom and the instruction is given directly to the students identified as being gifted by a gifted education specialist, through which enrichment and extension of content curriculum is explored. The lessons are planned by the gifted education specialist. Lesson plans must specify the program standards addressed and the content standards addressed. The structure of this model allows the teacher to delve into deeper depths of knowledge of content standards that cannot be examined in the regular classroom for various reasons (e.g., lack of time, curriculum mapping requirements, remedial needs of other students). No more than two segments out of a six-segment instructional day can be spent providing gifted education services in the resource model; therefore, one-third of a gifted student’s instructional day may be spent out of the regular classroom setting meeting with a gifted specialist for which the gifted FTE weight can be claimed for funding.

**Other approved model.** Models not listed in the policy manual must be approved by the GaDOE for implementation prior to being put into practice. When a school applies to have an approved innovative model not listed in the manual to be allowed as gifted education service, there must be an application for approval including a description of the plan, rationale for the model, information regarding the role of the gifted specialist, instructional practices, lesson plan features, setting, and number of
students to be served in the model. Means for model evaluation of effectiveness and the nature of the curriculum must also be included in the application. Along with approval, the GaDOE specifies how many segments of the day can be claimed at the gifted FTE weight for an approved innovative model (GaDOE, 2012a).

**Advanced content.** The advanced content model is implemented in a regular classroom setting wherein the content is modified to be beyond the abilities of typical students in the grade level. Gifted students are combined with high ability students to comprise a homogeneous-ability class. There are no restrictions on the number of gifted students allowed to be clustered in this model for instruction. Lesson plans must show why the curriculum needs to be advanced and how it is being modified to justify funding as an advanced content course. The course description must be provided from the district to show how and why the content is being modified for the course. Only students served in the model who have been identified as gifted may be coded to receive the gifted FTE weight for funding. In this setting, the gifted education specialist gives direct instruction. No more than two segments per day can be claimed in advanced content per content area. Therefore, students could possibly spend all six segments of the instructional day in advanced content courses, receiving direct instruction from a gifted education specialist among homogeneous ability peers.

**Cluster.** The cluster model is another instructional model approved for providing gifted education services in Georgia. In the cluster model, students are served by a gifted education specialist in a general education setting (i.e., a regular education classroom) in groups of 6-8 students who have been identified as gifted. The instruction is given directly to the students identified as being gifted by a gifted education specialist, through
which content curriculum is taught to the cluster of gifted students and enrichment and extension is explored in a greater context of a heterogeneous class. The lessons are planned by the gifted education specialist who is the regular education classroom teacher. Lesson plans must specify the gifted education program standards addressed and the content standards addressed. The lesson plans must also specify how the lesson is differentiated to meet the needs of gifted learners, the learners for whom it is intended, and the rationale for why those students need lessons differentiated from others.

The structure of this model allows the teacher to delve into depths of knowledge regarding content standards that may not necessarily be examined with the class as a whole. Since the lessons are planned to specifically meet the needs of the gifted learners, general education students usually work on different assignments or on different depths of knowledge requiring different levels of rigor so that all learners in the setting are working on the same content standards but not necessarily at the same level. Therefore, students can work in heterogeneous classrooms with their age peers on work with their ability peers. This is a realistic example of the intersection of Renzulli (1977) and Vygotsky’s (1978) theories.

The gifted education specialist is in the setting with the learners and provides direct instruction. Two segments out of a six-segment instructional day can be spent providing gifted education services in the cluster model; therefore, one-third of a gifted student’s instructional day may be spent in the regular classroom setting under the guidance of a gifted specialist for which the gifted FTE weight can be claimed for funding. This is not to misrepresent the fact that students may be served in the setting for
the entire instructional day by a gifted specialist; however, only two of the segments served can be claimed for funding at the gifted FTE weight under this model.

**Collaborative.** The collaborative model is the last of the instructional models presented here which are approved for providing elementary gifted education services in Georgia. In the collaborative model, students are served by a regular education teacher in a general education setting (i.e., a regular education classroom) in groups of no more than 8 students who have been identified as gifted. The instruction is given directly to the students identified as being gifted by the regular education teacher, through which content curriculum is taught to the cluster of gifted students and enrichment and extension is explored in a greater context of a heterogeneous class. The lessons are planned by a gifted education specialist who collaborates with the regular education classroom teacher. Therefore, the gifted education specialist provides indirect service to the cluster of gifted students. This is the distinguishing feature of the collaborative model in comparison to the cluster model. This model also allows a convergence of Renzulli (1977) and Vygotsky’s (1978) theories in realistic settings.

Since the regular education teacher who delivers the instruction to the gifted learners is not a gifted education specialist, time must be provided for the gifted education specialist to develop the lesson plans and meet with the regular education teacher to collaborate on lesson delivery. Similar to the cluster model, the lesson plans must specify the gifted education program standards addressed and the content standards addressed, how the lesson is differentiated to meet the needs of gifted learners, the learners for whom it is intended, and the rationale for why those students need lessons differentiated from others. In addition, in the collaborative model, lesson plans must also
include documentation of the time given for the teachers to collaborate. Guidelines for specific amounts of time based on the number of students for whom instruction is planned must be followed. Also, when appropriate, students should be involved in the planning process in the form of a contract, which they sign indicating they understand the content being modified and the expectations for outcomes.

The structure of this model also allows the teacher to explore depths of knowledge regarding content standards that may not necessarily be examined with the class as a whole while general education students may work on different assignments or on different depths of knowledge requiring different levels of rigor so that all learners in the setting are working on the same content standards but not necessarily at the same level. Therefore, students can work in heterogeneous classrooms with their age peers on work with their ability peers. The gifted education specialist is not in the setting with the learners and is not required to meet directly with the students, thus providing indirect instructional services. Six segments out of a six-segment instructional day can be spent providing gifted education services in the collaborative model; therefore, 100 percent of a gifted student’s instructional day may be spent in the regular classroom setting under the indirect guidance of a gifted specialist but the direct instruction of a regular education teacher for which the gifted FTE weight can be claimed for funding. The current funding structure is disproportional based on the model implemented. The funding structure and model are defined in terms of services rendered by gifted education specialists. Regular education teachers are not required to meet any professional development prerequisites regarding gifted education; however, to be considered a gifted education specialist, certain professional development requirements must be met.
Roles of Gifted Education Specialist

As noted, the roles of gifted education specialists in Georgia differ based on the instructional model employed. In order for instructional segments to be claimed at the gifted FTE weight, gifted education specialists must provide some type of instructional service, direct or indirect, to gifted learners.

Professional development requirements. In the state of Georgia the teacher certification agency is the Georgia Professional Standards Commission (GaPSC). Once a teacher becomes certified to teach a certain grade range of students, endorsements can be added to the certification. Endorsements represent additional professional development in the form of continuing education hours, a conferred degree, and the proof of competency through passing the state certification assessment in an area, among others. In order for educators with an existing teacher certificate to add a gifted endorsement, they must attend the equivalent of a year’s professional development regarding gifted learners. There are four courses involved in the training, requiring a minimum of 200 contact hours (Chattahoochee-Flint RESA, 2012). The courses are designed to teach educators about the specific needs of gifted learners in the areas of: characteristics, assessment, strategies and materials for teaching, and specialized program and curriculum development. Once the series of courses is complete, the GaPSC attaches an endorsement to the teacher’s certification indicating the successful completion. The gifted endorsement on a teacher’s certification is what deems him/her a gifted education specialist. Unlike other endorsements, such as those received in conjunction with advanced degrees, increases in pay are not a part of earning a gifted endorsement. The
roles of gifted education specialists are very different according to the instructional model used.

**Cluster model.** The role of a gifted specialist in the cluster model is to give direct instructional service to a cluster of gifted students. Gifted education specialists in the cluster model develop their own lesson plans. Given that there is not a financial incentive to acquire a gifted endorsement and expense is incurred to take the required courses, few teachers seek out this additional professional development.

**Collaborative model.** The role of a gifted specialist in the collaborative model is to give indirect instructional service to a cluster of gifted students. Gifted education specialists in the collaborative model are given ensured protected planning time to develop lesson plans modified for gifted students taught by another teacher. The gifted education specialists collaborate with the regular education teachers delivering the direct instruction. Since there is a lack of gifted education specialists, schools often implement the collaborative model to meet the mandate to provide gifted education services in a time of doing more with less (i.e. lack of funding).

**Fidelity of implementation.** As with any program, the efficacy of gifted instructional models is dependent on the fidelity of implementation. When one teacher is planning the lessons delivered by another, fidelity of implementation is subjective and is perhaps a limitation of the collaborative model. Although extensive documentation is required of the collaborative model to ensure thorough collaboration between educators takes place, research has not been found to prove that collaboration with a partner teacher can show the same correlation with student achievement that professional development
has on student achievement. Gifted education specialists have received the professional development shown to correlate with student achievement gains.

**Approaches in Gifted Education**

The review of literature has established that the academic needs of gifted learners are different than their same age peers. Gifted learners are able to receive new information easily and can quickly move on to other topics or delve deeper through enrichment on a faster pace. Approaches to meeting the challenges in gifted education include curriculum models, instructional models, general clustering models, and instructional strategies. Parker et al. (2010) noted that attempts to verify the efficacy of the programs offered to gifted students are needed due to a paucity of research to validate current practices. Linn-Cohen and Hertzog (2007) also noted that recommendations of best practices from scholarly sources are rarely supported by empirical evidence describing the implementation and subsequent impact of such practices on student achievement. The current study responds to these proposals for future research.

**Curriculum Models**

Curriculum is the content with which mastery is developed and compared to which achievement is measured. Models implemented to deliver curriculum to gifted students have been studied (Burney, 2008; VanTassel-Baska & Brown, 2007). Curriculum models specialized to meet the needs of gifted learners include delivery of curriculum developed to be rigorous, with a different scope than the general education curriculum, and paced to be rapid, with a different sequence than the general education curriculum. VanTassel-Baska and Brown provided the following five features of curriculum models as an operational definition in their review of gifted education
curriculum models: “[a] A framework for curriculum design and development.  [b] Transferable and usable in all content areas.  [c] K-12 applicability.  [d] Applicable across schools and grouping settings.  [e] Incorporation of differentiated features for the gifted/talented learner (p. 343).” Such curriculum models ensure mastery of the basic standards for achievement measurement and include development and compacting. Considerations must be given to the developmental needs of gifted learners in curriculum planning because grade level curriculum is not designed to be at a level of complexity needed or paced briskly enough to challenge them (Burney, 2008).

**Curriculum development.** Curriculum must be developed keeping foundational schemata for students and pedagogical requirements for teachers in mind. Skills needed as prior knowledge have to be taught first and activated before new content is added to a learner’s repertoire. As educators plan advanced curriculum (Gavin et al., 2009), the sequence of the delivery is most important. An example of curriculum development designed to match the mandated curricular requirements with academic activities specific to students’ interests includes Renzulli’s School-wide Enrichment Model. Through this curriculum model, students are identified for a talent pool and given interest and learning style inventories. Curriculum is compacted and enrichment activities match students with opportunities and exploration beyond the general education curriculum (VanTassel-Baska & Brown, 2007). Other types of curriculum development include challenging activities, accelerated approaches, advanced products and processes, enriched experiences, higher order thinking stimulants, and differentiated presentations.

**Curriculum compacting.** When students are capable of moving quickly through the sequence of curriculum, educators can present new material and assess understanding.
in a condensed timeline. Curriculum compacting is the modification of the curriculum to eliminate the content that has already been shown as mastered. It allows teachers to replace such content with engaging activities designed to develop the gifted traits needed for higher level thinking skills and decision-making skills. This model of curriculum development provides a medium for educators to provide enrichment and acceleration (Stamps, 2004). In a study conducted by the National Research Center on the Gifted and Talented (Reis, Westberg, Kulikowich, & Purcell, 1998), curriculum compacting was shown to be effective in allowing teachers to eliminate mastered concepts and beneficial by allowing teachers to move on to topics found to be interesting to students with positive effects on affective outcomes and achievement on standardized tests. Stamps’ study showed similar results with curriculum compacting allowing teachers to eliminate between 25 and 50 percent of the prescribed curriculum. Further, Stamps’ study showed that students were able to assist in developing 85 percent of enrichment activities which developed stimulated student interest and motivation.

After their comprehensive review of the efficacy of current curriculum models in gifted education, VanTassel-Baska and Brown (2007) encouraged future research to focus on collecting evidence regarding curriculum effectiveness in various settings with various populations (p. 353). Curriculum compacting is complex and fast paced and allows students to flow through the sequence of mandated curriculum faster than same age and grade level peers.

**Instructional Models**

Targeting instruction to meet the needs of gifted learners has become part of many state policies in gifted education programs (Jolly & Kettler, 2008; Swanson, 2007)
and prominent in current research (Rogers, 2007). Instructional models found among the review of literature include acceleration and pull-out instruction in resource settings made popular in special education delivery.

**Acceleration.** One instructional model found effective in meeting the academic needs of gifted learners is acceleration. Acceleration is a type of intervention that moves students through the scope of curriculum at a pace commensurate with their abilities. In the meta-analysis conducted by Steenbergen-Hu and Moon (2011), the effects of acceleration were analyzed and found to be generally positive as a means of motivation and long-term sustainment of achievement. Since acceleration can take on the form of skipping grades, parents have expressed concerns for social development (Colangelo et al., 2004; Neihart, 2007; Steenbergen-Hu & Moon). However, it is clear from the research that accelerated students adjust well affectively and socially in accelerated situations (Colangelo et al.; Neihart). Colangelo et al. have conducted a great deal of research regarding acceleration and found that at least eighteen types of acceleration exist (p. 12). Examples of acceleration include early entrance, dual enrollment, grade skipping, and extracurricular programs. In Neihart’s review of studies, examples of socioaffective benefits of acceleration include “more favorable attitude toward subject matter, greater development of students’ career interests, healthy social relationships, and high motivation” (p. 334). Using acceleration as an instructional approach is one way to meet the unique needs of gifted learners and can be conducted in mixed-abilities or homogeneous-ability settings.

**Pull-out instruction.** Students in gifted education programs may be served in instructional models that remove them from the regular classroom for a portion of the day
to receive instruction designed to meet their gifted needs. This is known as pull-out instruction or the resource model, which was made popular as a special education setting. The resource model for gifted instruction for elementary gifted education programs in Georgia is an example of pull-out instruction. Rogers (2007) noted that pull-out instructional models have been shown to have teachers with more training in gifted education than other instructional models who “...have more access to differentiated materials, and come to the program ‘excited’ rather than burdened by daily responsibilities for differentiation” (p. 389). This was supported by Dimitriadis’s (2012) study that found evidence supporting the use of the pull-out instructional model for allowing teachers to focus their attention and provide extended opportunities for students in smaller settings with homogeneously grouped peers. Dimitriadis also shared evidence that the professional development associated with the pull-out instructional model had an effect on teachers’ confidence and subsequently their students’ level of motivation (p. 241). These findings were similar to those in Vaughn and Feldhusen’s (1991) meta-analysis of research on pull-out models in gifted education, which showed significant positive effects in the areas of achievement, critical thinking, and creativity. The pull-out model allows gifted education specialists to tailor instructional approaches and assignments to develop gifted traits in high ability learners.

**General Clustering Models**

The review of literature has established the efficacy of clustering students for receiving gifted education services. The homogenous grouping of gifted students in clusters within the larger heterogeneous classroom setting (Brulles et al., 2010; Pierce et al., 2011; Teemant et al., 2011) has been established as meeting the unique needs of
gifted learners. The cluster and collaborative models for gifted instruction for elementary gifted education programs in Georgia are examples of clustering models. Additionally, gifted learners may be served in classrooms with only gifted students comprising the entirety of the class.

**Homogenous classrooms.** In homogenous classrooms, gifted learners are clustered as one large group comprising the entire class. The advanced content model for gifted instruction for elementary gifted education programs in Georgia is an example of a homogeneous classroom. There have been studies regarding the efficacy of this type of gifted education delivery model through which mixed findings have been reported. In Shields’ (2002) study, homogeneous classrooms serving only gifted students showed students achieved at high academic levels and they had positive self-perceptions. Similar to Shields’ study, Adams-Byers, Whitseel, and Moon’s (2004) study regarding the effects of homogeneous grouping on gifted learners showed high academic levels; however, the latter revealed an affective dimension of a desire to work in heterogeneous settings for ease or rank among peers. Although the study conducted by Preckel and Brüll (2008) noted a decrease in academic self-concept over time and lower social self-concept for gifted students homogeneously grouped, contrasting findings from the study conducted by Lee, Olszewski-Kubilius, and Thomson (2012) showed social and emotional adjustment to be generally positive although self reports indicated academic self-concept higher than social self-concept.

While the gifted learners are among same age and ability peers, the class is able to move along in the curriculum sequence more rapidly and can delve deeper into concepts, such as was evidenced in Linn-Cohen and Hertzog’s (2007) qualitative study of two
homogeneously grouped gifted classrooms. Their study also showed that the structure of the homogeneous instructional model allowed the teachers to “…match the level of demand to ability in order to tailor curriculum for each student” (p. 255). Homogeneously structured instructional models allow clusters of gifted students to be taught using differentiated curriculum at a fast pace with complex expressions of mastery.

**Social learning.** Studies have shown the efficacy of cluster models as social contexts for learning and the ability of these models to provide optimal conditions for meeting the instructional needs of gifted learners (Adelson et al., 2012; Burney, 2008; Pierce et al., 2011). Using cultural and ethnical differences to target diverse gifted learners and tailor instructional practices (Briggs et al., 2008; Montague, Enders, & Dietz, 2011; Neumeister et al., 2007) have been proven effective in improving student achievement as skill acquisition is made relevant and understandable. These opportunities to develop gifted traits among peer groups can influence learning as gifted learners often motivate one another, either intrinsically or extrinsically (Burney, 2008). In the study conducted by Brulles et al. (2010), achievement was statistically significant and the percent of change was higher for gifted students served in clustered social learning settings. Additionally, these findings were consistent from second grade to eighth grade, for both genders, for all ethnic groups, and regardless of language acquisition status. The evidence supporting social learning as a clustering model for gifted learners has been linked to student achievement gains and supports Vygotsky’s (1978) sociocultural theory.
Instructional Strategies

Instructional strategies for gifted learners have been extensively researched (Mitchell, 2010; Reis & Renzulli, 2009 & 2010; Renzulli, 2011). These include using sociocultural practices in instruction (Eddles-Hirsch et al., 2010; Teemant et al., 2011) to promote learning within one’s zone of proximal development, enrichment, differentiation, and teaching to learning styles.

Enrichment. Enrichment is an instructional strategy through which teachers are able to develop students’ knowledge of content by offering experiences designed to extend learning. Al-Hroub (2010) defined enrichment as providing “…gifted students with a more varied educational experience, either by modifying the curriculum to include depth and/or breadth or by exposing them to topics not normally included in the curriculum” (p. 260). In Al-Hroub’s study of twice exceptional students, enrichment was a strategy employed as part of the treatment in a multisensory-enrichment program, resulting in significantly higher mathematics achievement. Taking students beyond the required curriculum into what they may be interested in learning or by using activities that are perceived as “fun” are ways to help further develop giftedness through the instructional strategy of enrichment.

Differentiation. Since students do not learn at the same pace or the same way, differentiating the delivery style and acceptable means of showing mastery is important, particularly among gifted learners. Differentiation is the purposeful planning of content delivery individualized to meet the needs of learners. As teachers become familiar with their students they are able to differentiate through teaching students self-regulation techniques (Housand & Reis, 2008). Burney (2008) gave explicit reasons that
differentiation is necessary, including developing needed cognitive strategies, self-regulation, and effort (p. 135). Other ways of differentiation include teaching toward learning styles. Kanevsky (2011) showed that this is effective for gifted and non-gifted students with the most popular technique for both groups being their desire to be a part of the personalization of the learning process in their favorite subject. For gifted learners, the social aspect of learning was significant, proving that these learners prefer to work with like ability peers. Notable in Kanevsky’s commentary was the exhortation that differentiation should be made with each individual student in mind and with the common sense approach of not attempting to modify every lesson for every learner, thus teaching other ways of learning and expression. Differentiating lessons not only helps students meet academic standards through personalized instruction and expression, academic potential is explored when students learn how to recognize how to use their strengths in face of a challenge.

**Learning styles.** Learning style is how a learner approaches learning. As teachers learn the best means to teach individual students, interests and preferences of students become evident. Promoting those interests and preferences through targeted lessons is one way of teaching gifted learners using their learning styles as an instructional strategy for engagement and motivation. Using learning styles as an instructional strategy has been shown to be effective for increasing motivation and achievement in middle school students (Lauria, 2010; Sagan, 2010). Personalizing instruction to match interest and aptitude motivates learners and can further develop giftedness in specific areas, such as mathematics (Koshy et al., 2009).
Research on Approaches in Gifted Education and Mathematics Instruction

In the national report regarding the state of gifted education entitled *National Excellence: The Case for Developing America’s Talent* (Ross, 1993), the steering group reported on the advancements made in the field, noted areas of weakness, and provided concerns that needed to be addressed in order to effectively educate the gifted learners in public schools in the United States. At that time, evidence was given to show that increased attention to the gifted population of students had become more of a priority; however, it was regarded in the section entitled *A Quiet Crisis in Educating Talented Students* that gifted students were failing to meet their potential in spite of the efforts up to that point. In fact, the group did not mince words when it stated,

That so many of our students work below their potential has grave implications for the nation. The scholarship, inventiveness, and expertise that created the foundation for America’s high standard of living and quality of life are eroding. Most top students in the United States are offered a less rigorous curriculum, read fewer demanding books, complete less homework, and enter the work force or postsecondary education less well prepared than top students in many other industrialized countries. These deficiencies are particularly apparent in the areas of mathematics and science. (p. 1)

In response, the following year a task force was formed by the NCTM, known as the Task Force on the Mathematically Promising, which analyzed the area of mathematics education to gifted learners (Sheffield, 2006). In the report that followed, *Report of the Task Force on the Mathematically Promising* (Sheffield, Bennett, Berriozábal, Dearmond, & Wertheimer, 1995), it was noted that the claim made by NCTM in 1980 in
its report *An Agenda for Action* was still true some fifteen years later: “The student most neglected in terms of realizing full potential is the gifted student of mathematics.

Outstanding mathematical ability is a precious societal resource, sorely needed to maintain leadership in a technological world” (Sheffield, 2000, p. 1). Gavin et al. (2009) reexamined the statement nearly thirty years after its publication and supported the notion that it remained to hold true, that being the mathematics educational needs of gifted learners continued to be insufficiently served, although slight improvement in the overall system could be noted.

In its 1995 publication, the Task Force created a model for developing promising mathematicians, which included ways to prompt students for deeper concept exploration and assess using rubrics to encourage creativity (Sheffield, 2000). Empirical evidence suggests that giftedness in the area of mathematics can be cultivated with intentional instruction designed to meet the learning needs of gifted students, which supports the position taken by the Task Force (Sheffield et al., 1995) that mathematical promise is not a fixed state of being and can be fostered to maximize success. This supports Renzulli’s theory that giftedness is not a fixed entity and it is developmental (Reis & Renzulli, 2009). Rogers (2007) found that fast-paced classes are best for teaching mathematically precocious learners. Implications from Rogers’ research included “that there should be a qualitatively different presentation of content in areas such as mathematics, science, and foreign language for students who are extraordinary in these areas” (p. 390). Additionally, Usiskin and Sheffield have both argued that “experiential learning in mathematics, using inquiry and problem-based strategies versus teaching for automaticity...
through drill and practice, leads to deeper mathematical understandings among gifted mathematicians” (as cited in Rogers, 2007, p. 390).

The literature shows that research in gifted education and research in mathematics currently progress with little overlap in either field (Leiken, 2011). While most of the strategies and models examined in this review of literature have been for use in general education settings, there are others found in the literature that have been studied for implementation on a larger spectrum, specifically large-scale specialized programs and school-wide initiatives. These two examples show different ways of reaching the goals set out in the reports *National Excellence: The Case for Developing America’s Talent* (Ross, 1993) and *Report of the Task Force on the Mathematically Promising* (Sheffield et al., 1995) regarding how gifted education in mathematics and mathematics instruction in gifted education can be delivered for maximizing the potential of gifted learners.

**Specialized Programs**

Research exists regarding the effects of specialized programs, through which mathematics instruction is delivered, on the achievement of groups of gifted learners. Specialized programs have been developed by gifted education researchers and experts in the field and are characterized by nontraditional settings. This review of literature has established that clustering gifted students to receive instruction is advantageous. Specialized programs using the cluster model through which to deliver instruction to gifted learners exist with structural elements including homogeneous and heterogeneous environments.

**Effects of specialist-developed instruction to gifted learners in homogenous settings.** Specialized programs exist which are designed to cultivate giftedness in content
areas such as mathematics. One of the distinguishing factors between programs is the
gifted education pedagogical awareness of the educator who delivers instruction, a gifted
education specialist or a general education teacher. Empirical evidence exists regarding
the impact of the structures of these programs exists.

*Instruction delivered by gifted education specialists.* The Study of
Mathematically Precocious Youth model uses a talent search to identify gifted students
who are capable of rigorous, fast-paced instruction in mathematics (VanTassel-Baska &
Brown, 2007). This specialized program was designed and is implemented by gifted
education experts affiliated with various research institutions to deliver the equivalent of
year-long courses in three-week classes. This program includes provisions for third
through twelfth grades; however, the full scope and sequence begins in seventh grade
(VanTassel-Baska & Brown). Longitudinal data has proven its efficacy regarding student
achievement and retention of information (VanTassel-Baska & Brown).

In their study of the Summer Program, Young et al. (2011) studied the effects of
mathematics instruction designed, planned, and delivered by gifted education experts to
gifted students. The findings showed that the demographic variables were not found to
predict mathematics achievement in their study; variables associated with academic
preparedness were most predictive of student success. Ultimately, students could master
the equivalence of a year’s worth of curriculum over the course of a summer when
instruction was delivered by gifted education experts (Young et al.).

*Instruction delivered by general education teachers.* Another type of
specialized program exists wherein instruction has been developed by gifted education
specialists and delivered to gifted students by general education teachers. One particular
study found focused on the standards prescribed by NCTM (2000) for mathematics competency and the suggestions for program structures presented in the Report of the Task Force on the Mathematically Promising (Sheffield et al., 1995) for cultivating mathematically gifted traits in students. In the study, Gavin et al. (2009) detailed the positive results of Project M³: Mentoring Mathematical Minds on the mathematics achievement of gifted students. The intensive program included the design of units of study by gifted education specialists for third through fifth graders which were taught by general education teachers in a composition very close to that of the collaborative gifted instructional model in Georgia (GaDOE, 2012a). The differences between the two include Project M³ provided professional development, albeit limited to two weeks prior to the beginning of the school year regarding gifted education philosophy and teaching strategies, and the collaborative model does not require nor provide any professional development. Prior to beginning presentation for each Project M³ unit teachers had one day of training regarding content in addition to the weekly collaboration meetings. The collaborative model requires weekly collaborative planning; however, no additional training is required regarding the content being taught. Lastly, Project M³ provided fidelity of implementation classroom visits wherein the content delivery was monitored. Although the collaborative model requires rigorous documentation of implementation, no visits by gifted specialists to monitor fidelity for content delivery are required. The suggestions for future research from the study conducted by Gavin et al. included studying the results of implementing such a model with less professional development for teachers (p. 200). This study is the closest found in the review of literature to the current study.
School-wide Initiatives

The effects of school-wide initiatives through which mathematics instruction is delivered to smaller concentrated groups or clusters of gifted learners have been researched. These studies include settings wherein gifted students comprise the homogeneous totality of the population served, such as in Science, Technology, Engineering, and Mathematics (STEM) schools for gifted learners, as well as settings wherein gifted students are clustered together in a greater heterogeneous ability setting, such as in the School-wide Enrichment Model. Effects on achievement vary based on whether the instruction is delivered by gifted education specialists or content area specialists.

Effects of specialist-developed instruction to gifted learners in heterogeneous settings. Gifted students are served through school-wide initiatives designed to address creativity development and/or enrichment opportunities for all students. When students receive such services in the area of mathematics, programs are distinguished by who delivers the instruction, a gifted education specialist or expert, or a general education teacher

Instruction delivered by gifted education specialists. The Schlichter Models for Talents Unlimited Inc. is an example of a school-wide initiative where enrichment is given by teachers who have received training in developing talents in students in elementary grades. This model is employed by all teachers in all content areas, including mathematics, with all students, regardless of gifted status. In their review of gifted models, VanTassel-Baska and Brown (2007) shared evidence that this particular model is effective for increasing student achievement for all students.
Instruction delivered by general education teachers. The School-wide Enrichment Model is an example of a program developed by gifted education experts for implementation as an instructional means for offering enrichment in all content areas by general education teachers. In Field’s (2010) study, it was found that the School-wide Enrichment Model implemented through the use of the Renzulli Learning System improved achievement scores for both gifted and general education students; however, the study did not include achievement in the area of mathematics.

STEM schools are focused on developing students in the areas of science, technology, engineering, and mathematics. Due to the specialized nature of the programs studied, content experts design, plan, and deliver instruction to students. Olszewski-Kubilius’ (2010) showed that when gifted students attended STEM schools focused on developing content knowledge and giftedness in the areas of science, technology, engineering, and mathematics, students who were successful were interested in careers in one of the four areas and were able to take risks and were self-confident. Those who were not as successful expressed problems with self-regulation and self-esteem. Most of the students are homogeneously grouped; however, not all of the students are gifted based on the distinction of the schools and admission requirements. Duly noted, the content experts were trained as general education teachers and were not gifted education experts. Students unable to attend STEM schools should foster talent development in the areas of science, technology, engineering, and mathematics in other programs such as internships and summer programs (Olszewski-Kubilius).

With a variety of approaches to developing mathematical proficiency in gifted learners, educators need more information regarding best practices (Jolly & Kettler,
2008). Since there is no federal mandate for gifted education, meeting the needs of these unique learners is a challenge financially and practically. More studies are needed regarding the intersection of gifted education and mathematics education to address the overwhelmingly documented deficiency of mathematical achievement in the United States, specifically the underachievement of gifted learners.

**Summary**

The sociocultural theory provides that students learn best when cultural tools are acquired in social contexts (Vygotsky, 1978). The zone of proximal development for each learner and for a group as a whole provides a space of potential for learning in which learners acquire knowledge from adults or more capable peers and can manipulate skills independently. This clustering of peer learners provides the framework for implementing clustering strategies in instructional models.

The theory of giftedness provides that learners have the ability to foster gifted traits over time (Renzulli, 2012). These traits are personified through various abilities, such as above average intelligence, motivation, commitment to task, and innovative approaches to situations. Students who have been identified as gifted learners receive instruction tailored to meet their needs through various curricular and program models as well as instructional strategies. Clustering gifted students to receive instruction is the overlapping of the sociocultural theory and the theory of giftedness in the practical educational setting.

Underachievement among learners in the United States has been shown for many years to be problematic and representative of the norm more than the exception. The report *A Nation at Risk* (NCEE, 1983) gave evidence that students were behind
academically at that point. In response to the national predicament in the educational system, the NCLB Act of 2001 established accountability measures to ensure students were making achievement gains annually, particularly in the areas of mathematics and reading. In the state of Georgia, fifth grade is one of the three years where achievement must meet standards in the content areas of mathematics and reading or students must be retained. In the report and in the act, mathematics achievement and gifted education were addressed specifically as being areas to be given focus for development.

Despite funding for research and implementation of accountability measures, underachievement among gifted learners has risen to epidemic proportions and resulted in drop-out rates comparable to less able learners. There are different types of underachievement among gifted learners, purposeful underachievement and selective achievement. Various reasons are given for why underachievement occurs at such high rates for gifted students, including a lack of focus on the needs of gifted learners due to the NCLB Act (2001), lack of motivation, lack of challenge induced boredom, insufficient curriculum development, and response to perceived expectations. The loss of social capital due to underachievement among gifted learners is an effect predicted in the reports A Nation at Risk (NCEE, 1983) and A Nation Accountable (USDOE, 2008), and addressed through Renzulli’s (2012) Operation Houndstooth subtheory of giftedness. Key to addressing gifted underachievement is the role of the educator in provision of interventions.

In the state of Georgia, the role of the gifted education specialist varies based on the instructional model provided. Teachers must engage in additional professional development to become a gifted education specialist in Georgia. The instructional
models in elementary grades include cluster, collaborative, resource, advanced content, and other approved models. Each model carries certain requirements for program implementation and structures for program funding. The cluster and collaborative models are very similar; however, the models differ in the role of the gifted education specialist with regard to direct or indirect service to students. There have been no studies found to substantiate the use of the collaborative model as defined by the state of Georgia (GaDOE, 2012a). More information is needed to determine if the collaborative model provides similar achievement as the cluster model since disproportional allotment of funds is actuated through the models employed.

Clustering models are among approaches in gifted education studied to determine best practices for meeting the challenges presented by the needs of gifted learners. Other models include curriculum models, such as curriculum development and compacting, and instructional models, such as acceleration and pull-out instruction. Instructional strategies have been researched and enrichment, differentiation, and learning styles have been proven effective for implementing to affect achievement of gifted learners.

The focus of mathematics on a national level combined with the needs of gifted learners have become the subjects of studies regarding specialized programs and school-wide initiatives through which mathematics instruction has been delivered to gifted students and achievement has been measured. As noted by Gavin et al. (2009), “The impact of different models of mathematics curriculum for gifted students has not been fully established given the limited curriculum that is available” (p. 190). Leikin’s (2011) search of literature ended likewise, recommending further research regarding effective ability grouping for mathematically gifted students. Finally, VanTassel-Baska and
Brown (2007) stated that “research evidence needs to continue to be collected over time to verify the effectiveness of the curriculum in various settings and with various populations of learners” (p. 353). After a thorough review of the literature, a void remains in the body of knowledge regarding whether a difference exists in the mathematics achievement of gifted students taught by a gifted education specialist directly or by a general education teacher who collaborates with a gifted education specialist and teaches the lessons planned by the specialist.
CHAPTER THREE: METHODOLOGY

Clustering gifted students to receive instruction has been proven to be effective in increasing student achievement (Brulles et al., 2010). Evidence has shown that providing instruction tailored to nurture the growth of gifted traits is optimal for motivating students who may otherwise become underachievers due to a lack of appropriate challenge (Reis & Renzulli, 2009). Programs designed to specifically address mathematics achievement in gifted learners exist and have shown positive results for increasing success in mathematics courses (Gavin et al., 2009). Continued research is needed regarding best practices for teaching mathematics to gifted learners, including determining which clustering instructional model yields higher achievement gains (Leikin, 2011).

Therefore, the purpose of this study was to investigate differences in achievement possibly indicating the relative efficacy of the gifted instructional model implemented for mathematics on achievement of gifted students. This chapter will present the procedures of the study, including research design, participants, setting, instrumentation and data analysis.

Research Design

A causal-comparative design was used in this study. This design allows the researcher to investigate plausible causal factors for naturally occurring variations in behaviors (Gall et al., 2007). The causal-comparative design has been defined as being a type of nonexperimental investigation in which researchers seek to identify cause-and-effect relationships by forming groups of individuals in whom the independent variable is present or absent—or present at several levels—and then
determining whether the groups differ on the dependent variable. (Gall et al., p. 306)

In this study, the causal-comparative design was used to determine if gifted students’ achievement in mathematics as measured by scale scores on two different instruments differs based on the model used to deliver direct instruction. This design was deemed most appropriate because it “explore[s] causal relationships between variables” (Gall et al., 2010, p. 337) when manipulation of the independent variable is not possible (Campbell & Stanley, 1963). In this study, exploring possible causation between the independent and dependent variables is the purpose of the study, as outlined in the research questions, using archival data; therefore, the treatment has occurred and manipulation is not possible, thus necessitating an ex-post facto approach.

Other gifted education studies have been conducted using the causal-comparative design. In Olszewski-Kubulius and Lee’s (2004) study, the causal-comparative design was used to explore the role of participation of in-school and out-of school activities on the talent development of 230 gifted students. They analyzed the content areas in which students were most involved and found mathematics to be represented the most. The 2011 study of Olszewski-Kubulius and Lee incorporated the causal-comparative design in exploration of differences between males and females and other groups’ scores on off-level tests. They were able to use archival data from 250,000 talent searches which were collected over the years of 2000 to 2008 to explore trends previously reported among groups. They found that males outscored females three to one in mathematics performance. These studies further prove that this design is useful, effective, and most suitable for this study.
The ex-post facto nature of the design allowed observation of naturally occurring variations in existing groups. The comparison groups included students served in the cluster gifted instructional model and students served in the collaborative gifted instructional model as defined by the GaDOE (2012a) for mathematics instruction. Archival data exists from when participants were given a pretest and posttest of mathematics achievement in their fifth grade year. The pretest data was used to control for the selection threat to validity. Archival data also exists from when participants were given an assessment at the end of their fourth grade year which established prior achievement and an assessment at the end of their fifth grade year which measured overall mathematics achievement as well as mathematics competency on several subscales. The prior achievement was used to control for the selection threat to validity.

The research questions for the study were as follows:

Research Question One: What is the difference in mathematics achievement as measured by the STAR Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement?

Research Question Two: What is the difference in mathematics achievement as measured by the CRCT Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement?

The following null hypotheses were provided for the study.
Null hypothesis corresponding with Research Question One:

H_{01}: There is no statistically significant difference in mathematics achievement as measured by the STAR Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement.

Null hypotheses corresponding with Research Question Two:

H_{02}: There is no statistically significant difference in overall mathematics achievement as measured by the CRCT Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement.

H_{03}: There is no statistically significant difference in mathematical competency in numbers and operations as measured by the CRCT Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement.

H_{04}: There is no statistically significant difference in mathematical competency in measurement as measured by the CRCT Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement.
H₀₅: There is no statistically significant difference in mathematical competency in geometry as measured by the CRCT Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement.

H₀₆: There is no statistically significant difference in mathematical competency in algebra as measured by the CRCT Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement.

H₀₇: There is no statistically significant difference in mathematical competency in data analysis and probability as measured by the CRCT Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement.

Participants

The gifted students in Georgia Rural School District from which the sample was derived were in the fifth grade and received gifted instructional services in the content area of mathematics during the academic years of 2009-2010, 2010-2011, and 2011-2012, having been previously identified as being gifted based on the GaDOE (2012a) and Georgia Rural School District gifted education identification policies. Convenience sampling due to proximity and accessibility (Gall et al., 2007) was employed, using the
following specific criteria: (a) all participants have been identified as gifted and received resource model services daily; (b) all participants must have received fifth grade mathematics instruction using either the cluster or collaborative instructional models; and (c) all participants must have data from each of the collection points from the CRCT: Math Grades 4 and 5 assessments and STAR Math Grade 5 fall and spring benchmark assessments. A total of 69 students were served in the gifted education program during the years studied; however, two students did not have data from collection points in fourth grade for the CRCT due to moving from other states. Therefore, the total number of students comprising the sample was 67.

The students were being served in the fifth grade in the cluster or collaborative models for mathematics instruction following the guidelines outlined by the GaDOE (2012a). The instruction lasted the entire academic years: 2009-2010, 2010-2011, and 2011-2012. For brevity, the comparison groups will be known as cluster or collaborative in the commentary regarding the demographic composition. The overall cluster group consisted of 32 participants, with 40.62% males and 59.38% females. The participants in the cluster group were 56.25% African American/Black, 0% Asian, 34.37% Caucasian/White, 9.38% Hispanic, and 0% Multiracial. The cluster group also had 59.38% low socioeconomic status based on free/reduced lunch status used to distinguish the site as a Title I school, and 3.12% unidentified socioeconomic status. The overall collaborative group consisted of 35 participants, with 34.29% males and 65.71% females. The participants in the collaborative group were 48.57% African American/Black, 2.86% Asian, 31.14% Caucasian/White, 8.57% Hispanic, and 8.57% Multiracial. The
collaborative group also had 42.86% low socioeconomic status, with 22.86% unidentified socioeconomic status.

All of the students were clustered for instruction based on their gifted status and received instruction in departmentalized teams of two teachers using a gifted instructional model of cluster or collaborative for all content areas. The students were required to take the mathematics classes taught using either the cluster or collaborative models, which were taught by three different teachers over the period of the years examined (i.e., academic years of 2009-2010, 2010-2011, and 2011-2012). All students were also served through the resource model daily. The resource model was taught by the same teacher in the same setting for all of the years examined. The resource teacher had between six and nine years experience teaching over the duration of the study, with between four and seven years experience teaching with a gifted endorsement.

The collaborative model was taught by one teacher with between one and two years experience teaching over the duration of the study. The consultative teacher working with the collaborative teacher was the resource model teacher. The collaborative teacher obtained gifted endorsement the last year of those studied, therefore providing the cluster model during the 2011-2012 school year. The cluster model was also provided by two other teachers. The two teachers had 11 and 12 years experience teaching mathematics. These two teachers provided the cluster model two out of the three years studied and one of these teachers previously served in the math lab at the research site. These two cluster teachers had experience teaching at other schools while the collaborative/cluster teacher had only taught at the school studied. All three teachers taught the same curriculum, the Georgia Performance Standards for fifth grade.
mathematics, following the same curriculum sequence. The research site had the same mathematics academic coach for the entirety of the years studied, who provided weekly professional learning communities for teachers to reflect together on teaching practices, student performance goals, and academic data. All teachers and the academic coach were females. The cluster teachers were 34% African American/Black and 66% Caucasian/White. The academic coach was Caucasian/White with between 21 and 24 years teaching experience.

**Setting**

**Overview of Research Site**

The setting for this study is one upper elementary school, known as Georgia Rural Elementary School, serving grades three through five in rural Southwest Georgia. During the years studied, the school system in which the site is located had four schools serving elementary-aged students. All schools in the system are Title I schools based on the overall free/reduced lunch status. The system averaged a total of 4765 students enrolled for the years studied. Based on NCLB (2001), the percentage of schools in the system meeting AYP for the academic years in the study, 2009-2010, 2010-2011, and 2011-2012, declined drastically from the 2009-2010 school year to the following school year (see Table 1).
Table 1

Supplementary Information Regarding Enrollment at Research Site

<table>
<thead>
<tr>
<th>Academic Year</th>
<th>Schools Making AYP</th>
<th>AYP Status</th>
<th># Students Enrolled</th>
<th>Low SES</th>
<th>Gifted</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009-2010</td>
<td>62.50%</td>
<td>Met</td>
<td>715</td>
<td>83%</td>
<td>10%</td>
</tr>
<tr>
<td>2010-2011</td>
<td>12.50%</td>
<td>Did Not Meet</td>
<td>701</td>
<td>83%</td>
<td>11%</td>
</tr>
<tr>
<td>2011-2012</td>
<td>12.50%</td>
<td>Hold Harmless</td>
<td>678</td>
<td>83%</td>
<td>12%</td>
</tr>
</tbody>
</table>

Note. Schools making AYP is based on overall district status. Every other category is based on site status. AYP = Adequate Yearly Progress; SES = Socioeconomic Status

The research site did not meet AYP during the 2010-2011 school year due to the lack of the Black male subgroup to meet the AMO in the area of math. Based on a waiver from the state of Georgia regarding NCLB reporting requirements, schools did not receive an AYP status based on 2011-2012 school year achievement measures. This waiver was a part of the application that changed accountability protocols in Georgia which continues to be developed; thus schools kept the most previous year’s AYP status in a “hold harmless” rank for 2011-2012. Although the overall school enrollment decreased over the years studied, the percentage of the school population identified as gifted increased each year. The research site’s population was distributed as noted in Table 2. Slight fluctuations in overall female to male ratios could be seen. Additionally, no more than four percentage points’ difference could be seen in changes of any one race over time in representation at the research site during the years studied.
Table 2

Research Site’s Population Distribution

<table>
<thead>
<tr>
<th>Academic Year</th>
<th>Female</th>
<th>Male</th>
<th>Asian</th>
<th>Black</th>
<th>Hispanic</th>
<th>White</th>
<th>Multiracial</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009-2010</td>
<td>53%</td>
<td>47%</td>
<td>0%</td>
<td>66%</td>
<td>5%</td>
<td>26%</td>
<td>2%</td>
</tr>
<tr>
<td>2010-2011</td>
<td>48%</td>
<td>52%</td>
<td>0%</td>
<td>66%</td>
<td>7%</td>
<td>24%</td>
<td>2%</td>
</tr>
<tr>
<td>2011-2012</td>
<td>47%</td>
<td>53%</td>
<td>1%</td>
<td>67%</td>
<td>7%</td>
<td>22%</td>
<td>3%</td>
</tr>
</tbody>
</table>

Note. There were no students with the racial representation of Native American/American Indian during the academic years investigated.

General Overview of Gifted Education at Research Site

All students served in the gifted education program at the research site were previously identified as being gifted using the state’s criteria (GaDOE, 2012a). The curriculum for all gifted education settings, regardless of the instructional models, at the research site includes the entirety of the fifth grade Georgia Performance Standards for mathematics (GaDOE, 2008). All students received student expectations for learning correlated to a curriculum map which was paced for the overall student body, not the gifted subgroup in particular. The curriculum map was used in the gifted model settings for sequencing delivery of curriculum. The curriculum map also paced the standards assessed on common benchmark assessments given to all students in the school district.

The research site’s math academic coach worked with all teachers, regardless of the type subgroups served including status of gifted model, on a weekly basis to disaggregate data on common and benchmark assessments, redeliver professional development, and work through state-provided units for instruction. The students were served in the models for 180-day academic years. The research site also used supplementary programs in the area
of mathematics instruction in all classes, including programs with personalized goals. Part of those programs included extrinsic rewards for meeting the goals. All fifth grade classes, including those with the cluster and collaborative models, were taught on the same hall exclusive of other grade levels.

**Cluster Model Classrooms**

In the cluster model of gifted instruction, the eligible students are placed as a group “into an otherwise heterogeneous classroom, rather than being dispersed among all of the rooms/courses at that grade level” (GaDOE, 2012a, p. 14). The cluster group size cannot exceed eight. The GaDOE requires for the following conditions to be met for cluster model implementation:

The regular classroom teacher must have a current GaPSC [Georgia Professional Standards Commission] approved gifted endorsement. A maximum of two gifted FTE [full time equivalent] segments per day may be counted at the gifted weight. The teacher must document the curriculum differentiation for the gifted student(s) by completing individual or group contracts which include the following requirements: a description of the course curriculum which is based on Georgia standards that very clearly show how the advanced course content, teaching strategies, pacing, process skills, and assessments differ from courses more typical for student(s) at that grade level; separate lesson plans which show reason(s) why the gifted student(s) need an advanced curriculum in the content areas of English language arts, mathematics, science, social studies, and world languages; and dates and amount of time (in segments) the student(s) will be
engaged in the higher-level activities and how the students will be evaluated (formative and summative). (GaDOE, 2012a, p. 14)

The lessons prepared for cluster settings at Georgia Rural Elementary School are created by the regular classroom teacher, who is gifted-endorsed, and the plans are archived for auditing purposes. A review of the archived plans revealed that typical lessons included differentiation from regular education lessons in the areas of content, process, product, environment and assessment, as required by the GaDOE; therefore, documentation shows that the cluster model at the research site adhered to the conditions set forth in the state’s policy guidelines (GaDOE, 2012a), assuming that all documentation was completed accurately and honestly.

One threat to internal validity of this study is treatment fidelity. Due to the ex-post facto design of the study, actions to control fidelity of implementation cannot be taken; therefore, open-ended questions were asked in conjunction with review of the archived documentation to note qualitative aspects of the setting that may not be revealed through the review of archival documents to gain more perspective on the treatment fidelity, albeit retrospectively. Open-ended questions were asked of the cluster and collaborative teachers, assistant principal, consultative teacher working with the collaborative teacher who also served as the resource teacher, and the math academic coach. The findings demonstrate affective differences between classrooms based on the teachers providing direct instruction. Three teachers over the duration of the years studied implemented the cluster model. Those teachers ranged in age, race, number of years experience teaching, and experience teaching at other schools.
There is an affective quality to teaching that is difficult to quantify and therefore
difficult to define; however, the differences noted from responses by outside observers
showed that the teachers differed based on this interpersonal quality. One teacher who
served in the cluster model was in the third year of teaching experience, having only
taught at Georgia Rural Elementary School. The social quality in the classroom was
described as “trendy” with high expectations for achievement and behavior. Students
showed respect for the teacher; however, although previous years were noted with an
evident lack of pedagogy, it was noted that this had improved by the third year of the
teacher’s experience. This teacher was voted among peers to represent the research site
as teacher of the year based on the year’s service rendered in the cluster setting. There
were a total of eight students included in this study served in the cluster model by this
teacher over the duration of the years studied. This teacher also served students in the
collaborative model and was therefore present in both settings. The second teacher who
served in the cluster model was in the twelfth year of teaching, having taught at one other
school in an adjacent school system. The social quality in the classroom was described as
“engaging” with resolute efforts to build relationships with students. Students expressed
respect for the teacher. The teacher was National Board Certified, having completed
rigorous demonstration of pedagogical awareness and instructional prowess. There were
a total of 12 students included in this study served in the cluster model by this teacher
over the duration of the years studied. The third teacher who served in the cluster model
was in the eleventh year of teaching, having taught at one other school in the state of
Georgia. This teacher had previously served students in the math lab at the school.
Description of that setting will follow. The social quality in this cluster model classroom
was described as “involved” with an awareness of individual student needs. Students expressed respect for the teacher in response to high levels of expectations for achievement and behavior. There were a total of 12 students included in this study served in the cluster model by this teacher over the duration of the years studied.

**Collaborative Model Classroom**

In the collaborative model, the gifted eligible students are grouped similarly to the cluster model, with the size of the group maximized at eight students. The GaDOE (2012a) requires the following conditions to be met for collaborative model implementation:

- The collaborating gifted teacher must have a clear renewable GaPSC approved gifted education endorsement. The gifted teacher, the regular classroom teacher, and the gifted student(s) (when appropriate) collaborate and document the development of differentiated instructional strategies, Georgia standards based curriculum, and evaluation practices. The collaborating regular classroom teacher and gifted teacher must be provided adequate planning time which must be documented and approved by the LEA [local education agency].....The gifted education teacher must be given one full period each week or its monthly equivalent during which he/she has only gifted education collaborative planning responsibilities (as determined by the local system) for every three classes in which he/she has collaborative teaching responsibilities. The total number of gifted students whose instruction may be modified through this collaborative approach may not exceed eight per class….Instructional segments that have been modified for gifted learners may be counted at the gifted FTE weight if the gifted
education teacher, and regular education teacher document the curriculum modifications made for the gifted students in the following ways: separate lesson plans which show the reason(s) why any student whose instruction is counted at the gifted FTE weight needs an advanced curriculum in that particular content area (e.g., national norm-referenced tests and/or benchmark tests); a time and discussion log of the collaborative planning sessions between the teachers; individual or small group contracts indicating the differentiated learning standards for the gifted student(s) and the alternative instructional strategies in which the gifted student(s) will be engaged. (p. 15)

The lessons prepared for the collaborative model settings at Georgia Rural Elementary School are planned by a gifted education specialist and implemented by a regular education teacher. The plans are archived using the same protocols as the cluster model and augment the same curriculum using the same areas of focus. A review of the archived plans at Georgia Rural Elementary School revealed that typical lessons included differentiation from regular education lessons in the areas of content, process, product, environment and assessment, as required by the GaDOE, and that planning time is specifically scheduled between the gifted education specialist and the regular education teacher weekly. Documentation shows that it has been determined at Georgia Rural Elementary School that, due to the age of the students served, contracts are not appropriate and are not included as part of either model of gifted instruction. The review of documentation shows that the collaborative model at Georgia Rural Elementary School adhered to the conditions set forth in the state’s policy guidelines, assuming that all documentation was completed accurately and honestly.
To address the implementation threat to validity open-ended questions were asked in conjunction with review of the archived documentation regarding the collaborative model exactly as they were for the cluster model. There was one direct instruction teacher in the first and second years of experience, having only taught at GRES. The social quality in the classroom was described as “trendy” with high expectations for achievement and behavior. Students showed respect for the teacher; however, it was noted that a lack of pedagogy was evident though improved each year. All of the students who were included in this study as being served in the collaborative model during the academic years being studied were served by the same direct instruction collaborative model teacher. The collaborative model teacher served one cohort of students in the 2009-2010 academic year and another cohort of students in the 2010-2011 academic year. There was not a cohort of students served in the collaborative model during the 2011-2012 academic year. This teacher obtained gifted endorsement the third year of the study and served a cohort of students in the cluster model that year. This teacher was therefore present in both settings. The gifted resource model teacher served as the consultative teacher with whom the collaborative model service provider worked closely to plan for model implementation.

**Resource Model Classroom**

Students served in both cluster and collaborative models for mathematics also received gifted instruction using the resource model in a pull-out setting daily. This instruction integrated higher order thinking skills with cross-curricular projects and was documented as being delivered exactly the same to both groups by the same instructor. Archived documentation showed that the instruction in the resource model was not
limited to the sole curriculum of mathematics. The instructor served as the consultative
gifted specialist for the collaborative model. To maintain consistency, open-ended
questions were asked in conjunction with review of the archived documentation
regarding the resource model to garner information about the affective characteristics of
the teacher and setting since she worked in conjunction with the collaborative model.
The resource teacher had between six and nine years experience teaching over the
duration of the study, with between four and seven years experience teaching gifted
students after obtaining a gifted endorsement. The teacher, having taught at only the
research site, was described as innovative and creative. The social quality in the
classroom was described as “intensive” with focused and intentional efforts to offer
extension opportunities for students. Students expressed respect for the teacher and were
eager to please the teacher by meeting the high expectations set. The teacher was
previously chosen by peers to represent as the school’s teacher of the year. Every student
included in this study was served in the resource model daily by this teacher over the
duration of the years studied. Notably the structure of the gifted program at Georgia
Rural Elementary School prescribes that students in all grades are served in the resource
model daily by this same teacher. Therefore, some of the students may have been served
every day in the gifted resource model since the third grade by this teacher. The gifted
resource classroom was located on a separate hall from the cluster and collaborative
model settings in the same school building. Although this instructional model does not
serve as a category of the independent variable in this study, it is noted here to show that
it was consistent for students in both models since it supported the mathematics
curriculum delivery in fifth grade.
Supplementary Instruction Labs

The research site used funding from Title I to create labs for additional instruction in the areas of mathematics and technology to be supplemental to the instruction required and taught in general education settings. All students in the entire school population were served in these settings during the years noted.

Math lab. The math lab was a setting in which classes focused on mathematics concepts being taught in the general classroom setting. Time spent in the math lab was scheduled as a part of a rotational exploratory class. Every five weeks, classes would spend a daily 45-minute segment of time for a week in the math lab. Students in the 2009-2010 and 2010-2011 school years were served in this setting. Due to a lack of funding, the math lab teacher was moved to teach fifth grade during the 2011-2012 school year. During that year, the teacher served as a cluster model service provider. Therefore, it was possible that students served in the fifth grade cluster model by the provider during the 2011-2012 school year had also been taught by that same teacher in a different setting for a different purpose in the previous two school years.

Technology lab. The technology lab was a setting in which classes used technology focused on various curricular concepts to supplement instruction in the regular classroom. Time spent in the technology lab was scheduled as a part of a rotational exploratory class just like the math lab was scheduled. Every five weeks, classes would spend a daily 45-minute segment of time for a week in the technology lab. This was the setting in which the STAR Math assessment, one of the instruments used in the study, was administered. Standardization of administrations will be discussed in detail in the instrumentation section. The technology lab was located on a separate hall in
the same building as the cluster and collaborative model settings, on the same hall, next
door to the resource model setting.

**Overview of Researcher’s Roles at Research Site**

Although the ex-post facto design of the study precludes any changes to the roles
of the researcher at the site, in order to address any concerns for researcher bias or
possible extraneous variable that would decrease the internal validity of the study based
on the researcher’s various roles, full disclosure of such is essential. The role of this
researcher at the research site during the years from which the data was garnered was
varied. The researcher is one of the assistant principals at the site. In such capacity, it is
possible that the researcher conducted evaluative procedures on the teachers during the
years being studied. Additionally, it would be possible in such capacity that the
researcher dealt with disciplinary procedures regarding the students during the years
being studied. However, no instructional or grading responsibilities were part of the role
of assistant principal. Another role of this researcher at the research site during the years
studied was the school testing coordinator. In this capacity, the researcher was in charge
of verifying that standardization of testing procedures and environments were consistent
with expectations from the state and local boards of education regarding the
administration of the CRCT, which is one of the instruments used to collect data in this
study. Although this would make it possible for the researcher to have been present in
the testing environment during administration of the assessment, the researcher was not
an examiner and did not administer any sections of the instruments. Finally, the
researcher had a gifted endorsement from the Georgia Professional Standards
Commission for all of the years during which the data was collected. Due to the
noninstructional nature of the researcher’s position, there was no interaction with students or teachers where the existence of the endorsement could have been used for garnering full time equivalent funding or to provide instructional services.

Overview of RESA District and State

Due to the ex-post facto design of this study, intact groups were used and randomization was impossible, as is the case with pre-experimental designs. However, to document the representativeness of subjects in anticipation for the population threat to external validity, this researcher conducted an examination of the research site within the greater context of its school district, Regional Educational Service Agency’s (RESA) district and the state. The RESAs in Georgia support specific regions of the state divided into districts based on proximity. These agencies offer professional development specialized to assist schools in school improvement endeavors and other instructional support. All school systems in the state are supported through a RESA. The research site is in the Chattahoochee-Flint RESA district, which represents 15 school districts. During the academic years examined, the research site was found to be comparable in enrollment population to the school district and RESA district in gender ratios and low socioeconomic status; however, the research site was found to be more comparable to the state in the percentage of gifted students served (see Table 3). The specific data examined was collected regarding fifth grade students who took the CRCT: Grade 5 Math assessment (Governor’s Office of Student Achievement, 2012 & 2013).
Table 3

_Fifth Grade Enrollment Population at Research Site Compared to School District, RESA District and State_

<table>
<thead>
<tr>
<th>Group</th>
<th># of Students</th>
<th>Female</th>
<th>Male</th>
<th>Low SES</th>
<th>Gifted</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2009-2010</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>State</td>
<td>127,228</td>
<td>48.9%</td>
<td>51.1%</td>
<td>59.2%</td>
<td>9.8%</td>
</tr>
<tr>
<td>RESA District</td>
<td>3921</td>
<td>49.1%</td>
<td>50.9%</td>
<td>71.4%</td>
<td>3.3%</td>
</tr>
<tr>
<td>School District</td>
<td>386</td>
<td>51.6%</td>
<td>48.5%</td>
<td>100.0%</td>
<td>5.6%</td>
</tr>
<tr>
<td>Research Site</td>
<td>222</td>
<td>54.5%</td>
<td>45.5%</td>
<td>100.0%</td>
<td>8.1%</td>
</tr>
<tr>
<td><strong>2010-2011</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>State</td>
<td>125,821</td>
<td>49.4%</td>
<td>50.6%</td>
<td>59.8%</td>
<td>10.4%</td>
</tr>
<tr>
<td>RESA District</td>
<td>4056</td>
<td>48.8%</td>
<td>51.2%</td>
<td>77.8%</td>
<td>3.2%</td>
</tr>
<tr>
<td>School District</td>
<td>408</td>
<td>52.5%</td>
<td>47.6%</td>
<td>100.0%</td>
<td>6.4%</td>
</tr>
<tr>
<td>Research Site</td>
<td>249</td>
<td>53.4%</td>
<td>46.6%</td>
<td>100.0%</td>
<td>10.6%</td>
</tr>
<tr>
<td><strong>2011-2012</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>State</td>
<td>116,784</td>
<td>50.2%</td>
<td>49.8%</td>
<td>60.3%</td>
<td>16.9%</td>
</tr>
<tr>
<td>RESA District</td>
<td>3501</td>
<td>—</td>
<td>—</td>
<td>82.9%</td>
<td>3.1%</td>
</tr>
<tr>
<td>School District</td>
<td>311</td>
<td>—</td>
<td>—</td>
<td>84.0%</td>
<td>6.1%</td>
</tr>
<tr>
<td>Research Site</td>
<td>211</td>
<td>47.0%</td>
<td>53.0%</td>
<td>84.0%</td>
<td>11.5%</td>
</tr>
</tbody>
</table>

_Note._ Data not available noted with dash marks. Number of students tested in fifth grade for years noted. Percentages based on number of students tested, with the exception of the percentage of gifted students. Gifted enrollment is based on total school district enrollment. Socioeconomic status of 100% is based on Title I total school program, as reported to the Georgia Department of Education. SES = Socioeconomic Status; RESA District = Regional Education Service Agency District

Additional demographic representation was examined and revealed that the research site was comparable in ethnicity and race representation to the school district.
and RESA district but differed greatly in the larger percentage of minorities represented over those represented on the state level (see Table 4). Again, the specific data examined was collected regarding fifth grade students who took the CRCT: Grade 5 Math assessment (Governor’s Office of Student Achievement, 2012 & 2013).

Table 4

*Fifth Grade Demographics of Research Site Compared to School District, RESA District and State*

<table>
<thead>
<tr>
<th>Group</th>
<th>2009-2010</th>
<th>2010-2011</th>
<th>2011-2012</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Asian</td>
<td>Black</td>
<td>Hispanic</td>
</tr>
<tr>
<td>State</td>
<td>3.2%</td>
<td>37.1%</td>
<td>11.6%</td>
</tr>
<tr>
<td>RESA District</td>
<td>1.3%</td>
<td>60.7%</td>
<td>4.5%</td>
</tr>
<tr>
<td>School District</td>
<td>0.5%</td>
<td>75.9%</td>
<td>5.7%</td>
</tr>
<tr>
<td>Research Site</td>
<td>0.9%</td>
<td>67.1%</td>
<td>5.4%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>2009-2010</th>
<th>2010-2011</th>
<th>2011-2012</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Asian</td>
<td>Black</td>
<td>Hispanic</td>
</tr>
<tr>
<td>State</td>
<td>3.4%</td>
<td>37.1%</td>
<td>12.0%</td>
</tr>
<tr>
<td>RESA District</td>
<td>1.5%</td>
<td>62.5%</td>
<td>5.3%</td>
</tr>
<tr>
<td>School District</td>
<td>0.5%</td>
<td>77.0%</td>
<td>7.1%</td>
</tr>
<tr>
<td>Research Site</td>
<td>0.8%</td>
<td>67.9%</td>
<td>7.2%</td>
</tr>
</tbody>
</table>

Note. Percentages based on number of fifth grade students tested. RESA District = Regional Education Service Agency District


Instrumentation

STAR Math Assessment

The STAR Math assessment created by Renaissance Learning (2009) was one of the instruments used in this study, specifically to inform Research Question One. This computer-based adaptive assessment is given as a benchmark to monitor progress at prescribed intervals at least twice an academic year. The STAR Math assessment consists of 24 selected-response questions and is tailored to each student based on responses using the adaptive feature from an item bank of over 1900 possible questions (Renaissance Learning, 2009). According to Renaissance Learning (2012c), extensive item calibration determines each test item's difficulty in relation to thousands of other students through the application of item response theory and computer-adaptive testing. The software provides individualized reports regarding student performance.

The STAR Math assessment tests the following domains: “numbers and operations, algebra, geometry and measurement, data analysis, statistics, and probability” (Renaissance Learning, 2012a, p. 49). The item banks are broken down by number and type as follows: “items 1–8: numeration concepts, items 9–16: computation processes, items 17–24: word problems, estimation, data analysis and statistics, geometry, measurement, algebra” (Renaissance Learning, 2012b, p. 9). Overall, the assessment covers 8 strands with 214 objectives (p. 9). The average administration time is 11.5 minutes with a standard deviation of 4 minutes (p. 9). Based on information available from Renaissance Learning (2012b), there have been 29 published predictive validity studies including 39,869 students with a correlation of .70 for fifth grade STAR scale scores and later performance on accountability tests used to document AYP for NCLB.
Renaissance Learning (2012b) has also referenced 58 published concurrent validity studies including 6,873 students with a correlation of .64 for fifth grade STAR scale scores and external assessments of mathematics achievement. Since Cronbach’s alpha cannot be used with adaptive tests, estimates of the internal consistency reliability were calculated using the split-half method, yielding 0.8 reliability (Renaissance Learning, 2009). In a norming study construct validity was determined comparing the increases in scaled scores over grades (Renaissance Learning, 2009).

The scale score from the STAR Math assessment was collected as the unit of analysis from the fall benchmark, or pretest, and the spring benchmark, or posttest. The scale scores on STAR Math assessments range from 0-1400 (Renaissance Learning, 2012b) and are “calculated based on the difficulty of items and the number of correct responses” (p. 26). Specifically, the mean scale score for the fall benchmark in fifth grade is 645 based on the fall 2008 to fall 2011 STAR Math norming study (Renaissance Learning, 2012d, p. 94) with a standard deviation of 98. The mean scale score for the spring benchmark in fifth grade is 710 based on the spring 2008 to spring 2011 STAR Math norming study (p. 94) with a standard deviation of 100. The scale scores correspond to a functional grade level score at which the student performs with 70 percent accuracy or better (Renaissance Learning, 2012d). The standard error of measurement is 40 points. Therefore, a student’s scale score provides a functional grade level confidence band of 40 points below and 40 points above the scale score (Renaissance Learning, 2012d). The cut scores are assigned to categories as follows: at or above benchmark category corresponds to a scale score at or above 648, on watch category corresponds to a scale score between 608 and 647, intervention category
corresponds to a scale score between 545 and 607, and urgent intervention category corresponds to a scale score below 544 (Renaissance Learning, 2010).

The assessment has been deemed reliable through being normed to the population from which the sample in this study is drawn. In fact, the school to which the population at the research site directly feeds was a part of the norming study (Renaissance Learning, 2009). Specifically,

STAR Math reliability was estimated using three different methods (split-half, generic, and test-retest) when the test was normed in the spring of 2002. Renaissance Learning obtained a nationally representative sample by selecting school districts and schools based on their geographic location, per-grade district enrollment, and socioeconomic status. The final norming sample for STAR Math included approximately 29,200 students from 312 schools in 48 U.S. states. The reliability estimates were very high, comparing favorably with reliability estimates typical of other published math achievement tests…During the STAR Math norming study, schools submitted their students’ STAR Math results along with data on how their students performed on other popular standardized tests. Scores were received for more than 10,000 students. The resulting correlation estimates were substantial and reflect well on the validity of STAR Math as a tool for assessing math achievement. (Renaissance Learning, 2012b, p. 18)

Renaissance Learning (2010) reported collecting and analyzing three types of reliability data (p. 8), including alternate forms reliability, and concluded that “in all types of analysis, the reliability level of STAR Math exceeds .90,” thus the assessment is highly reliable (Gall et al., 2007). The STAR Math assessment has been deemed reliable and
valid for assessing student achievement in mathematics; therefore, it is an appropriate instrument to assess the dependent variable in this study. Since the STAR Math assessment was given at the beginning and end of the academic years, archival data exists from pretests and posttests and can therefore provide the means for establishing equality of groups ensuring the selection threat to validity has been addressed. The structure of the instrument requires students to take a 5-question “pretest” at the beginning of the assessment to familiarize the student with the user interface of the software. This “pretest” does not count for or against the student; however it is required to be completed prior to beginning the actual test. Since the students at the school take the assessment three times a year, fall, winter, and spring, the testing threat to validity is present, particularly for those who have taken the assessment for all years in school. The adaptive nature of the software precludes the assessment from being identical to one given in the past; therefore, parallel test forms address this threat.

**CRCT Math Assessment**

The second instrument used in this study is the CRCT Math assessment (GaDOE, 2012c) is a criterion-referenced assessment measuring students’ mastery of Georgia Performance Standards. The CRCT Math assessment instrument was used in this study to inform Research Question Two. The assessment is administered as a cumulative assessment at the end of each academic year to assess how well students master the curriculum as is required by Georgia law (O.C.G.A. § 20-2-281) for students in grades three through eight. This instrument is used to collect data as required by NCLB (2001) for accountability purposes. The CRCT is a selected response assessment and was developed through a process of expert authorship and field testing with series and cycles
of refinement and rejection for future test versions. The assessments have a total of 60 questions divided over two sections given during one testing session. Each section has a minimum testing time of 45 minutes and a maximum testing time of 70 minutes with a ten minute break between sections comprising the entire testing session administration. Scale scores are reported with correlating performance levels of mastery. Performance levels of mastery are as follows for the 2010, 2011, and 2012 Georgia CRCT: Grade 4 and Grade 5 Math assessments: the exceeds expectations category has corresponding scale scores of 850 and above, the meets expectations category has corresponding scale scores of 800 to 849, and the does not meet expectations category has corresponding scale scores of below 800 (GaDOE, 2010a, 2011a, 2011b, 2012b). These assessments are equated in order to allow use of multiple forms and in subsequent years’ administrations, thereby enforcing the same standard for performance (GaDOE, 2010a). Equating “permits one to interpret differences in test performance as the result of changes in student achievement as opposed to fluctuations in the properties of the test form” (GaDOE, 2010a, p. 3). For each of the years in the study, the GaDOE reports alignment studies used to collect evidence of internal consistency (GaDOE, 2010a, 2011b, 2012b). Additionally, external validity has been established in comparison with external assessments used to assess the same constructs (GaDOE, 2010a, 2011b, 2012b). As an analysis of construct validity, this researcher collected data (Governor’s Office of Student Achievement, 2012 & 2013) regarding student performance on the assessment over a period of three years on various population levels (see Table 5). Gall et al. (2007) advised that content-related validity evidence is important when comparing instructional methods using an assessment instrument. If an assessment has construct validity, the
researcher can use the evidence collected as a true measure of achievement on the content.

Table 5

Percentages of Students Meeting and Exceeding on the Georgia CRCT: Grade 5 Math Assessment

<table>
<thead>
<tr>
<th>Groups</th>
<th>All</th>
<th>Gifted</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009-2010</td>
<td></td>
<td></td>
</tr>
<tr>
<td>State</td>
<td>89%</td>
<td>100%</td>
</tr>
<tr>
<td>RESA District</td>
<td>83%</td>
<td>100%</td>
</tr>
<tr>
<td>School District</td>
<td>76%</td>
<td>100%</td>
</tr>
<tr>
<td>Research Site</td>
<td>80%</td>
<td>100%</td>
</tr>
<tr>
<td>2010-2011</td>
<td></td>
<td></td>
</tr>
<tr>
<td>State</td>
<td>92%</td>
<td>100%</td>
</tr>
<tr>
<td>RESA District</td>
<td>87%</td>
<td>100%</td>
</tr>
<tr>
<td>School District</td>
<td>80%</td>
<td>100%</td>
</tr>
<tr>
<td>Research Site</td>
<td>82%</td>
<td>100%</td>
</tr>
<tr>
<td>2011-2012</td>
<td></td>
<td></td>
</tr>
<tr>
<td>State</td>
<td>91%</td>
<td>100%</td>
</tr>
<tr>
<td>RESA District</td>
<td>86%</td>
<td>100%</td>
</tr>
<tr>
<td>School District</td>
<td>76%</td>
<td>100%</td>
</tr>
<tr>
<td>Research Site</td>
<td>80%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Note. Percentages based on number of students tested, not number of students enrolled. RESA = Regional Educational Service Agency

The information presented shows consistency within percentage point ranges of 2, 4, 4, and 3 at the research site, school district, RESA district, and state, respectively, over the
duration of the years studied. Thus, construct validity has been deemed valid.

Cronbach’s alpha has been reported for each year’s assessment as a measure of the internal consistency: 2010 – Grade 4 was .92 and Grade 5 was .93; 2011 – Grade 4 was .92 and Grade 5 was .91; 2012 – Grade 4 was .92 and Grade 5 was .91 (GaDOE, 2010a, 2011b, 2012b). Each year’s assessments indicate high reliability (Gall et al.). Cronbach’s alpha was computed to test the reliability of the assessments used in the present study. Cronbach’s alpha was found to be .73 and .78 for the Grade 4 and Grade 5 assessments, respectively, indicating that internal consistency is approaching the .80 Gall et al. consider sufficiently reliable for most research purposes.

The CRCT Math assessment has been created specifically to test the mathematics achievement of Georgia students in reference to the Georgia Performance Standards and, based on studies noted, has been determined reliable and valid for assessing student achievement in mathematics; therefore, it is an appropriate instrument to assess the dependent variables for Research Question Two in the study. Since the CRCT Math assessment was administered at the end of each academic year, archival data exists from the fourth grade and fifth grade administrations. Scale scores on each of the assessments were used as units of analysis. The data collected from the fourth grade assessments was used to establish equality of groups to ensure the selection threat to validity was addressed.

The CRCT Math assessments have subscales for which raw scores are reported in the domains of numbers and operations, measurement, algebra, geometry, and data analysis and probability. The data collected from the subscales were also analyzed. Gall et al. (2007) note that the reliability of subscores do not generally yield reliability
measures as high as total scores and should therefore be used cautiously (p. 201). The GaDOE has not published any reliability reports on the subscales. The total allowable raw scores in the subscales for the CRCT: Grade 4 Math assessment were as follows: numbers and operations – 26, measurement – 10, geometry – 12, algebra – 6, data analysis and probability – 6. The total allowable raw scores in the subscales for the CRCT Grade 5 Math assessment were as follows: numbers and operations – 23, measurement – 19, geometry – 6, algebra – 6, data analysis and probability – 6.

**Procedures**

**Preliminary Processes**

Approval for conducting the study and subsequent approval to changes were received from the Liberty University Institutional Review Board (see Appendices A & B). Once institutional approval was obtained, local consent was sought from the school principal and system superintendent through a letter of request (see Appendix C). Due to the archival nature of the data, no consent or assent forms were necessary. Once local consent was gained from the principal and superintendent (see Appendix D), permission to use the STAR Math assessment as an instrument in the study was sought from the publisher, Renaissance Learning. Additionally, permission to use the CRCT Math assessment as an instrument in the study was sought from the publisher, CTB/McGraw-Hill. These consents were procured through subsequent correspondence from the publishers.

Due to the primary researcher’s role as test coordinator at Georgia Rural Elementary School, most archival data is readily accessible; however, to ensure the integrity of the study, a formal request was sent to the gifted education specialist to
collect the following data for all fifth grade students served in the cluster or collaborative models for mathematics: gender, race, socioeconomic status based on free/reduced lunch, homeroom teacher, mathematics teacher in fifth grade, gifted instructional model for mathematics, year in fifth grade at the research site, scale scores on fall and spring administrations of the STAR Math assessment from the fifth grade, scale and subscale scores on CRCT: Grade 4 and Grade 5 Math assessments for the 2009-2010, 2010-2011 and 2011-2012 school years. The third party gifted education specialist provided an Excel spreadsheet containing the data requested, having linked the data per student to codes she developed to represent each student that would not include personal identifiers known to the researcher. The data was sent securely to the researcher and saved on a jumpdrive which was kept secure at the research site's record vault until data analysis was complete. Following the guidelines of the Federal Educational Rights and Privacy Act (1974), Georgia Rural School District was protected from institutional liability through preservation of privacy during the collection of information regarding the students and teachers for each model during each year the data were collected, including demographic and certification status information.

**Review of Archival Documentation**

This researcher reviewed documents which included lesson plans, collaborative planning documentation sources, and details regarding between-group similarities including curriculum, pacing, group sizes, and environment, as well as between-group differences including instructional strategies, certification status, demographics, and teaching experience. The review of these documents provided confirmation that the guidelines of the GaDOE (2012a) gifted education program were followed during the
years of the study. This could not entirely establish treatment fidelity; therefore, additional sources of information regarding model implementation were reviewed.

Other documentation reviewed included proof of trainings for teachers in how to administer the instruments during the years of the study. There was evidence of standardization of the CRCT Math assessment administration. Explicit disclosure is important here to note that the researcher, in the role as test coordinator at the research site for the state’s high stakes accountability assessment, the CRCT, served as the trainer and created the original documentation proving the trainings occurred and the environments were standardized for administration of the assessments. The testing location for the CRCT Math assessment was the homeroom classroom for the students. This may or may not have been the classroom in which the mathematics curriculum was taught. Administrations of the CRCT Math assessment followed standardized protocols and were given between 8:00 A.M. and 11:30 A.M. during the first two weeks of April each year of the study.

No documentation could be found that proved examiners were trained in administering the STAR Math assessment or subsequent standardization of the administrations. The structure of the adaptable software is standard; nevertheless, the environment in which the assessment was given was not documented as having been standardized. The testing location for the STAR Math assessment administrations was the technology lab located next door to the gifted resource classroom. The lab had enough computers for every student to have his/her own station, separated by dividers, to complete the assessment without disturbance, according to documentation. The STAR Math assessment administrations were given throughout the school day at varying times.
The pretest, or fall benchmark, was given in August each year of the study. The posttest, or spring benchmark, was given in May each year of the study.

**Informal Interviews**

In order to thoroughly document the settings for each model implemented, short, informal interviews were conducted with the cluster and collaborative teachers who served the students for whom the data was collected. No data was collected through these informal interviews and no information gleaned was analyzed in any way during data analysis. One of the teachers of the cluster model no longer teaches at the research site and could not be interviewed. Informal interviews were also conducted with the math academic coach, the gifted education specialist, and the assistant principal. Interview questions included open-ended prompts and were asked following the same protocol to garner information about the environments and dispositions of the teachers. Although this did not contribute to data for analysis it did allow for comparisons in the affective dimensions of the instructional environments for narrative purposes when retrospectively considering fidelity of program implementation.

The following questions were asked of the cluster and collaborative teachers:

What were typical lessons like in your cluster or collaborative classroom? How did you document the service you provided the students in your cluster or collaborative classroom? How was the instruction given to gifted students in your classroom different than that given to general education students? How would you describe the feeling of your classroom? Likewise, the following questions were asked of the gifted education specialist, math academic coach, and assistant principal: What were typical lessons like in the cluster or collaborative classrooms? How did service providers document the
services provided to the students? How was the instruction given to gifted students in the classrooms different than that given to general education students? How would you describe the feeling of the cluster and collaborative classrooms? The math academic coach and assistant principal were also asked the following questions regarding the gifted education specialist since the resource model was provided by her and the collaborative model was implemented with her guidance: How did the collaborative model teacher and the gifted education teacher collaborate? How did you know lessons were planned by the gifted education specialist as opposed to the collaborative teacher? How would you describe the feeling of the resource classroom? The responses were noted for narrative purposes.

**Data Analysis**

The following research questions were the focus of this study:

Research Question One: What is the difference in mathematics achievement as measured by the STAR Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement?

Research Question Two: What is the difference in mathematics achievement as measured by the CRCT Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement?

The following null hypotheses were provided for the study.
Null hypothesis corresponding with Research Question One:

$H_{01}$: There is no statistically significant difference in mathematics achievement as measured by the STAR Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement.

Null hypotheses corresponding with Research Question Two:

$H_{02}$: There is no statistically significant difference in overall mathematics achievement as measured by the CRCT Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement.

$H_{03}$: There is no statistically significant difference in mathematical competency in numbers and operations as measured by the CRCT Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement.

$H_{04}$: There is no statistically significant difference in mathematical competency in measurement as measured by the CRCT Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement.
$H_05$: There is no statistically significant difference in mathematical competency in geometry as measured by the CRCT Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement.

$H_06$: There is no statistically significant difference in mathematical competency in algebra as measured by the CRCT Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement.

$H_07$: There is no statistically significant difference in mathematical competency in data analysis and probability as measured by the CRCT Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement.

To test the research hypothesis for Research Question One, an independent $t$-test was conducted to determine if there was a statistically significant difference in the means of the comparison groups’ scores on the STAR Math assessment pretest. There was no statistically significant difference in STAR Math assessment pretest scores; therefore, prior achievement was not used as a covariate in posttest analyses as the researcher was able to assume that differences in the posttest means could be more clearly attributed to the independent variable rather than preexisting differences (Howell, 2011). An analysis
of variance (ANOVA) was conducted to evaluate the differences in the means of the STAR Math assessment posttest scores, using an alpha level of .05.

Preliminary analyses were conducted to assess the assumptions for the ANOVA. The assumptions tested were no outliers, normality and homogeneity of variance. SPSS software, version 19, was used to conduct the analyses. A boxplot was created to test the assumption of no outliers; Kolmogorov-Smirnov test with Lilliefors’s Significance Correction was conducted to test the assumption of normality; and, Levene’s Test for Equality of Variances was analyzed to test the homogeneity of variance.

The effect size was computed using partial eta squared and interpreted using Cohen’s $d$ (1988) with the observed power calculated using SPSS, version 19. Wendorf (2009) noted that Cohen’s $d$ is used “to provide a standardized measure of an effect defined as the difference between two means…” and indicates “the size of the treatment effect relative to the within-group variability of scores” (p. 3). Cohen (1988) prescribed a minimum of 30 participants per group to conduct an ANOVA with a medium effect size (.5) and significance level of $p < .05$ in order to have a power of .80. The groups in this study were comprised of 32 and 35 participants, thus satisfying recommendations set forth by Cohen for the statistical analysis used.

To test the research hypotheses for Research Question Two, an independent $t$-test was conducted to determine if there was a statistically significant difference in the means of the comparison groups’ scores on the CRCT: Grade 4 Math assessment. There were no statistically significant differences in the overall mathematics achievement scale scores and the mathematical competency scores on the five subscales; therefore, prior achievement was not used as a covariate on cumulative assessment data analyses. This
was consistent with the findings from the STAR Math assessment data and also allowed
the researcher to assume the differences on the CRCT: Grade 5 Math cumulative
assessment’s mean scale scores and subscale scores could be more clearly attributed to
the independent variable (Howell, 2011) and the groups were initially similar. A
multivariate analysis of variance (MANOVA) was conducted to evaluate the differences
in means of the comparison groups’ scores on the CRCT: Grade 5 Math assessment scale
scores and mathematical competency scores on the five subscales using an alpha level of
.01. Green and Salkind (2011) note that a one-way MANOVA “evaluates whether the
population means on a set of dependent variables vary across levels of a factor or factors”
(p. 222). This analysis was most appropriate because the groups were characterized by
one independent variable with two categories and five correlated dependent variables
(Green & Salkind). The Bonferroni procedure adjusted the alpha level for the posthoc
pairwise comparisons to .01 to control for Type I error (Green & Salkind). The posthoc
pairwise comparisons evaluated the differences in the posttest subscale scores to test
hypotheses two through seven.

Preliminary analyses were conducted to assess the assumptions for the
MANOVA. The assumptions tested were bivariate normality, no extreme outliers and
multivariate normality, linearity, multicollinearity and singularity, homogeneity of
variance-covariance, and homogeneity of variance. SPSS software, version 19, was used
to conduct the analyses. The assumption of bivariate normality was assessed using the
Kolmogorov-Smirnov test with Lilliefors’ Significance Correction. The assumptions of
no extreme outliers and multivariate normality were assessed using Mahalanobis distance
values, a normal probability plot and a scatter-plot. The assumption of linearity was
assessed using skewness statistics and observations of plots. The assumptions of multicollinearity and singularity were assessed using correlation among the dependent variables. The assumption of homogeneity of variance-covariance was assessed using Box’s M test. The assumption of homogeneity of variance was assessed using Levene’s Test for Equality of Variances.

The effect size was computed using partial eta squared and interpreted using Cohen’s $d$ (1988) with the observed power calculated using SPSS, version 19. Tabachnick and Fidell (2007) recommend the number of participants per group to be more than the number of dependent variables to conduct a MANOVA. The groups in this study were comprised of 32 and 35 participants, with a total sample of 67, thus satisfying recommendations set forth by Tabachnick and Fidell for the statistical analysis used.

In keeping with Institutional Review Board guidelines, once the three year time period of maintaining the data has expired, the researcher will reformat the jumpdrive used for storing the research data to delete all previously saved information and the files on the computer storing the data will also be deleted.
CHAPTER FOUR: FINDINGS

The purpose of this study was to determine if the mathematics achievement of gifted learners differed based on the gifted instructional model used to deliver mathematics instruction in a rural Southwest Georgia school. The models compared were the cluster and collaborative instructional models as defined by the GaDOE (2012a). This chapter presents the findings of this study. These findings are presented as pretest descriptive statistics and results for hypothesis one and hypotheses two through seven, posttest descriptive statistics, posttest inferential statistics for hypothesis one and hypotheses two through seven, and a summary of the results.

Pretest and Prior Achievement Analyses

Data analyses were conducted on each hypothesis separately, using the SPSS software version 19. Preliminary analyses were used determine whether statistical assumptions were found tenable. The level of measurement was on the interval level. Random sampling cannot be assumed due to the structure of the study. Observations for each variable were independent.

Pretest and Prior Achievement Descriptive Statistics

The total number of participants in the study was 67. The STAR Math (Renaissance Learning, 2009) assessment pretests were analyzed for pooled means and standard deviations, $M = 747.78$ ($SD = 87.98$). The overall mathematics achievement on the Georgia CRCT: Grade 4 Math (GaDOE, 2009c, 2010b, 2011c) assessment, as determined by the scale score, was analyzed for pooled means and standard deviations, $M = 869.85$ ($SD = 33.28$). Cases of missing values were excluded pairwise. There were three cases of missing values on the subscales for the Georgia CRCT: Grade 4 Math
The pooled means and standard deviations for the subscales on the Georgia CRCT: Grade 4 Math assessment were calculated as follows: numbers and operations $M = 22.45$ ($SD = 2.34$); measurement $M = 8.78$ ($SD = 1.45$); geometry $M = 9.95$ ($SD = 1.68$); algebra $M = 5.58$ ($SD = 0.69$); and data analysis and probability $M = 5.75$ ($SD = 0.56$). The descriptive statistics for the dependent variables disaggregated according to comparison groups, cluster and collaborative, are presented in Table 6.

Table 6

Pretest and Prior Achievement Descriptive Statistics for Dependent Variables, Disaggregated by Comparison Groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cluster Model $(n = 32)$</th>
<th>Collaborative Model $(n = 35)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAR Math</td>
<td>750.38 $SD = 68.20$</td>
<td>745.40 $SD = 103.79$</td>
</tr>
<tr>
<td>CRCT: Grade 4 Math</td>
<td>865.19 $SD = 32.42$</td>
<td>874.11 $SD = 33.95$</td>
</tr>
<tr>
<td>Numbers and Operations</td>
<td>22.28 $SD = 2.30$</td>
<td>22.63 $SD = 2.39$</td>
</tr>
<tr>
<td>Measurement</td>
<td>8.97 $SD = 1.06$</td>
<td>8.59 $SD = 1.76$</td>
</tr>
<tr>
<td>Geometry</td>
<td>9.72 $SD = 1.65$</td>
<td>10.19 $SD = 1.69$</td>
</tr>
<tr>
<td>Algebra</td>
<td>5.47 $SD = 0.76$</td>
<td>5.69 $SD = 0.59$</td>
</tr>
<tr>
<td>Data Analysis &amp; Probability</td>
<td>5.69 $SD = 0.59$</td>
<td>5.81 $SD = 0.54$</td>
</tr>
</tbody>
</table>

Pretest Results for Hypothesis One

The null hypothesis for Research Question One, that there is no statistically significant difference in mathematics achievement as measured by the STAR Math assessment of fifth grade gifted students who receive instruction in the collaborative
instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement, was evaluated using an independent *t*-test on pretest scores for both comparison groups. The assumption of normality was tested using the Kolmogorov-Smirnov test for normality with Lilliefors’s Significance Correction. Normality was found tenable for both groups at the alpha level of .05 (Howell, 2011). Homogeneity of variance was evaluated on the SPSS output using Levene’s Test for Equality of Variance, which was not found tenable, $F(65) = 5.56, p = .02$; therefore, the findings were reported using the SPSS output for equal variances not assumed.

The results of the independent samples *t*-test were not significant, $t(59.21) = 0.23, p = .82$, indicating that there was no significant difference between the scores of the cluster group ($M = 750.38, SD = 68.20$) and the collaborative group ($M = 745.40, SD = 103.79$). The mean difference was 4.98 and the effect size was .001 ($\eta^2 = .01$) indicating a small effect based on Cohen (1988). The 95% confidence interval for the difference between the means was -37.62 and 47.57. Therefore, based on the results of no significant difference in STAR Math assessment pretest scores, the researcher was able to assume the groups were similar and the measurement of prior achievement, scale scores on the pretest, was not used as a covariate (Howell, 2011).

**Prior Achievement Results for Hypotheses Two through Seven**

The null hypothesis for Research Question Two, that there is no statistically significant difference in overall mathematics achievement as measured by the CRCT Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive
instruction in the cluster instructional model while controlling for previous mathematics achievement, was evaluated using an independent t-test on CRCT: Grade 4 Math assessment scores for both comparison groups. The assumption of normality was tested using the Kolmogorov-Smirnov test for normality with Lilliefors’ Significance Correction. Normality was not found tenable for both groups at the alpha level of .05 (Howell, 2011). However, the t-test is robust with moderate violations of the assumptions of normality (Sprinthall, 1994). Homogeneity of variance was evaluated on the SPSS output using Levene’s Test for Equality of Variance, which was found tenable, $F(65) = .41, p = .52$; therefore, the findings were reported using the SPSS output for equal variances assumed.

The results of the independent samples t-test were not significant, $t(65) = -1.10, p = .28$, indicating that there was no significant difference between the scores of the cluster group ($M = 865.19, SD = 32.42$) and the collaborative group ($M = 874.11, SD = 33.95$). The mean difference was -8.93 and the effect size was .018 ($\eta^2 = .01$) indicating a small effect based on Cohen (1988). The 95% confidence interval for the difference between the means was -25.16 and 7.30. Therefore, based on the results of no significant difference in CRCT: Grade 4 Math assessment overall mathematics achievement scores, the researcher was able to assume the groups were similar and the scale scores as the measurement of prior achievement were not used as a covariate in posttest data analysis (Howell, 2011).

An independent t-test was conducted for each of the CRCT: Grade 4 Math assessment subscales. Assumption testing was conducted for null hypothesis three as related to the numbers and operations subscale for both comparison groups. The
The assumption of normality was tested using the Kolmogorov-Smirnov test for normality with Lilliefors’s Significance Correction. Normality was not found tenable for both groups at the alpha level of .05 (Howell, 2011). Homogeneity of variance was evaluated on the SPSS output using Levene’s Test for Equality of Variance, which was found tenable, $F(62) = .38, p = .54$.

The results of the independent samples $t$-test were not significant, $t(62) = -.59, p = .56$, indicating that there was no significant difference between the numbers and operations subscale scores for the cluster group ($M = 22.28, SD = 2.30$) and the collaborative group ($M = 22.63, SD = 2.39$). The mean difference was -.34 and the effect size was .005 ($\eta^2 = .01$) indicating a very small effect based on Cohen (1988). The 95% confidence interval for the difference between the means was -1.52 and .83.

Assumption testing was conducted for null hypothesis four as related to the measurement subscale for both comparison groups. The assumption of normality was tested using the Kolmogorov-Smirnov test for normality with Lilliefors’s Significance Correction. Normality was not found tenable for both groups at the alpha level of .05 (Howell, 2011). Homogeneity of variance was evaluated on the SPSS output using Levene’s Test for Equality of Variance, which was not found tenable, $F(50.98) = 6.92, p = .01$.

The results of the independent samples $t$-test were not significant, $t(50.98) = 1.03, p = .31$, indicating that there was no significant difference between the measurement subscale scores for the cluster group ($M = 8.97, SD = 1.06$) and the collaborative group ($M = 8.59, SD = 1.06$). The mean difference was .38 and the effect size was .017 ($\eta^2$).
indicating a small effect based on Cohen (1988). The 95% confidence interval for the difference between the means was -.35 and 1.10.

Assumption testing was conducted for null hypothesis five as related to the geometry subscale for both comparison groups. The assumption of normality was tested using the Kolmogorov-Smirnov test for normality with Lilliefor’s Significance Correction. Normality was not found tenable for both groups at the alpha level of .05 (Howell, 2011). Homogeneity of variance was evaluated on the SPSS output using Levene’s Test for Equality of Variance, which was found tenable, $F(62) = .16, p = .70$.

The results of the independent samples $t$-test were not significant, $t(62) = -1.12, p = .27$, indicating that there was no significant difference between the geometry subscale scores for the cluster group ($M = 9.72, SD = 1.65$) and the collaborative group ($M = 10.19, SD = 1.69$). The mean difference was -.47 and the effect size was .019 ($\eta^2 = .01$) indicating a small effect based on Cohen (1988). The 95% confidence interval for the difference between the means was -1.30 and .37.

Assumption testing was conducted for null hypothesis six as related to the algebra subscale for both comparison groups. The assumption of normality was tested using the Kolmogorov-Smirnov test for normality with Lilliefor’s Significance Correction. Normality was not found tenable for both groups at the alpha level of .05 (Howell, 2011). Homogeneity of variance was evaluated on the SPSS output using Levene’s Test for Equality of Variance, which was not found tenable, $F(58.46) = 4.91, p = .03$.

The results of the independent samples $t$-test were not significant, $t(58.46) = -1.28, p = .21$, indicating that there was no significant difference between the algebra subscale scores for the cluster group ($M = 5.47, SD = .76$) and the collaborative group ($M = .76$) indicating a small effect based on Cohen (1988). The 95% confidence interval for the difference between the means was -1.30 and .37.
=5.69, SD = .59). The mean difference was -.22 and the effect size was .026 (\(\eta^2 = .01\)) indicating a small effect based on Cohen (1988). The 95% confidence interval for the difference between the means was -.56 and .12.

Assumption testing was conducted for null hypothesis seven as related to the data analysis and probability subscale for both comparison groups. The assumption of normality was tested using the Kolmogorov-Smirnov test for normality with Lilliefors’ Significance Correction. Normality was not found tenable for both groups at the alpha level of .05 (Howell, 2011). Homogeneity of variance was evaluated on the SPSS output using Levene’s Test for Equality of Variance, which was found tenable, \(F(62) = 2.12, p = .15\).

The results of the independent samples \(t\)-test were not significant, \(t(62) = -.87, p = .38\), indicating that there was no significant difference between the data analysis and probability subscale scores for the cluster group (\(M = 5.69, SD = .59\)) and the collaborative group (\(M = 5.81, SD = .54\)). The mean difference was -.13 and the effect size was .013 (\(\eta^2 = .01\)) indicating a small effect based on Cohen (1988). The 95% confidence interval for the difference between the means was -.41 and .16.

In summary, statistical analyses revealed no significant difference between groups on the STAR Math assessment pretest mean scale score, CRCT: Grade 4 Math assessment mean scale score or mean subscale scores. Therefore, the groups are considered as initially similar for prior achievement and statistical covariance is not needed on posttest or cumulative assessment data analyses to control for equality of groups.
Posttest and Cumulative Achievement Analyses

The total number of participants in the study was 67. There were no cases of missing values in the posttest scores.

Posttest and Cumulative Achievement Descriptive Statistics

The STAR Math (Renaissance Learning, 2009) assessment posttests were analyzed for pooled means and standard deviations, $M = 794.31$ ($SD = 83.53$). The overall mathematics achievement on the Georgia CRCT: Grade 5 Math (GaDOE, 2010a, 2011d, 2012d) assessment, as determined by the scale score, was analyzed for pooled means and standard deviations, $M = 875.96$ ($SD = 35.74$). The pooled means and standard deviations for the subscales on the Georgia CRCT: Grade 5 Math assessment were calculated as follows: numbers and operations, $M = 19.60$ ($SD = 2.58$); measurement, $M = 15.90$ ($SD = 2.50$); geometry, $M = 5.28$ ($SD = .92$); algebra, $M = 5.39$ ($SD = 1.00$); and data analysis and probability, $M = 5.48$ ($SD = 0.75$). The descriptive statistics for the dependent variables disaggregated according to comparison groups, cluster and collaborative, are presented in Table 7.
Table 7

*Posttest and Cumulative Achievement Descriptive Statistics for Dependent Variables, Disaggregated by Comparison Groups*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cluster Model</th>
<th>Collaborative Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( n = 32 )</td>
<td>( n = 35 )</td>
</tr>
<tr>
<td>STAR Math</td>
<td>M = 804.19, SD = 75.50</td>
<td>M = 785.29, SD = 90.39</td>
</tr>
<tr>
<td>CRCT Grade 5</td>
<td>M = 876.22, SD = 40.75</td>
<td>M = 875.71, SD = 31.06</td>
</tr>
<tr>
<td>Numbers and Operations</td>
<td>M = 20.00, SD = 2.40</td>
<td>M = 19.23, SD = 2.71</td>
</tr>
<tr>
<td>Measurement</td>
<td>M = 15.88, SD = 2.42</td>
<td>M = 15.91, SD = 2.61</td>
</tr>
<tr>
<td>Geometry</td>
<td>M = 4.97, SD = 1.03</td>
<td>M = 5.57, SD = 0.70</td>
</tr>
<tr>
<td>Algebra</td>
<td>M = 4.97, SD = 1.26</td>
<td>M = 5.77, SD = 0.43</td>
</tr>
<tr>
<td>Data Analysis &amp; Probability</td>
<td>M = 5.59, SD = 0.76</td>
<td>M = 5.37, SD = 0.73</td>
</tr>
</tbody>
</table>

**Posttest Inferential Statistics for Hypothesis One**

The null hypothesis for Research Question One states that there is no statistically significant difference in mathematics achievement as measured by the STAR Math assessment (Renaissance Learning, 2009) of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement. The researcher conducted an independent \( t \)-test first using the STAR Math assessment pretest scores to determine if a statistically significant difference existed between the comparison groups. There was no statistically significant difference found in previous mathematics achievement. Therefore, previous achievement
as defined as the measurement of mean pretest scale scores was not considered as a
covariate for posttest analyses (Howell, 2011). A one-way analysis of variance
(ANOVA) was conducted using STAR Math posttest mean scale scores to test the null
hypothesis for Research Question One.

Preliminary analyses to assess the assumptions for the one-way ANOVA were
carried out for null hypothesis one on the STAR Math assessment posttest data. The
assumption of no outliers was found tenable for the comparison groups using observation
of a boxplot. Observation of histograms for each group showed the collaborative group
did not have a normal distribution, unlike the cluster group. The assumption of normality
of the comparison groups was further tested through the Kolmogorov-Smirnov test with
Lilliefors’s Significance Correction using SPSS software, version 19, at the alpha level of
.05. The test confirmed observations of the histograms. Normality was found tenable for
the cluster group, $p = .20$. Normality was not found tenable for the collaborative group, $p
= .01$. However, according to Howell (2011), one-way ANOVAs are robust when
normality is not found tenable. The assumption of homogeneity of variances was tested
and found tenable using Levene’s Test of Equality of Variance $F(1, 65) = 2.167, p = .15$.

The results of the one-way ANOVA yielded no statistically significant difference
between the STAR Math assessment posttest mean scale scores of fifth grade gifted
students who receive instruction in the collaborative instructional model and fifth grade
gifted students who receive instruction in the cluster instructional model, $F(1, 66) = .85,
$ p = .36$. The effect size, determined using partial eta squared from the SPSS output, was
$.013 (\eta^2 = .01)$ indicating a small effect size based on Cohen (1988) and a small variance
in STAR Math assessment posttest mean scale scores explained by gifted instructional
model. The observed power was .15 which indicates that a Type II error is possible (Howell, 2011). Based on the findings, the researcher failed to reject the null hypothesis for Research Question One.

**Cumulative Achievement Inferential Statistics for Hypotheses Two through Seven**

Null hypothesis two for Research Question Two states that there is no statistically significant difference in overall mathematics achievement as measured by the CRCT Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement. Null hypotheses three through seven for Research Question Two state that there is no statistically significant difference in mathematical competency in the domains of numbers and operations, measurement, geometry, algebra, and data analysis and probability as measured by the corresponding subscales of the CRCT Math assessment of fifth grade gifted students who receive instruction in the collaborative instructional model as opposed to fifth grade gifted students who receive instruction in the cluster instructional model while controlling for previous mathematics achievement.

The researcher conducted an independent $t$-test first using the CRCT: Grade 4 Math assessment scores to determine if a statistically significant difference in prior achievement existed between the comparison groups. There was no statistically significant difference found in previous mathematics achievement. Therefore, previous achievement as defined by the measurement of the mean scale score and mean subscale scores on the CRCT: Grade 4 Math assessment was not considered as a covariate for posttest analyses as the groups were assumed to be initially similar in prior achievement.
(Howell, 2011). A one-way multivariate analysis of variance (MANOVA) was conducted to using CRCT: Grade 5 Math assessment mean scale scores and subscale scores to test the null hypotheses for Research Question Two.

Preliminary analyses to assess the assumptions for the one-way MANOVA were conducted for null hypothesis two, including the assumptions of normality, no extreme outliers, multicollinearity and singularity, and homogeneity of variance. The Mahalanobis distance values were assessed to evaluate the presence of extreme outliers and multivariate normality (Green & Salkind, 2011). No extreme outliers were present using the + / - 3.3 criterion and no multivariate outliers were found using the critical value of 22.458 (Tabachnick & Fidell, 2007). Therefore, the assumptions of no multivariate outliers and multivariate normality were found tenable. The assumption of bivariate normality was tested through the Kolmogorov-Smirnov test with Lilliefors’s Significance Correction. Normality on the CRCT: Grade 5 Math assessment scale score measurement of overall mathematics achievement was found tenable for both comparison groups at the .05 alpha level. Normality was not found tenable for either of the comparison groups on the dependent variables of numbers and operations, measurement, geometry, algebra, and data analysis and probability at the .05 alpha level. According to Tabachnick and Fidell (2007) one-way MANOVAs are robust in violation of normality when the sample is larger than 20. The sample size in this study is 67. The assumption of linearity was assessed using skewness statistics and observation of plots, and found tenable. The assumptions of multicollinearity and singularity were assessed using correlation among dependent variables. Although not all correlations were significant at the alpha level of .05, the assumptions were found tenable with no correlation values
above. 80 (Tabachnick & Fidell, 2007). The subscales among which correlations were not significant included algebra and numbers and operations, algebra and measurement, algebra and data analysis and probability, data analysis and probability and measurement, and data analysis and probability and geometry (see Table 8). Despite the lack of several significant correlations between dependent variables, the MANOVA remains the most appropriate analysis to control for the correlated dependent variables. The MANOVA allows for posthoc analyses to assess differences among groups for the linear combinations of dependent variables while controlling for Type I error using the Bonferroni procedure (Green & Salkind; Howell, 2011; Tabachnick & Fidell, 2007).

Table 8

Correlation Matrix for CRCT: Grade 5 Math Subscales

<table>
<thead>
<tr>
<th></th>
<th>NO</th>
<th>M</th>
<th>G</th>
<th>A</th>
<th>DAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>—</td>
<td>.55*</td>
<td>.25*</td>
<td>.16</td>
<td>.41*</td>
</tr>
<tr>
<td>M</td>
<td>.55*</td>
<td>—</td>
<td>.32*</td>
<td>.07</td>
<td>.47*</td>
</tr>
<tr>
<td>G</td>
<td>.25*</td>
<td>.32*</td>
<td>—</td>
<td>.28*</td>
<td>.22</td>
</tr>
<tr>
<td>A</td>
<td>.16</td>
<td>.07</td>
<td>.28*</td>
<td>—</td>
<td>-.03</td>
</tr>
<tr>
<td>DAP</td>
<td>.41*</td>
<td>.47*</td>
<td>.22</td>
<td>-.03</td>
<td>—</td>
</tr>
</tbody>
</table>

Note. The subscales indicated in the table are identified as follows: NO = Numbers and Operations; M = Measurement; G = Geometry; A = Algebra; DAP = Data Analysis and Probability. N = 67 for all subscales. * p < .05.

The assumption of homogeneity of variance-covariance was not found tenable using Box’s M test with an alpha level of .001, M = 84.13, F(21, 15266) = 3.61, p = .000. The assumption of homogeneity of variances for each subscale was tested using Levene’s Test for Equality of Variance with an alpha level of .01. For the subscale of numbers and operations, homogeneity of variance was found tenable, F(1, 65) = 3.97, p = .05. For the
subscale of measurement, homogeneity of variance was found tenable, \(F(1, 65) = .06, p = .81\). For the subscale of geometry, homogeneity of variance was found tenable, \(F(1, 65) = 6.05, p = .02\). For the subscale of algebra, homogeneity of variance was not found tenable, \(F(1, 65) = 21.65, p = .00\). For the subscale of data analysis and probability, homogeneity of variance was found tenable, \(F(1, 65) = .41, p = .52\). According to Green and Salkind (2011), homogeneity of variance test results should be interpreted cautiously as results may be due to violations of normality, small sample size, and/or a lack of power (p. 226). Additionally, Tabachnick and Fidell (2007) note that Box’s \(M\) test is highly sensitive and that if the ratios of largest to smallest variance among dependent variables are small (i.e., not approaching 10:1), the use of the MANOVA is not invalidated (p. 280-281). The largest ratio among the dependent variables is 8.78:1 for the algebra subscale. The next largest ratio among the dependent variables is 2.16:1 for the geometry subscale. All other ratios of largest to smallest variance are 1.28:1 and below. Based on the result of Box’s \(M\) test, lack of normality among subscales, and unequal sample sizes, Pillai’s criterion will be used to evaluate multivariate significance (Tabachnick & Fidell, 2007). Pillai’s Trace is robust in violation of homogeneity of variance-covariance and is the criterion of choice when “the research design is less than ideal…” (Tabachnick & Fidell, 2007, p. 269).

The one-way MANOVA found a statistically significant main effect difference between the comparison groups on the scale score. The Pillai’s Trace of .32 was significant, \(F(6, 60) = 4.72, p < .01\), partial \(\eta^2 = .32\), observed power .96. This indicates the researcher can reject the null hypothesis for Research Question Two as 32 percent of the multivariate variance of the dependent variables is associated with the group factor
with a very small margin for Type I error (Green & Salkind, 2011). Posthoc pairwise comparisons were conducted to determine the source of the significant difference and if a multivariate interaction effect was present. The Bonferonni procedure was used to control for Type I error, with an adjusted alpha level of .01 due to multiple comparisons (Green & Salkind; Howell, 2011).

Results of the posthoc pairwise comparison for null hypothesis three on the subscale of numbers and operations were not statistically significant, \( F(1, 65) = 1.51, p = .22 \), partial \( \eta^2 = .02 \). The observed power was .07 indicating the possibility of a Type II error. The researcher failed to reject null hypothesis three for Research Question Two. Results of the posthoc pairwise comparison for hypothesis four on the subscale of measurement were not significant, \( F(1, 65) = .004, p = .95 \), partial \( \eta^2 = .00 \). The observed power was .01 indicating the possibility of a Type II error. The researcher failed to reject null hypothesis four for Research Question Two. Results of the posthoc pairwise comparison for hypothesis five on the subscale of geometry were significant, \( F(1, 65) = 7.97, p < .01 \), partial \( \eta^2 = .11 \). The observed power was .51 indicating the possibility of a Type I error. The researcher rejected null hypothesis five for Research Question Two. Results of the posthoc pairwise comparison for hypothesis six on the subscale of algebra were significant, \( F(1, 65) = 12.70, p < .01 \), partial \( \eta^2 = .16 \). The observed power was .79. The researcher rejected null hypothesis six for Research Question Two. Results of the posthoc pairwise comparison for hypothesis seven on the subscale of data analysis and probability were not significant, \( F(1, 65) = 1.50, p = .23 \), partial \( \eta^2 = .02 \). The observed power was .15 indicating the possibility of a Type II error. The researcher failed to reject null hypothesis seven for Research Question Two.
Based on these results, there is sufficient evidence to reject the null hypothesis for Research Question Two regarding the main effect difference between comparison groups. Fifth grade gifted students who receive instruction in the collaborative instructional model do have overall mathematics achievement scores that are significantly different compared to fifth grade gifted students who receive instruction in the cluster instructional model. Additionally, students had significantly different scores on the CRCT: Grade 5 Math assessment subscales of algebra and geometry.

**Summary of the Results**

The purpose of this study was to determine if the mathematics achievement of gifted learners differed based on the gifted instructional model used to deliver mathematics instruction. The differences in mathematics achievement as measured by the STAR Math assessment (Renaissance Learning, 2009) scale scores were analyzed to determine if a statistical significance exists between the mean scale scores of fifth grade gifted students who receive instruction in the comparison models of cluster and collaborative. There were no statistically significant differences in mathematics achievement posttest scale scores between the comparison groups revealed on the STAR Math instrument. Overall mathematics achievement was also analyzed using the CRCT: Grade 5 Math assessment (GaDOE, 2010a, 2011d, 2012d) scale scores to determine if a statistically significant difference between the comparison groups exists. There was a statistically significant main effect difference in the overall mathematics achievement mean scale score between the comparison groups. Posthoc pairwise comparisons indicated statistically significant differences on the subscales of geometry and algebra.
No statistically significant differences were revealed on the subscales of numbers and operations, measurement, and data analysis and probability.
CHAPTER FIVE: DISCUSSION

This chapter will present a review of the findings of this study with a discussion of how the results can be used and the implications for the future. Specifically included are the statement of the problem, summary of the methodology and findings for each research question, discussion of the findings for each research question, implications for theoretical and practical applications, limitations, and recommendations for further research.

Statement of the Problem

The underachievement of American students in the area of mathematics has been a concern of educators, parents, policymakers, and researchers for many years. Reports of a divide between the academic aptitude of American students and their foreign counterparts abound, including the NCEE (1983) report *A Nation at Risk*, the National Math Advisory Panel’s (2008) *Foundations for Success* report, the USDOE’s (2008) follow-up report *A Nation Accountable*, and the National Center for Education Statistics (2011) report entitled *The Condition of Education 2011*, among others. Each of these reports has served to remind the public of the deficient mathematical literacy of American students. The problem of underachievement is an insidious danger to potential social capital. The gifted subgroup of learners is not immune to this problem.

When the NCLB Act of 2001 added accountability measures to ensure students were making academic gains, schools began to focus on students who had not been meeting standards. This caused an even further gap between gifted students’ potential and performance, as attention was not proportionally served to this segment of the population since it was already meeting the standards on standardized assessments of
achievement (Hopson-Lamar, 2009). Compounding this effect is the lack of federal funding and mandating for gifted education. Although states like Georgia have enacted legislation to afford these services for students, the lack of a federal mandate similar to Individuals with Disabilities Education Act of 2004 precludes federal funding for gifted education, common definitions of giftedness, minimum program standards, and accountability measures for the subgroup of gifted learners. Grants became available through NCLB to research best practices in gifted education. NCLB also required implementation of programs to be based on research-based strategies. The NCTM (2000) produced standards for math programs to guide implementation of rigorous curriculum development and instructional strategies to ensure mathematical literacy and underachievement in mathematics were addressed through research-based best practices. Renzulli’s (1977) theory of giftedness provides that gifted traits can be developed over time. This theory has been a catalyst for research of best practices in gifted education to increase student achievement among gifted learners in the content area of mathematics.

Vygotsky’s (1978) sociocultural theory provides that social settings foster development of skills through cultural environments within a zone of proximal development. Using this theory, many gifted education programs approach instruction of gifted students through clustering groups of learners with similar abilities. The gifted instructional models approved for providing instruction in elementary grades in Georgia include such clustering practices. The models are similar but differ with regard to direct and indirect instructional services given to gifted learners by gifted education specialists with gifted endorsements on their teacher certification. The empirical evidence reviewed by the researcher revealed that many studies exist to validate tailoring instruction to meet
the needs of gifted learners (Adelson et al., 2012; Kanevsky, 2011). Other studies were found to substantiate the instructional practice of clustering students in heterogeneous environments (Brulles et al., 2010; Linn-Cohen & Hertzog, 2007). The researcher also reviewed studies focused on improving mathematical literacy among gifted learners (Gavin et al., 2009; Koshy et al., 2009) to address gifted underachievement in mathematics. In a thorough review of the literature, the researcher identified a paucity of research on the practice of implementing the collaborative model as defined by the GaDOE (2012a). Therefore, the purpose of this study was to determine if the gifted instructional model used to deliver mathematics instruction showed a difference in the mathematics achievement of fifth grade gifted students when comparing the cluster and collaborative models specifically.

Summary of the Methodology and Findings

The examiner used archival data collected from three academic years, 2009-2010, 2010-2011, and 2011-2012, to test the null hypotheses for Research Questions One and Two through a causal comparative design. There were 67 participants overall, with 32 in the cluster group and 35 in the collaborative group. The setting was a Title I upper elementary school in rural Southwest Georgia.

Research Question One

The researcher examined differences in STAR Math assessment scores of students in the comparison groups for Research Question One. The students in both groups were identified as gifted prior to the fifth grade and received the entire scope and sequence of the fifth grade mathematics curriculum, the Georgia Performance Standards, through instruction in either the cluster setting or collaborative setting for the duration of a 180-
For Research Question One, the researcher conducted an independent \( t \)-test on the STAR Math pretest scores to determine equality of groups since randomization was not possible. Since no significant difference between the group means was found, the researcher was able to assume there were no initial differences and the use of prior achievement as a covariate in posttest data analysis was unnecessary (Howell, 2011). Therefore, a one-way ANOVA was conducted on the STAR Math posttest scores to examine differences between groups. The results revealed no significant differences, \( p = .36 \), in mathematics achievement between the comparison groups based on the gifted instructional model used to deliver mathematics instruction, cluster or collaborative. Therefore, the researcher failed to reject the null hypothesis for Research Question One.

**Research Question Two**

The researcher examined differences in overall mathematics achievement using CRCT: Grade 4 Math assessment scale scores of students in the comparison groups for Research Question Two. An independent \( t \)-test was conducted on the CRCT: Grade 4 Math assessment scale and subscale scores to examine initial group differences. There was no statistically significant difference between the groups for the overall scale scores or any of the subscale scores for numbers and operations, measurement, geometry, algebra, and data analysis and probability. Since no significant difference between the group means was found, the researcher was able to assume there were no initial group
differences and the use of prior achievement as a covariate in posttest data analysis was unnecessary (Howell, 2011).

A one-way MANOVA was conducted on the CRCT: Grade 5 Math assessment scale and subscale scores to examine differences between the comparison groups. The results revealed a statistically significant main effect difference between the comparison groups on the overall scale scores. Therefore, the researcher rejected null hypothesis two for Research Question Two. The Bonferroni procedure was used in posthoc pairwise comparisons to adjust the alpha level due to multiple comparisons to control for Type I error (Green & Salkind, 2011; Howell, 2011). The alpha level was adjusted to .01. The posthoc pairwise comparisons revealed a significant difference between comparison groups on the subscales of geometry, \( p < .01 \), and algebra, \( p < .01 \). Therefore, the researcher rejected null hypotheses five and six for Research Question Two. There was no significant difference between comparison groups on the subscales of numbers and operations, \( p = .22 \), measurement, \( p = .95 \), and data analysis and probability, \( p = .23 \). Therefore, the researcher failed to reject null hypotheses three, four, and seven for Research Question Two.

**Discussion of the Findings**

**Research Question One**

The results of the analysis for Research Question One indicated that there was no significant difference between the mathematics achievement of gifted learners based on the gifted instructional model used to teach mathematics, cluster or collaborative. This is consistent with Reis’s et al. (1998) study of the effects of curriculum compacting models on mathematics achievement as measured on achievement tests in which they found the
use of compacting models had no significant effect on the overall achievement of gifted learners when the compacting models were implemented. However, this is deceptive as the gifted learners in the compacting models were able to eliminate 40-50% of the curriculum without significant effect on overall achievement; thus, the models were both effective. The current study differs from Reis’ et al. (1998) in that their study included a control group and a treatment group in which only general education teachers served gifted learners and the current study examined differences among comparison groups in which groups were served directly by a gifted-endorsed teacher in the cluster model or indirectly by a gifted-endorsed teacher and directly by a general education teacher in the collaborative model.

Research Question Two

The results of the analysis for Research Question Two indicated that there was a significant difference between the mathematics achievement of gifted learners based on the gifted instructional model used to teach mathematics, cluster or collaborative. The posthoc analyses revealed specific areas in which the groups differed: geometry and algebra. Although the overall results contradict the findings from Research Question One, they are consistent with the findings of Gentry and Owen’s (1999) study in which student achievement was tested in relation to clustering practices used. They found that all achievement levels benefited from the grouping when compared to students who were not grouped. Notable differences between their study and this study abound, however. In Gentry and Owen’s study, a total-school flexible grouping approach was implemented. Therefore, the settings were homogeneous as opposed to the current study’s small cluster of homogeneously grouped students within a larger heterogeneous setting.
The findings in Gavin’s et al. (2009) study of the Project M³: Mentoring Mathematical Minds showed through using a treatment and control group design that units of instruction developed for mathematically promising students by gifted specialists can be implemented by general education teachers with positive effects on student achievement. Many constructs of their study were similar to the current study, such as using pretest and posttest scores to evaluate achievement, clustering gifted learners for instruction in mathematics, and providing indirect instruction through unit development and teacher collaboration with gifted specialists. This study was found in the review of literature to be most closely structured to the current study. However, the studies also differed on many constructs. The current study compared two groups receiving modified instruction, unlike Gavin’s et al. This study compared a group with indirect instructional service provided through a collaborating teacher who delivered face-to-face instruction with no additional professional development in the content area or specialization of gifted education. Gavin’s et al. study compared groups wherein one had a teacher giving face-to-face instruction with additional professional development on content and specialization in gifted education, albeit a short timeframe of two weeks. Also, the current study compared smaller homogeneously clustered groups of students within larger heterogeneous settings while Gavin’s et al. used homogeneously clustered classes of around 20 students total. Lastly, the current study is pre-experimental using archival data while Gavin’s et al. study used an experimental, action research design.

Results from the current study support further research on the effects of the gifted instructional model used to deliver mathematics instruction on the mathematics achievement of gifted learners. Reviews of existing studies demonstrate that there is
insufficient evidence comparing how instructional models are implemented in gifted education where students are clustered in small homogeneous groups within larger heterogeneous settings, thus leaving practitioners with inconsistent evidence upon which to base current practices for delivering instruction to gifted learners. The current study provides inconsistent results based on the instruments used to assess differences in mathematics achievement as determined by gifted instructional model used. Due to the results of the one-way MANOVA for Research Question Two revealing significant main effect differences between the overall scale score, with specific significant differences between groups found on the subscales of geometry and algebra, there is an indication that student achievement differs based on the gifted instructional model used to deliver mathematics instruction; thus, the cluster and collaborative models do significantly differ. This indicates that either the cluster or collaborative model may have the potential to influence mathematical achievement more than the other among gifted learners with the overall mathematics scale score on the CRCT: Grade 5 Math assessment and the geometry and algebra subscale scores. It should be noted that further studies must be conducted to determine which model shows an effect on student achievement and to what extent.

Implications

Theoretical

Findings from the present study support both Renzulli’s (1977) theory of giftedness and Vygotsky’s (1978) sociocultural theory. The student achievement gains in overall mathematics achievement demonstrated empirical evidence to support the theory that when students are grouped together in social contexts to receive instruction they have
achievement gains, as was noted by the comparison of pretest scores to posttest scores. This gives credence to Vygotsky’s approach to sociocultural development insomuch that students were clustered to receive instruction in classrooms where they could thrive in their zones of proximal development as they interacted with similar ability peers. Student achievement gains also demonstrate support for Renzulli’s approach (2012) to cultivating giftedness, as the researcher’s review of archival documentation revealed differentiated curriculum and plans allowed students to express themselves creatively and experiment with ideas and interests that they may not have been afforded in a general education classroom void of modifications for gifted learners. Therefore, the findings of this study support the clustering of gifted students for mathematics instruction from either a gifted education specialist or a general education teacher working closely with a gifted education specialist to differentiate curriculum in order to provide experiences for gifted learners to promote student achievement and foster development of gifted traits within a social context.

Practical

The results of this study showed inconsistent findings based on the instruments used to measure the overall mathematics achievement of students in cluster and collaborative settings from data analysis for Research Question One to Research Question Two. However, since there was a significant main effect difference between mathematics achievement based on the instructional model used to deliver mathematics instruction evidenced through data gathered on one of the instruments, the current practice of using both models should not be negated. Further studies need to be conducted to determine which model promotes the highest gains in student achievement,
if the findings can be replicated. Many studies support the practice of clustering gifted learners for instruction (Linn-Cohen & Hertzog, 2007; Pierce et al., 2011; Reis & Renzulli, 2010), including the current study in which the results offer empirical evidence that the elementary gifted instructional models used in Georgia, which include the practice of clustering, show statistically significant main effect differences in mathematics achievement of fifth grade gifted learners.

Results from this study may influence how the models are implemented at the research site in the future. Since the results yielded significant results, this study should be used to plan an experimental study (Campbell & Stanley, 1963). Additionally, given the significant results and the main difference between the models being the level of professional development of the direct instruction provider, the results should be used to influence decisions regarding professional development offered in the area of gifted education.

Limitations

Certain limitations should be considered with the current study. Inherent to the design of this study are limitations or certain weaknesses, though attempts have been made to control as many threats to internal validity as possible. Threats to internal validity included the history threat (Campbell & Stanley, 1963; Gall et al., 2007), possibly due to inclusion in the resource model. Efforts to mitigate the history threat to validity included using the resource model as a criterion variable wherein all students received the same instruction using the same materials and resources from the same teacher for the same amount of time. The testing threat to internal validity (Campbell & Stanley; Gall et al.) was possible with respect to the STAR Math assessments since those
were given at three intervals each school year. However, controlling for the testing threat was built in to the design of the assessment as it is computer-adaptive and parallel test forms are created using item response theory. Parallel test forms are used for the CRCT as well, thereby controlling for this threat with respect to the second instrument. The strongest threat to the internal validity of this study is the differential selection threat (Campbell & Stanley; Gall et al.). Due to the ex post facto design of the study, intact groups had to be used and randomization was impossible. The inability to use random assignment was controlled using statistical comparisons for determining covariance to equate the groups on previous achievement.

The roles of the researcher at the research site were expressly presented so that researcher bias could be avoided. Since the data used were archival and the researcher did not have direct or indirect instructional relationships with the students in the study, researcher bias was not found to be present; however, it is listed as a possible threat to internal validity. The implementation threat to validity is expressly considered since the ex-post facto design of the study allowed only review of archival documentation and narrative recall of how the settings and lessons were provided as opposed to true experimental research which would allow the researcher to control for the implementation threat. Other concerns for limitations to the study due to implementation threats include having different teachers in the cluster model each year as opposed to having only one teacher in the collaborative model for the duration of the years studied. Also having one teacher who served in one model for two years and the other model for one year caused data to be affected in both groups by the same teacher. Such limitations
preclude the generalizability of the findings to all fifth grade gifted education settings as replication may be limited and cautious interpretations of the findings are explicit.

External threats to validity include population validity due to representativeness of the sample (Gall et al., 2007), although careful description of the sample and the larger contexts in which the sample is situated were provided. The external threat of ecological validity due to description of the treatment (Campbell & Stanley, 1963) is possible due to the ex-post facto design of the study. These threats are limitations to the generalizability of the findings from the study (Campbell & Stanley). Gall et al. note the “inferences about causality on the basis of the collected data are necessarily tentative” (p. 310) in causal-comparative studies and caution should be taken when making conclusions using the results. The pre-experimental structure of causal-comparative research does not permit strong conclusions (Campbell & Stanley; Gall et al.) therefore they are limited in value (Campbell & Stanley). However, ex-post facto designs are useful for gathering information of interest for future experimental studies (Campbell & Stanley) and for initial exploratory investigations where the independent variable cannot be manipulated (Gall et al.). Causal-comparative designs can be preferable to education stakeholders because the groups formed based on the independent variable are consistent with how practitioners actually interact with the variables being studied (Gall et al.).

**Recommendations for Further Research**

The limitations of the current study and the absence of existing research on the differences in mathematics achievement based on the instructional models implemented in gifted education in Georgia behooves further research on this topic. Now that a pre-experimental study has been conducted providing empirical evidence that statistically
significant main effect differences exist in mathematics achievement based on the instructional model used to deliver mathematics instruction, cluster and collaborative, a more rigorous experimental design should be used to further examine the source of the differences and the effects of those differences. Since no study could be found regarding the effects of the instructional models as defined by the GaDOE and given the additional funding secured through provisions of those models, consideration should be given to comparing the effects of the cluster and collaborative models based on gender, socioeconomic status and ethnicity.

Georgia was awarded a waiver from the AYP measures from NCLB (2001) in 2011-2012 as a part of an overhaul of the education system which includes new curriculum, Common Core Georgia Performance Standards, and corresponding assessment known as the Partnership for Assessment of Readiness for College and Careers, new accountability program known as the College and Career Readiness Performance Index, and new teacher evaluation program known as Teacher Keys Evaluation System. As these changes emphasize teacher focus on student readiness for the future in certain career paths, the focus set by NCLB on the lower performing students may change to be more equitable for all students. Further research regarding how gifted education instructional models are impacted by the new system should be conducted.

Finally, the provision of professional development in gifted traits and meeting the needs of gifted learners would be beneficial to all educators. Therefore, additional studies comparing implementations of the collaborative model with and without the support of the gifted education specialist would help determine the value of professional
development in the area of gifted education. Future studies could provide empirical
evidence regarding best practices in gifted education to assist educators in meeting the
unique needs of gifted learners.

**Biblical Interpretations of the Findings**

The Bible shows that everyone has been given gifts. We are told in 1 Corinthians
12:4-6 (English Standard Version),

> 4 Now there are varieties of gifts, but the same Spirit; 5 and there are varieties of
> service, but the same Lord; 6 and there are varieties of activities, but it is the same
> God who empowers them all in everyone.

Our gifts are different based on how God expects us to serve Him and how He plans to
use us to further His kingdom. As Christians first and then as educators, we are called to
glorify Him with our talents and abilities.

Part of the theoretical framework for this study provides that giftedness can be
developed over time. The Bible shows us that we should develop our gifts; in 1 Peter
4:10-11 (English Standard Version),

> 10 As each has received a gift, use it to serve one another, as good stewards of
> God’s varied grace: 11 whoever speaks, as one who speaks oracles of God;
> whoever serves, as one who serves by the strength that God supplies—in order
> that in everything God may be glorified through Jesus Christ. To him belong
> glory and dominion forever and ever. Amen.

The other part of the theoretical framework provides that we learn better when we work
together to build up one another. This is shown through 1 Corinthians 14:12 (English
Standard Version),
12 So with yourselves, since you are eager for manifestations of the Spirit, strive to excel in building up the church.

It is also shown in Romans 12:3-5 (English Standard Version),

3 For by the grace given to me I say to everyone among you not to think of himself more highly than he ought to think, but to think with sober judgment, each according to the measure of faith that God has assigned. 4 For as in one body we have many members, and the members do not all have the same function, 5 so we, though many, are one body in Christ, and individually members one of another.

Finally, this study serves to confirm that what we were told in 1 Timothy 4:11-16 is still important today.

1 Timothy 4:11-16 (English Standard Version), 11 Command and teach these things. 12 Let no one despise you for your youth, but set the believers an example in speech, in conduct, in love, in faith, in purity. 13 Until I come, devote yourself to the public reading of Scripture, to exhortation, to teaching. 14 Do not neglect the gift you have, which was given you by prophecy when the council of elders laid their hands on you. 15 Practice these things, immerse yourself in them, so that all may see your progress. 16 Keep a close watch on yourself and on the teaching. Persist in this, for by so doing you will save both yourself and your hearers.

We must use studies like this one to provide means for change. When we do what is best for children, God is glorified through our service. That includes helping them be the best version of themselves by cultivating their gifts and teaching them to use their gifts to help others.
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APPENDIX A

Liberty University Institutional Review Board Approval Letter

January 24, 2013

Lezley B. Anderson
IRB Exemption 1522.012413: Effects of Gifted Instructional Model for Fifth Grade Mathematics Achievement

Dear Lezley,

The Liberty University Institutional Review Board has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study to be exempt from further IRB review. This means you may begin your research with the data safeguarding methods mentioned in your approved application, and that no further IRB oversight is required.

Your study falls under exemption category 46.101 (b)(4), which identifies specific situations in which human participants research is exempt from the policy set forth in 45 CFR 46:

(4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

Please note that this exemption only applies to your current research application, and that any changes to your protocol must be reported to the Liberty IRB for verification of continued exemption status. You may report these changes by submitting a change in protocol form or a new application to the IRB and referencing the above IRB Exemption number.

If you have any questions about this exemption, or need assistance in determining whether possible changes to your protocol would change your exemption status, please email us at irb@liberty.edu.

Sincerely,

Fernando Garzon, Psy.D.
Professor, IRB Chair Counseling

(434) 592-4054
Good Afternoon Lezley,

This email is to inform you that your request to change the name of the study to Gifted Learners and Mathematical Achievement: An Analysis of Gifted Instructional Models “to make the title consistent with the constructs of the study design,” change the “null hypothesis for research question two from determining mathematics achievement using the Georgia Criterion-Referenced Competency Test (CRCT) to determining overall mathematics achievement using the CRCT,” and add “additional null hypotheses in relation to research question two to include subscales from the instrument to determine mathematical proficiency in numbers and operations, measurement, algebra, geometry, and data analysis and probability” to change the data analysis “from conducting only a one-way analysis of covariance (ANCOVA) to conducting a one-way ANCOVA for the null hypothesis regarding mathematics achievement and a one-way multivariate analysis of variance regarding mathematical proficiency on the subscales” has been approved.

Thank you for complying with the IRB requirements for making changes to your approved study. Please do not hesitate to contact us with any questions.

We wish you well as you continue with your research.

Best,

G. Michele Baker, M.A.
Institutional Review Board Coordinator
The Graduate School

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APPENDIX C

Letter Requesting Local Consent for Study at Research Site

Lezley Barker Anderson
xxxxxxx@liberty.edu
Liberty University
Dr. Kathie C. Morgan, Ed. D.
xxxxxxx@liberty.edu

xxxxxxx Elementary School
Attn: xxxxxxxxxx, Principal
xxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxx

January 28, 2013

RE: Consent to Conduct Doctoral Study

Dear xxxxxxxxxx:

I am a doctoral candidate at Liberty University School of Education. As the principal investigator of the study entitled *Effects of Gifted Instructional Model for Fifth Grade Mathematics Achievement*, I am requesting your permission to conduct my study at your site using archival data. Specifically, I would request the data collection points for gifted students served at your school during the school years of 2008-2009, 2009-2010, 2010-2011, and 2011-2012. The study focuses on the analysis of data to determine if a statistically significant difference exists between the two gifted instructional models of cluster and collaborative in mathematics achievement for fifth graders.

Please be advised that I have obtained Institutional Review Board approval from Liberty University and would further request that, should you deem permission granted, you send a letter signed granting written permission to conduct the study and for release of the data.

In order to maintain confidentiality, I will request that the data be stripped of student names, addresses, or testing identification numbers which could be readily or easily correlated with the data. Further, upon your consent, I will request each student’s data series be assigned a unique student identification code known only to you or your designee. Please see the information listed below to be sent in a password protected Excel spreadsheet via e-mail at the address listed above.

- unique student identification code which you assign,
- gender,
- ethnicity,
- socioeconomic status,
- scale score on fourth grade mathematics Georgia Criterion-Referenced Competency Test for spring 2009, 2010, and 2011 assessments,
- scale score on fifth grade mathematics Georgia Criterion-Referenced Competency Test for spring 2010, 2011, and 2012 assessments,
- scale score on fifth grade fall benchmark Renaissance Learning STAR Math Assessment for 2009, 2010, and 2011,
- scale score on fifth grade spring benchmark Renaissance Learning STAR Math Assessment for 2010, 2011, and 2012,
- school year of fifth grade,
- type of instructional model used for mathematics instruction

Please assign the following password to the spreadsheet: Xxxxxxx

After the three year time period for maintaining the data has expired, as the principal investigator, I will delete the spreadsheet containing the data from the computer on which it will be stored.

Should you have any questions or concerns, please do not hesitate to contact me or my dissertation committee chairperson, Dr. Kathie C. Morgan. I look forward to receiving your decision and the data requested and sharing the results of the study with you.

Yours truly,

Lezley Barker Anderson
Liberty University Doctoral Candidate
Student Identification Number xxxxxxxx
APPENDIX D

Letter Granting Local Consent for Study at Research Site

January 22, 2013

Lezley B. Anderson  
Doctoral Candidate

RE: Study Using Archival Data

Dear Mrs. Anderson:

I have received your request to conduct your doctoral research study *Effects of Gifted Instructional Model for Fifth Grade Mathematics Achievement* using archival data from the years of 2009-2012 from the STAR Reading Assessment and CRCT Math Assessments for 4th and 5th grades. I am hereby granting you permission to conduct your study at this site.

Please contact [contact information] to obtain the specific data you require. Let me know if you need any other information. I look forward to receiving the results of your study and wish you well in your endeavors.

For the Children,

Principal

[Redacted]