

Improving Mathematics Achievement of Exceptional Learners  
Through Differentiated and Peer-Mediated Instruction

by  
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An Applied Dissertation Submitted to the  
Fischler School of Education and Human Services  
in Partial Fulfillment of the Requirements  
for the Degree of Doctor of Education

Nova Southeastern University  
2007

Approval Page

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## Acknowledgments

I would like to thank Dr. Elizabeth Brennan, my dissertation chair, for her encouragement and support. She has made this journey very enlightening and fulfilling. With her assistance, I have completed a piece of work that I am very proud of. I extend my gratitude to Dr. Judy Shoemaker. I would like to thank the organization that allowed me to conduct this research. Most importantly, I would like to thank the students and their parents for participating in this research. I truly enjoyed the experience and learned as much from them as I hope they have learned from me.

Furthermore, I owe a special thanks to my husband, Anthony, and daughter, Amani, for enduring all that was involved in the completion of this dissertation.

## Abstract

Improving Mathematics Achievement of Exceptional Learners Through Differentiated and Peer-Mediated Instruction. Ivory, Tontaleya S., 2007: Applied Dissertation, Nova Southeastern University, Fischler School of Education and Human Services. Mathematics Achievement/Teaching Methods/Special Education/Achievement Tests/Standardized Tests

The purpose of this study was to implement differentiated and peer-mediated instruction to determine if these instructional interventions were successful in preparing students with disabilities for state standardized tests. In addition, this study identified how exceptional needs learners responded to techniques utilized during differentiated and peer-mediated instruction. The objective of this study was to determine if the interventions produced significant differences in mathematics achievement of exceptional learners and to provide a context in which the selected interventions invoked student behavioral response.

The study focused on the following questions:

1. What is the difference in achievement for students receiving differentiated instruction to those receiving peer-mediated instruction?
2. How does the implementation of differentiated instruction yield differences in achievement across exceptionalities, including learning disabled, mildly intellectually disabled, other health impairment, and emotional and behavioral disorder?
3. In what ways will the implementation of peer-mediated instruction yield differences in achievement across exceptionalities, including learning disabled, mildly intellectually disabled, other health impairment, and emotional and behavioral disorder?
4. How do exceptional learners respond to differentiated instruction?
5. What are the differences in response to differentiated instruction for exceptional learners classified as learning disabled, mildly intellectually disabled, other health impairment, and emotional and behavioral disorder?
6. How do exceptional learners respond to peer-mediated instruction?
7. What are the differences in response to peer-mediated instruction for exceptional learners classified as learning disabled, mildly intellectually disabled, other health impairment, and emotional and behavioral disorder?

To solve the problem multiple methodologies were utilized. Mixed-method designs employ qualitative and quantitative research. Qualitative research seeks to explore phenomena in a naturalistic setting through interpretive data analysis. Quantitative research seeks to explain phenomena through empirical data analysis.

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## Chapter 1: Introduction

The No Child Left Behind (NCLB) Act of 2001 holds states, districts, and schools accountable for student performance and achievement. With the push for education that works, NCLB has maintained its stance on benchmark assessments that mark progress and highlight weaknesses in core academic subjects (U.S. Department of Education, 2005). The growing trend in education to use data-driven instructional programs support the notion that assessments that are measurable can increase student productivity by pinpointing areas where students experience academic deficits. In an attempt to reduce the achievement deficits experienced by students with disabilities, educators are implementing standards that require instruction to address the learning style of each learner (Tomlison, 2002).

Dickinson (2005) asserted, “Research-based programs use action research techniques to formulate a question, research the literature, incorporate a solution, and analyze those results” (p. 1). In this approach, educators utilize a systematic problem solving process that requires them to identify the problem, gather information, develop a strategy, implement that strategy, and evaluate the results. At a glance, this system is seemingly similar to the basic principles employed by the scientific methods process and, in essence, it very well should. Tomlinson (2001) wrote that in order to implement instructional strategies that offer great benefit to “all learners,” there must be a calculated approach that will render valid and reliable results (p. 16).

### *Statement of the Problem*

The problem that was addressed in this study was the low mathematics achievement of exceptional needs students on state assessments. This problem was selected due to the continuous low achievement in mathematics experienced by students

with disabilities at the target middle school. Moreover, the low achievement of exceptional needs students had become a major source of concern for faculty and administration.

In 2005, a special education teacher, the researcher, was given the responsibility of examining the previous year's Criterion Referenced Competency Test (CRCT) data to determine the deficiency areas of exceptional needs students in the seventh grade. This investigation was prompted, in part, because the target middle school failed to make Adequate Yearly Progress (AYP) as evidenced by CRCT scores. AYP is a federally mandated way of reporting schools' and districts' success and student progress (U.S. Department of Education, 2005).

While examining the data, the researcher discovered that more than 54% of exceptional needs students failed to meet state and federal standards for academic achievement in mathematics. Perhaps most discouraging was the fact that this phenomenon has been persistent from the time of the initial administration of the CRCT. Specifically, students with disabilities at the target middle school experienced an average fail rate of 57% for all CRCT years combined (Georgia School Council Institute, 2006).

Though mathematics deficiencies have manifested at the target middle school, achievement of exceptional needs students has proved challenging across the state of Georgia. According to the Georgia Department of Education, 59% of seventh-grade exceptional learners in the state did not meet the federal standards for mathematics in 2005-2006. Surprisingly, students are not learning the mathematics they need to become skilled and proficient in math (National Council of Teachers of Mathematics [NCTM], 2000). Defur (2002) attributes this to student differences and teachers' inability to deliver effective instruction. As a result, students fail to adequately respond to instruction and



academic goals fail to be met (Defur). In Table 1, the performance of the seventh-grade students at the middle school and in the state of Georgia on the CRCT within the past 2 years is summarized.

Table 1

*CRCT Data for the Middle School and the State of Georgia*

Seventh grade	2005	2004
<b>Middle school</b>		
Exceeding standards	0	0
Meeting standards	46	38
Not meeting standards	54	62
<b>Georgia</b>		
Exceeding standards	4	3
Meeting standards	37	35
Not meeting standards	59	61

Established in August 1997, the target middle school is located outside the metropolitan area of Georgia. There are 1,037 students registered at the school; 13% of those students have exceptional needs. One principal, 3 assistant principals, 3 counselors, 1 school nurse, and 63 teachers are on the staff at the middle school. At the time of this study, there are 13 exceptional needs teachers, 3 of which teach seventh-grade mathematics at the middle school. The student:teacher ratio is 16:1. There are 355 sixth-grade students, 329 seventh-grade students, and 353 eighth-grade students. Student ethnicity breakdown is 4 American Indian, 3 Asian, 296 Black, 13 Hispanic, and 704 White. There are 528 male students and 492 female students.

The school system in which the middle school is associated serves the entire county. The 20 schools are organized into 12 elementary, including prekindergarten

through Grade 5; 4 middle, including Grades 6 through 8; 3 high, including Grades 9 through 12, and 1 alternative school for Grades 7 through 12.

During the time of this study, the researcher acted as a special education teacher.

Special education teachers complete seven different tasks at the middle school:

1. Develop and implement Individualized Education Plans (IEP).
2. Carry out instruction in resource, collaborative, coteaching and self-contained classes.
3. Act as case managers for identified exceptional needs students.
4. Act as school's Local Educational Authority during IEP meetings (LEA).
5. Develop and implement functional behavioral assessments and behavior intervention plans.
6. Complete achievement assessments for exceptional needs students.
7. Act as exceptional needs consultant to regular education teachers.

### *Purpose of Project*

The purpose of this study was to implement differentiated and peer-mediated instruction to determine if there is a positive affect on the mathematics achievement of exceptional learners on state assessments. Additionally, this study identified and described how exceptional needs learners responded to techniques utilized during differentiated and peer-mediated instruction. Due to the differences in rates of growth, moral and emotional development, readiness, interests, and learning profiles, it is critical that educators understand what strategies make students of varying disabilities and differences responsive in the mathematics classroom (Tomlinson, 2006).

Implementing interventions that lead to improved mathematics achievement and prepare students with disabilities for state assessments was the primary focus of this

study. The objective was to determine if the interventions would produce significant differences in mathematics achievement and to provide a context in which the selected interventions invoke student behavioral response. The initial implementation of these interventions was selected for the target middle school; however, the study provided a basic paradigm which could be implemented at other schools and grade levels.

### *Rationale for Study*

After conducting the preliminary literature review, the researcher discovered that adequate research was present on differentiated instruction, exceptional student education, high-stakes testing, peer-mediated instruction, and mathematics. However, there was not much literature or research that addressed these issues within the context of one another. The need for research in this area was necessary to address gaps that exist for students with disabilities.

According to the Georgia Department of Education (2006), mathematics achievement has persistently plagued exceptional learners at the target middle school. To that extent, implementing instructional strategies that have an affect on the math achievement of this group would seemingly address the concerns associated with their participation in state assessments.

This study was designed to compare the effectiveness of the selected instructional approaches. Based on exceptional learners' performance on standards-based assessment, it was evident that a variety of approaches must be explored. The need for methods that are complementary to a variety of learning styles has persistently been a target for research's attention. This research was framed using available literature, previously conducted research, interviews, surveys, student observations, and CRCT results.

### *Background and Significance of the Problem*

Kelly (2005) stated,

Since the 1970s, a series of assessments of U.S. students' performance has revealed an overall level of mathematical proficiency well below what is desired and needed . . . [the International Mathematics and Science Study rated U.S.] students among the worst in the world. (p. 18)

This clearly indicated that students in the United States are experiencing major difficulties attaining mathematics proficiency. Sadly, this occurrence has also plagued exceptional learners at the target middle school.

A national study conducted by the National Center of Educational Statistics (NCES) exposed two major deficiencies in mathematics achievement for exceptional learners:

1. There is a significant gap between the mathematical achievement of students with disabilities and students without disabilities.
2. Exceptional needs students are experiencing significant underachievement in mathematics.

Though the study conducted by NCES revealed significant deficiencies exist in mathematics achievement, it also showed an increase in mathematical ability for exceptional needs students over the years. Interestingly, the target middle school and the state of Georgia's mathematics results exhibited similar outcomes (see Table 1). This occurrence confirmed the problem's existence and displayed its affect on exceptional needs students nationwide. On the contrary, these results also acknowledged that gains can be made in exceptional needs students' achievement. These gains, however, have still left exceptional needs students with low-level mathematics proficiency.

In Table 2, the percentage of students with and without disabilities who exhibit below proficiency in mathematics is summarized. This information was documented by

NCES.

Table 2

*Students With and Without Disabilities Below Proficiency, Grades 4 and 8 for the Years 1996 Through 2005*

Middle school students	1996	2000	2003	2005
With disabilities	83	79	71	68
Without disabilities	36	33	27	27

The perpetual underachievement in mathematics by exceptional learners is not a phenomenon unique to the target middle school. Indeed, the persistence of this occurrence has been experienced statewide and nationwide. Jones, Wilson, and Bhojwani (1997) stated, “Students with disabilities generally make inadequate progress in mathematics. Their achievement is often limited by a variety of factors, including prior low achievement, low expectations for success, and inadequate instruction” (p. 2).

The target middle school’s data concurred with this assertion and further identified the problem’s existence in the school’s improvement plan (SIP). The SIP addressed the need to provide additional assistance to students with disabilities by setting higher expectations and providing quality instruction. To accomplish this goal, the target middle school earmarked funds for improving mathematics instruction, provided specialized training, and had several presenters provide workshops on increasing the success of all learners.

In 2006, an action plan was developed for students with disabilities in mathematics as a part of the SIP. In this action plan, it was highlighted that only 46% of students with disabilities met state standards. In light of this fact, the target middles

school set a goal to increase achievement by students with disabilities at a rate of at least 10% for the 2006-2007 school year.

This strategic plan was developed because failure to address the mathematics achievement of exceptional learners had several negative implications for the target middle school (a) students in this group would continue to perform below minimum proficiency levels, (b) the achievement scores at the target middle school would fail to meet federal standards as required by NCLB, and (c) continuous failure of the middle school in this area might have implied that enough was not being done to comply with standards set forth by Individuals With Disabilities Education Act (IDEA).

### *Research Questions*

This research was guided by seven research questions. These research questions were developed as a means to understand differentiated and peer-mediated instruction and their effects on student performance and engagement. Additionally, these questions were developed as a means of examining the appropriateness of differentiated and peer-mediated instruction in preparation for state assessments. These seven questions follow:

1. What is the difference in achievement for students receiving differentiated instruction to those receiving peer-mediated instruction?

2. How does the implementation of differentiated instruction yield differences in achievement across exceptionalities, including learning disabled (LD), mildly intellectually disabled (MID), other health impairment (OHI), and emotional and behavioral disorder (EBD)?

3. In what ways will the implementation of peer-mediated instruction yield differences in achievement across exceptionalities, including LD, MID, OHI, and EBD?

4. How do exceptional learners respond to differentiated instruction?

5. What are the differences in response to differentiated instruction for exceptional learners classified as LD, MID, OHI, and EBD?

6. How do exceptional learners respond to peer-mediated instruction?

7. What are the differences in response to peer-mediated instruction for exceptional learners classified as LD, MID, OHI, and EBD?

### *Assumptions*

The data utilized to identify the problem was assumed free of bias and errors. The researcher conducted a simultaneous data search through the target middle school, the Georgia Department of Education, and the Georgia Council of School Improvement to confirm existence of the problem. In addition, it was assumed that participants would actively engage in the study of mathematics. Furthermore, the researcher assumed that the literature used to place the problem in context was comprehensive, accurate, and representative of factual accounts of the research problem. The researcher further assumed that the interventions were implemented as intended.

### *Definition of Terms*

To assist with the comprehension of this research, a list of the terms utilized throughout this report is provided.

*Accommodations.* These are adjustments made in school services to meet the learning needs of students.

*Content.* This is the material students must learn. The instructional concepts should be broad based, and all students should be given access to the same core content. However, the content's complexity should be adapted to the students' learner profiles. Teachers can vary the presentation of content, such as textbooks, lecture, demonstrations, and taped texts, to best meet students' needs (Council for Exceptional Children [CEC],

2006).

*Criterion Referenced Competency Test (CRCT).* CRCT is a criterion-referenced test that was designed to measure how well students acquire, learn, and accomplish the knowledge and skills set forth in a specific curriculum or unit of instruction. The CRCT, therefore, is specifically intended to test Georgia's performance and content standards outlined in the Georgia Performance Stands (GPS) and Quality Core Curriculum (Georgia Department of Education, 2006).

*Differentiated instruction.* This is a teaching approach in which teachers adapt their instruction to student differences. Rather than developing a curriculum aimed at the “common student,” teachers modify their instruction to meeting individual students' readiness levels, preferences, and interests (Tomlinson, 2003). In differentiated instruction, the fact is recognized that there is a diverse student population and it enables educators to teach students of varying abilities in one class.

*Exceptional student education.* This is a form of specifically designed instruction to meet the unique needs of a child with a disability.

*Free Appropriate Public Education (FAPE).* FAPE is a section of IDEA that states students must have access to public education that confers some benefit.

*Individualized Education Plan (IEP).* The IEP is a plan developed for special education students related to the students' strengths and needs in need areas, their present levels of performance; goals and objectives relative to performance standards and the general curriculum, and the extent of participation in and accommodations within the natural environment (Georgia Department of Education, 2006).

*Individuals with Disabilities Education Act (IDEA).* IDEA is a federal law enacted in 1990 and reauthorized in 1997. It is designed to protect the rights of students



with disabilities by ensuring that everyone receives a FAPE, regardless of ability. Furthermore, IDEA strives not only to grant equal access to students with disabilities, but also to provide additional special education services and procedural safeguards (U.S. Department of Education, 2005).

*Learning environment.* This refers to the way the classroom works and feels. The differentiated classroom should include areas in which students can work quietly as well as collaborate with others, materials that reflect diverse cultures, and routines that allow students to get help when the teacher is not available (CEC, 2006).

*Modifications.* Supplementary aids and services which are defined as aids, services, and other supports that are provided in a general education class or other settings to enable students with disabilities to be educated with nondisabled students to the maximum extent appropriate in accordance with least restrictive requirements.

*Peer-mediated instruction and Intervention (PMII).* PMII occurs when students are strategically placed into groups that promote social learning.

*Process.* This refers to activities in which the student engages to make sense of or master the content. Examples of differentiating process activities include scaffolding, flexible grouping, interest centers, and manipulatives, varying the length of time for a student to master content, and encouraging an advanced learner to pursue a topic in greater depth (CEC, 2006).

*Product.* This refers to the culminating projects that ask students to apply and extend what they have learned. Products should provide students with different ways to demonstrate their knowledge as well as various levels of difficulty, group or individual work, and various means of scoring.

The *No Child Left Behind Act of 2001 (NCLB)*. NCLB is a landmark in education

reform designed to improve student achievement and change the culture of America's schools. Under NCLB, each state must measure every public school student's progress in reading and math in each of Grades 3 through 8 and at least once during Grades 10 through 12 (U.S. Department of Education, 2005).

## Chapter 2: Literature Review

### *Introduction*

In *Principles and Standards for School Mathematics*, published by the National Council of Teachers of Mathematics (NCTM) in 2000, the writers asserted,

All students, regardless of their personal characteristics, backgrounds, or physical challenges, must have opportunities to study and support to learn mathematics. Equity does not mean that every student should receive identical instruction; instead, it demands that reasonable and appropriate accommodations be made as needed to promote access and attainment for all students. (p. 12)

This statement suggests that effective instruction utilizes a continuum of methods to serve diverse student populations (Tucker, Singelton, & Weaver, 2002). Teachers can no longer rely on the notion that one size fits all and must instead create opportunities for students to learn in every situation. One of the biggest misconceptions about teaching and learning mathematics is the belief that there is only one method for determining solutions (Kelly, 2005). Those embracing this sentiment have left students with disabilities in a challenging position.

Over the past decade, national educational policy has enveloped legislation that promotes state assessments as a means of measuring state, district, and student progress. These policy changes aggressively advocate for the success of all students. Though these changes have prompted significant reform in how states and schools operate, not much has been done in the way of increasing exceptional learners' performance on state assessments (Carter et al., 2005).

Perhaps most disappointing, is the fact that students with disabilities fail to successfully master mathematical skills that aid them in their performance on state assessments (Carter et al., 2005). Maccini and Gagnon (2000) have found, exceptional learners experience mathematical deficits that manifest themselves in processing,

distinguishing relevant information, computational skills or lack reasoning and problem-solving skills. These are all critical skills according to the standards set forth by NCTM.

These deficits require instructional strategies that assist traditionally lower performing students. Indeed, federal policy promotes the use of methods that aim to meet each learner's ability and encourages teachers to provide instruction that is unique to the learner's ability and readiness (VanSciver, 2005). By using this approach, students are identified based on the needs of their group, and instruction is designed to meet those needs (VanSciver). Regrettably, one of the major concerns of utilizing this approach is that special education students are often in mixed-ability environments making targeting their needs a daunting task (Moody, Vaughn, Hughes, & Fischer, 2000).

The literature review focused on nine areas: education reform and NCLB; special education, state assessments, and IDEA; instructing students with disabilities; mathematics achievement for exceptional learners; mathematics achievement across exceptionalities theoretical framework for differentiated instruction; elements of differentiated instruction; elements of peer-mediated instruction; and theoretical framework for mixed-methods methodology. The researcher selected these areas for review based on their relativity to the research study and to offer the reader various perspectives in regards to differentiated and peer-mediated instruction. In addition, this literature review was developed to assist the researcher in framing the appropriate models of the selected interventions and to understand to what extent students with disabilities experienced deficits in mathematics.

#### *Education Reform and NCLB*

The Elementary and Secondary Education Act (ESEA) was passed in 1965 to ensure equal opportunity for all students. Following its creation, ESEA has undergone

many changes. One of the most recognized changes are those included in the NCLB Act of 2001. The major underpinnings of this law are to ensure that achievement gaps become extinct among diverse student populations.

During the 1988 reauthorization of ESEA, a new accountability system emerged. This accountability system was established so school districts could determine individual student gains on annual state assessments to identify schools with unsuccessful programs. Nagle, Yunker, and Malmgren (2006) wrote that among the issues surrounding this new system were “low expectations for disadvantaged students, an overemphasis on instruction in basic skills, isolation from the regular curriculum, and a reliance on procedural compliance rather than outcomes, provided the momentum for further change” (p. 2).

The ESEA was reauthorized in 1994. Title I provisions of the Act set forth the expectation that all students receive equity in education. This reauthorization, known as the Improving America’s Schools Act requires states and districts to set rigorous standards for student achievement and administer assessments to monitor student progress. Quenemoen, Lehr, Thurlow, and Massanari (2001, ¶ 2) stated, “Using assessment reports reflecting the progress of all students toward high standards, schools are to make the instructional and structural changes needed so that all of their students have opportunity to meet the standards.”

A continuous effort to produce greater accountability and educational equity for all children is the driving force of the latest ESEA reauthorization. Nagle et al. (2006) wrote that in 2002, “NCLB created measures to increase student achievement, improve schools, provide parents and the community with better information, and—once again—close those long-lasting and troubling achievement gaps between disadvantaged students

and their peers” (p. 2).

Consequently, NCLB has changed the way states address accountability and has subsequently made the federal government more involved in state educational policy. This was accomplished by requiring states to implement statewide accountability systems that ensure students are meeting state-based assessments guidelines.

As a part of the NCLB, schools must make AYP. AYP is achieved when three objectives are met (a) 95% of students in each subgroup must participate in state assessments, (b) students in each subgroup must meet or exceed proficiency, and (c) high school graduation rates must show progress. School systems that fail to make AYP over a long period are subject to being placed on a needs improvement list and could ultimately lose federal funding. In contrast, schools that meet or exceed AYP objective are eligible to receive achievement awards.

The legislation of the NCLB reinforced the belief that states, districts, and schools are responsible for the achievement of all students. Schools are held accountable for improving the academic performance of all students, including those with disabilities. Reactions to accountability provisions outlined by NCLB suggested the most difficult task in increasing school performance is raising achievement for students with disabilities (Nagle et al., 2006).

### *Special Education, State Assessments, and IDEA*

The original special education legislation known as the Education for All Handicapped Children Act of 1975 was enacted to protect the rights of toddlers, children, and youth with disabilities. The major goal of this legislation was to improve federal, state, and local resources for these individuals. Prior to this law’s existence, the educational needs of exceptional needs students went largely unmet. Among a series of

reauthorizations, members of Congress amended this law in 1990 and renamed it IDEA. IDEA was set to ensure that all students receive a FAPE and to increase learning outcomes for all students. In 1997, this legislation was again reauthorized and mandated access to general education curriculum for children with disabilities (NCTM, 2000).

In 2004 this legislation was reauthorized and renamed to the Individuals with Disabilities Reauthorization Improvement Act (IDEIA). Wright and Wright (2006) wrote that this latest reauthorization's purpose was to

Ensure that all children with disabilities have available to them free appropriate education that emphasizes special education and related services designed to meet their unique needs and prepare them for further education, employment and independent living and to ensure that the rights of children with disabilities and parents of such children are protect. (p. 9)

IDEIA was designed to align NCLB with IDEA 1997. Both laws put in place measures that require students with disabilities to participate in state assessments.

This mandate was imposed, in part, because of the belief that assessments increase states' accountability. Moreover, these assessments provide information as to how students with disabilities perform on state assessments. Until recently, this requirement was not state mandated. The absence of this data, however, made it relatively impossible for state or federal officials to understand how students with disabilities were performing in relation to other students. Lehr and Thurlow (2003) identified several implications for the absence of exceptional needs students' participation in state assessments: "(a) lack of participation result in inaccurate pictures of the success of educational programs, (b) increased referrals to special education, (c) low expectations for students with disabilities, and (d) programmatic decisions based on incomplete or inaccurate information"(p. 2).

Many issues surfaced with the participation of students with special needs in state

assessments (Gronna, Jenkins, & Chin-Chance, 1998). At the time of this study, educational reform emphasized higher academic standards and consistent expectations for all students. These higher standards and expectations displayed significant discrepancies in the achievement of students with disabilities and their nondisabled peers. Moreover, considerations about the participation of students with disabilities arose. Questions for consideration outlined by Gronna et al. and Neill (2003) follow:

1. Do these assessments accurately assess students with disabilities?
2. Is it ethical to compare students with identified disabilities with their normative counterparts?
3. Do state assessments accurately measure the academic progress of students with disabilities?

Answering these questions may have significant implications on how students with disabilities participate in state, high-stake, and standardized assessments.

Meyen, Poggio, Seok, and Smith (2006) suggested,

One of the most significant challenges facing policy makers in education today is to ensure that state assessments designed to measure student performance . . . will allow all students to demonstrate what they have learned. This is made complex by the varied attributes of students with disabilities and the curriculum these students receive. (p. 1)

A study conducted by Malmgren, McLaughlin, and Nolet (2005) revealed that proficiency levels for mathematics on state assessments were dismal for students with disabilities. In the state of Washington, only 25% of fourth graders were considered proficient in mathematics. In Wisconsin, only 31% of eighth-grade students met proficiency levels. Moreover, a third of all schools who failed to make AYP in Maryland did so because of their students with disabilities subgroup (Malmgren et al.).

In 2000, the Educational Policy Reform Research Institute was established by the



U.S. Department of Education (2002) to track and monitor the progress of students with disabilities in state assessments. The states of California, Maryland, New York, and Texas were selected to be monitored due to the diversity that existed within these states (Malmgren et al., 2005). The study conducted by the Educational Policy Reform Research Institute in 2000-2001 revealed that states were experiencing significant underachievement by their students with disabilities. In California, 60% of third graders, 65% of fourth graders, 70% of fifth graders, and 80% of eighth graders failed to meet state standards on stated-mandated mathematics assessments. In Maryland, these numbers were strikingly similar with 71% of third graders, 80% of fifth graders, and 81% of eighth graders failing to meet state standards in mathematics.

This trend suggests that students with disabilities were experiencing significant deficits in mathematics nationwide. Moreover, the need to identify strategies that assist students with disabilities was critical for their successful participation in general education programs. Researchers (Maccini & Gagnon, 2000; Tomlinson, 2002) stated that these strategies must be adopted by way of IEP goals and objectives and teacher instructional delivery.

### *Instructing Students With Disabilities*

In the IEP, the educational services that students with disabilities receive under IDEA are dictated. To that extent, the IEP plays an integral role in the development of instructional programs for students with disabilities. The laws outlined by the IDEA (20 USC 1401.25 et seq.) stipulate that exceptional learners must receive educational services that are intensive and individualized. Unfortunately, it was suggested in research that exceptional learners in general education and special education resources or pull-out programs receive little individualized instruction. Moreover, it was also suggested in

research that teachers tend to use whole group instruction a majority of the time (Moody et al., 2000). In the resource room, students are taught much like instructing a whole class of general education students (Moody et al.). Research conducted by Moody et al. reported that the use of whole class instruction was practiced even when differences in abilities were so noticeable that little observation was required to make those determinations (Moody et al.). This occurrence presented several negative implications for students with disabilities: (a) Students that understand basic concepts continually reviewed information that they already knew, and (b) students who do not have a firm grasp of the concepts are rushed through materials and often miss valuable information (Bottage, 1999).

One of the major provisions outlined in NCLB and IDEA, and key to the participation of students with disabilities in state-mandated assessments was the use of accommodations for students with disabilities. Lehr and Thurlow (2003) reported that “accommodations are changes in testing materials or procedures that enable students to participate in state or district assessments in a way that assesses abilities rather than disabilities” (p. 3). Accommodations are recognized as leveling the playing field. Conceptually, they act as an equalizer between students with disabilities and those without. Accommodations are made in five areas time, learning style, learning environment, content, and evaluation; and can be used on state-mandated assessments.

#### *Mathematics Achievement of Exceptional Learners*

Woodward and Brown (2006) asserted that the equity principle is one of the most challenging tasks facing students with disabilities. Woodward and Brown reported that “in-depth examinations of this population indicate that without substantive accommodations, these students do not exhibit high levels of success on either academic

measures or everyday activities” (p. 3). Moreover, when students repeatedly do poor in math, they tend to attribute that poor performance on their inability to comprehend mathematics. According to Woodward and Brown, as time progresses students tend to “avoid academic challenges, often by adopting self-handicapping strategies for coping with failure” (p. 3). Tucker et al. (2002) concurred with Woodward and Brown on this point. This issue becomes considerable as states push for more rigorous standards, especially, because these standards determine the states' ability to comply with federal mandates. It was suggested by NCTM (2000) that in order for students with disabilities to do well in mathematics, it must be meaningful to them. The literature suggested that students with disabilities believe that school is a mandate to be suffered through (Mckenna, 2005). This belief may very well explain why students at the target middle school were failing to meet and maintain state and federal standards. The researcher observed in the classroom setting that learning is often perceived as a nonnegotiable duty rather than an opportunity to gain valuable lessons.

Cawley (2002) suggested one of the greatest sources of concern for students with disabilities is, mathematics is no longer focused on computation but instead focuses on the application of mathematical skill in a variety of situations. This notion is alarming because many students with disabilities have difficulty processing information, thus, transferring skills from one format to another is likely to pose significant problems.

Teachers of mathematics must provide students with disabilities with effective math instruction so they will be successful on state assessments and increase overall mathematical skill. This is accomplished by teaching high-order thinking math skills as opposed to committing mathematical computation to rote memory (Warger, 2002). By understanding, Warger assumed that the student will understand mathematical

applications using a variety of techniques that promote reasoning.

One of the major problems in mathematical achievement for exceptional needs students is the number of academic deficiencies experienced outside of mathematics, such as reading comprehension, processing information, self-monitoring, and basic math skills (Maccini & Gagnon, 2002). In addition, exceptional needs students often experience memory deficits, which make it difficult for them to acquire mathematical basic skills and transfer them to higher order thinking mathematics (Kroesbergen & Van Luit, 2003). Often, exceptional needs students have learning difficulties that make learning the four basic mathematical operations problematic, including addition, subtraction, multiplication, and division, challenging. Thus, the acquirement of these skills for these students is less likely if they are not retaught after leaving elementary school (Kroesbergen & Van Luit; Maccini & Gagnon). These skills are important because mathematical skill does not end with proficiency in basic mathematical skill but requires students to have a command of mathematical problem solving to progress with more complex functions (Kroesbergen & Van Luit; Warger, 2002).

Woodward and Montague (2002) offer three areas in which special education students must improve in order to increase mathematics achievement. Those areas include mathematics facts, mathematics computation, and mathematic problem solving.

*Mathematics facts.* Fluency and fact retrieval are critical in student achievement. Exceptional needs learners must develop a keen ability for math recall and automatization (Kroesbergen & Van Luit, 2003; Woodward & Montague, 2003). The mathematical range for this category begins with simple addition and subtraction to completing four- to five-digit operations.

*Mathematics computation.* Learning basic mathematical operations has

traditionally been suggestive of the mastery of the skill. Students with disabilities have generally lacked in this area and, as a result, have failed to master automatization and computation. One highly noted challenge for students with disabilities is the failure to get a firm conceptualization on mathematical theory and its representations (Kroesbergen & Van Luit, 2003; Woodward & Montague, 2003).

*Mathematical problem solving.* This is arguably one of the most challenging facets of mathematical proficiency for students with disabilities. Problem solving rests on the hinges of rote memory, applications, computation, and basic math skill. All of which persistently pose problems for students with disabilities (Yang, Shaftel, Glasnapp, & Poggio, 2005). Moreover, Maccini and Gagnon (2000) wrote that instructional practices common in the special education classroom “focus narrowly on computational tasks rather than higher-order problem-solving activities” (p. 2).

Considering the identified difficulties experienced by students with disabilities, educators are searching for ways to accommodate these learners (Tucker et al., 2002). Planning for diverse student populations is a cumbersome task; however, the reality and necessity to do so still exists. According to the NCTM (2000), “Effective mathematics instruction requires understanding what students know and need to learn and then challenging and supporting them to learn it well” (p. 20). Understanding of mathematics generally begins when students can associate what is being learned with what they already know (Tucker et al., 2002).

#### *Mathematics Achievement Across Exceptionalities*

This study focused on exceptional learners with high incidence disabilities. High incidence disabilities are commonly referred to as mild disabilities, and make up two thirds of all students with disabilities (Friend & Bursuck, 2002). This section outlines the

basic characteristics of each exceptionality that was examined in this study as defined by the Georgia Learning Resource System. In addition, the literature and previous research are discussed as they pertain to the respective classifications.

*Other health impairment (OHI).* Students having limited strengths, vitality, or alertness, including a heightened awareness to environmental stimuli, that results in limited alertness with respect to the education environment. This is due to chronic or acute health problems, such as asthma, Attention Deficit Disorder or Attention Deficit/Hyperactivity Disorder (AD/HD), diabetes, epilepsy, heart condition, hemophilia, lead poisoning, leukemia, nephritis, rheumatic fever, and sickle cell anemia; and adversely affects a students' education performance (Georgia Learning Resource System, n.d.).

Students classified under OHI have varying medical, social, or psychological disorders. The problem that were explored in this section of the literature review were for those students diagnosed with AD/HD. AD/HD is considered a behavioral and mental disorder (Harlson, 2005). It is characterized by the prevalence of three major behaviors: (a) inattention, (b) hyperactivity, and (c) impulsivity. The persistence of the behaviors make it difficult for students to understand mathematical concepts. Particularly because they overlook details due to inattention, they are unable to spend a lot of time on one problem without being distracted, and they have a hard time displaying information from day to day (Harlson). The persistence of this disorder indicate the need for instructional practices that (a) helps students recognize patterns, (b) employs mnemonics, (c) utilizes visual cues, (d) real life simulations, and (e) uses manipulatives (Harlson).

*Mild Intellectual Disability (MID).* Students with MID have significantly below average intelligence, are significantly below grade level in all academic areas, and have

adaptive behavior deficits. The average IQ is approximately 100; an IQ of 55 to 70 is considered to be in MID range. Adaptive behavior deficits may be in the areas of self-help skills, communication skills, social skills, and motor skills. The MID student has difficulties with academic skills, oral and written communication skills, and peer interaction (Georgia Learning Resource System, n.d.)

*Learning Disability (LD)*. Characterized by a pattern of strengths and weaknesses in performance rather than general academic weaknesses. Most students with a learning disability have an average or above average intelligence and have one or more significant academic deficiencies in the following areas: (a) oral expression, (b) listening and comprehension, (c) written comprehension, (d) basic reading skills, (e) reading comprehension, (f) math calculation, and (g) math reasoning, (Georgia Learning Resource System, n.d.). Research conducted by Jones et al. (1997) reported that students with learning disabilities experience academic deficits attributable to six causes: (a) past achievement, (b) self-efficacy, (c) content, (d) management of instruction, (e) close of lesson and, (f) evaluation of instruction.

Research conducted by Maccini and Gagnon (2000) revealed, on average, students with learning disabilities are 2.7 grade levels below their nondisabled peers in mathematics. Research conducted by Cawley and Miller (1989) determined that most LD students perform at the fifth-grade level. Moreover, these students have significant problems with higher level math, making it difficult for them to perform successfully on state assessments designed for their grade level.

*Students' perception of self-efficacy*. Students with learning disabilities often recognize their academic limitations. This awareness often furthers the problem of academic achievement by prompting the self-fulfilling prophecy. The self-fulfilling

prophecy is an old adage that suggests you will do or achieve as you believe you will do or achieve. Meaning students with low expectations will more than likely perform low because of their perceived ability. Teachers are challenged to interrupt this cycle by providing opportunities for positive experiences in mathematics.

*Instructional content.* Students experiencing learning disabilities have a range of deficiencies that make learning mathematics particularly difficult. To address this issue, the teachers must ensure that the topics are presented in a variety of settings that support real-world simulations.

*Management of instruction.* Class management is critical to educating students with learning disabilities things, such as time, opportunities for success, and curriculum coverage are critical to the achievement of students with learning disabilities. Students with learning disabilities should be provided with peer instruction, direct instruction, interactive teacher and student responses, and strategy instruction.

*Educators effort to evaluate and improve instruction.* Teachers must be willing to consistently evaluate student performance. This evaluation to ensure that the goals and objectives are being met and instruction is meeting the needs of each student.

*Educators' belief about the nature of effective instruction.* In this section of the investigation, the authors suggested that teachers must acknowledge the variety of teaching philosophy that outline how mathematics should be taught. Meanwhile, the authors also positioned themselves against the constructivist theory. They contended that this position is illogical and indefensible. This sentiment was seemingly contradictory to their position regarding instructional content. In that, the authors contended that instruction should simulate real life, yet they asserted that it should not be done in the context of constructing information and adjusting it based on the individuals'



understanding of these concepts.

*Emotional or behavioral disability (EBD).* Students with EBD exhibit one or more of the emotionally based characteristics of sufficient duration, frequency, and intensity that it interfere significantly with educational performance to the degree that provision of special education services is necessary. The student's difficulty is emotionally based and cannot be adequately explained by intellectual, cultural, sensory, or general health factors (Georgia Learning Resource System, n.d.).

Bos and Vaughn (1998) attributed the lack of mathematics proficiency for students with EBD on (a) lack of persistence, (b) anxiety, and (c) attention problems. All of which are consistent with the characteristics outlined by Georgia Learning Resource System. Typically, the EBD student is 1.8 grade levels behind their nondisabled peers in mathematics (Maccini & Gagnon, 2000). This, to some degree, explains why these students have difficulty on grade-level state assessments.

#### *Theoretical Framework of Differentiated Instruction*

Garner's multiple intelligence theory suggests individuals possess an inherent uniqueness that is responsible for their ability to learn. Often, the exposure of these intelligences is left to the classroom teacher. With the variety of diverse learners, middle school educators must ensure that they develop and implement instructional strategies that assist all learners.

The theoretical underpinnings of multiple intelligences were adapted by the system of differentiated instruction. Pioneered by Garner (as cited in Kapunsnick & Hauslein, 2001), the theory of multiple intelligences asserts that individuals possess several intrinsic intelligences that make them stronger in some areas over others. This philosophy suggests that individuals possess certain inherent abilities that allow them to

grasp information more intelligently in some areas opposed to others. What this means is instructional strategies must be used to embrace differences and teachers must use a variety of instructional delivery methods that maximize their potential of reaching diverse learners.

For the purpose of this study, the researcher focused on seven of Gardner's proposed theory of multiple intelligence. The seven intelligences discussed in this study were the initial intelligences identified by Gardner. Gardner (1983) defined intelligence as "the capacity to solve problems or to fashion products that are valued in one or more cultural setting" (p. 9). Multiple intelligence theory contends that each learner has their unique ability and each of these abilities must be addressed and developed in every learning situation. Armstrong (1994) defined the types of multiple intelligence:

*Linguistic.* The capacity to use words effectively, whether orally as a storyteller, orator, or politician; or in writing as a poet, playwright, editor, or journalist.

*Logical mathematical.* The capacity to use numbers effectively, such as a mathematician, tax accountant, or statistician; and to reason well, such as a scientist, computer programmer, or logician.

*Spatial.* Spatial is the ability to perceive the visual-spatial world accurately, as a hunter, scout, or guide; and to perform transformations, as an interior decorator, architect, artist, or inventor.

*Bodily-kinesthetic.* Expertise in using one's whole body to express ideas and feelings, as an actor, a mime, an athlete, or a dancer; and facilitate in using one's hands to produce or transform things, as a craftsperson, sculptor, mechanic, or surgeon.

*Musical.* The musical capacity is to perceive, as a music aficionado; discriminate, as a music critic; transform, as a composer; and express, as a performer; musical forms.

*Interpersonal.* The interpersonal ability is to perceive and make distinctions in the moods, intentions, motivations, and feelings of other people.

*Intrapersonal.* Self-knowledge and the ability to act adaptively based on that knowledge is an intrapersonal intelligence. (pp. 28-30)

In Table 3, a brief summary of the multiple intelligence activities is provided.

Historically, intelligence has been measured as an all-encompassing phenomenon

that is centered on the belief that there is a single form of intelligence. Multiple intelligence theory is rooted on the assumption that individuals possess a variety of intelligences. In short, the theory is grounded under the philosophy of pluralization.

Table 3

*Summary of Multiple Intelligence*

Intelligence	How they connect	Activities of interest
Linguistic	Words	Discussions, conversation
Logical-mathematical	Numbers	Logical games, puzzles, brain teaser, problem solver
Spatial	Pictures	Graphs, pictures, concept maps
Bodily-kinesthetic	Body/movement	Hands-on, sports
Musical	Music	Rapping, mnemonic games, rhythmic learning
Interpersonal	People	Cooperative learning, peer tutoring
Intrapersonal	Self	Individualized instruction, independent study

The rationale for multiple intelligence occurred from the discovery of what is now considered brain-based research. Initially, intelligence was defined as a single semiotic function (Hatch & Gardner, 1993). This is the notion that the brain acts autonomously based on a single psychological process. Interestingly, it was discovered that each part of the brain carried out a separate psychological processes that controlled functions, such as linguistic, numerical, pictorial, and other symbolisms (Hatch & Gardner). The mere existence of multiple intelligence theory seriously challenges the notion that all students receive an equitable education (Whermann, 2000). This especially holds true when the

traditional teacher-centered classroom is considered. This setting is largely auditory instruction that requires students to engage by practicing pencil-paper exercises (Gardner, 1983). For the linguistic learner, this may provide optimal interaction; however, other students may not receive maximum opportunities to learn.

### *Elements of Differentiated Instruction*

In order to adequately implement the techniques utilized during differentiated instruction, it is critical to understand what differentiated instruction is and, most importantly, what it is not. Considering this educational concept has been around as long as the one-room schoolhouse, it is imperative that educators understand the guiding principles of using this method. Differentiated instruction is not merely providing a different lesson plan for every student; the purpose of differentiated instruction is to associate key concepts that create a lasting impression on students within the realm of their learning capabilities (Mercer & Mercer, 2005). Instruction can be differentiated through content, process, and product, or by manipulating the environment (U.S. Department of Education, 2005). Each category has its unique challenge; however, when developing various teaching strategies, the educator must keep in mind that the delivery method and product may be different but the desired curriculum must remain the same. The goal of differentiated instruction is not to teach different students different things. The goal is to teach different students the same things using a variety of instructional methods.

Hall (2002) wrote,

Differentiation is recognized as a compilation of many theories and practices [and these theories are supported by empirical data, which would validate the notion that differentiated instruction works] . . . practices noted as central to differentiation have been validated in the effective teaching research conducted from the mid 1980's to the present; these practices include effective management

procedures, grouping students for instruction, and engaging learners. (p. 2)

Differentiated instruction is an approach to teaching and learning where students have multiple options for taking in information and making sense of ideas. Conceptually, students learn through a constructivist perspective. This is when students are active participants in formulating ideas based on the information presented. This form of instruction requires teachers to be flexible in their approach to teaching and adjusting the curriculum and presentation of information to learners rather than expecting students to modify themselves for the curriculum. Classroom teaching is a blend of whole-class, group, and individual instruction. Differentiated instruction is based on the philosophy that instructional approaches should vary and be adapted in relation to individual and diverse students in classrooms. Hall (2002) suggested that differentiated instruction is a process that seeks to educate the whole child rather than developing a specific cognitive ability, and that curriculum should be administered as a tiered process to engage each learner.

The principles of differentiated instruction rest on the beliefs that all learners are capable of learning. Research-based data suggested that continuous assessment of student progress is imperative in creating successful differentiated instruction models. Teachers should use differentiated instruction strategies to tailor teaching to the various aptitudes of each student (McGreevy-Nichols, 2004). Because the differentiated instruction model is based on the premise that no two students are alike, learning experiences are geared to allow students to absorb information in different ways (McGreevy-Nichols). To effectively create programs that are successful, leaders must use data to validate and improve instruction (Marzano, 2003). Taylor (2003) suggested the following steps for using data to improve instruction:

1. Collecting the reports from standardized tests and classroom-based assessments, which begins with understanding what data is available.
2. Sorting and analyzing the data.
3. Identifying areas of improvement for specific students.
4. Planning how you will create lessons that meet the different needs of those students.

Data is an essential driving force in the development, implementation, and continuation of all instructional programs.

With models like differentiated instruction, the collection and compilation of data will be its greatest resource. Educators are charged with synthesizing data with the goal of improving educational organizations and increasing student achievement. The Council of Exceptional Children listed the following steps for successful differentiated instruction.

*Determine key concepts and learning goals.* The curriculum should be based on broad concepts, and teachers must have well-defined learning goals. According to the CEC (2006), it is recommended that teachers ensure that

. . . curriculum is clearly focused on the information and understandings that are most valued by an expert in a particular discipline.

*Link assessment to instruction.* Assessment should be ongoing. With the data gleaned from assessment, teachers learn where students need additional instruction as well as determine direction for future instruction.

*Implement flexible grouping.* Teachers use whole-class, small group, and individual instruction. Students can, and should, be grouped in a variety of ways based on readiness, interest, learning profiles, and randomly. Teachers can assign work groups, and sometimes students select their own work groups. The groups should change often.

*Use a range of instructional strategies.* In addition to planning instructional activities to meet student's learning readiness, all activities should be equally interesting and equally focused on essential understandings and skills. To make learning student-centered, the teacher should employ a wide variety of instructional strategies such as tiered activities, hands-on activities, scaffolding,

and projects. (¶ 3-6)

Differentiated instruction is present with the modification of three elements. In the aforementioned section, the researcher identified these elements as content, process, and product. Each element has its distinctive function for carrying out the major goals of differentiated instruction.

*Content.* Content is what is being taught. This usually generalizes to federal, state, and local curriculum. The actual curriculum will not be modified but just the source for synthesis. During this phase, the teacher must determine the most critical aspects of the content matter. Based on research studies (Hall, 2002; Tomlinson, 2002), the teacher will synthesize and develop a system in which to present information to a group of diverse learners upon determining this factor. Conceptually, the teacher is determining the main ideas in each unit and deciding what information in those units would assist students in content mastery.

*Process.* Process is recognized as the phase in which the teacher implements activities and determines how to group students. Researchers (Hall, 2002; Whermann, 2000) stated that process grouping can be based on three factors: readiness, interest, and learning profile.

*Readiness.* Readiness is grouping students based on their ability level. All groups share the same learning goal, but activities for each group may be slightly different. The purpose of this format provides each learner with the opportunity of acquisition. During the stage of differentiated instruction, each group has a goal to fulfill. At the end of the task, all groups should have acquired the principle knowledge of the themed unit. Successful grouping can also be achieved by pairing students with similar interests and learning profiles. In interests-based groups, students can be (a) homogeneously grouped

with like peers or (b) heterogeneously grouped with students of varying interests (Tomlinson, 1999).

*Interests.* Interest is what a student enjoys learning about, thinking about, and doing. Interest is a great motivator. A wise teacher links required content to student interests in order to hook the learner. Tomlinson (2003) wrote “the goal of interest differentiation is to help students connect with new information, understanding, and skills by revealing connections with things they already find appealing, intriguing, relevant, and worthwhile” (p. 3).

*Learning profile.* Learning profile is a student’s preferred mode of learning. According to Tomlinson (2003), “an individual's learning profile is influenced by learning style, intelligence preference, gender and culture . . . The goal of the learning profile differentiation is to help students learn in ways they learn best and to extend the ways in which they can learn effectively” (p. 4).

*Learning environment.* Learning environment, according to Tomlinson (2001), “is the setting in which learning takes place (i.e., quiet/noise, warm/cool, still/mobile, flexible/fixed, or busy/spare)” (p. 60).

Process differentiation can be accomplished in several ways: (a) scaffolding, (b) tiered assignments, and (c) ability and flexibility grouping (Tomlinson, 2003). Process differentiation refers to the modification of activities or groupings to meet students’ needs.

*Scaffolding.* Scaffolding, according to Tomlinson (2003), refers to any support system that enables students to succeed with tasks as they find genuinely challenging. Tomlinson stated,

Goals of scaffolding include helping students be clear about the task’s purpose



and directions, and helping students stay focused, meet the expectations for quality of work, find and use appropriate sources of information...Types of scaffolding include study guides, step-by step directions, comprehension strategies, use of a tape recording or video to support reading or understanding, modeling, icons that help interpret print, guided lectures, and multimode teaching.

*Tiered assignments.* Tiering is a process of adjusting the degree of difficulty of a question, task, or product to match students' current readiness level. To tier and assignment teacher must determine what a student should know . . . consider readiness range of students . . . develop or select an activity that is interesting and requires high level thought. (p. 6)

*Ability/Flexible grouping.* Reordering of students into working groups to ensure that all students work with a wide variety of classmates and a wide range of contexts during a relatively short span in the class. According to Tomlinson (2003), "Grouping enables students to work with peers with both similar and dissimilar interest. Teachers should not place students homogeneously in one group" (p. 7).

*Product.* Product refers to how students are assessed. Assessments assist educators with determining the specific competencies of each student, and allow educators to develop comprehensive educational plans based on these findings. The findings provide valuable information pertaining to a student's strengths and weaknesses, allowing educators to make concise decisions regarding placement and possible resources.

Vansciver (2005) classified this type of assessment as assessment for learning; teachers learn how to use high-quality assessments to differentiate instruction. Schools, more than ever, are relying on their teachers to develop functional instructional models that increase student achievement. Studies (Brimijoin, Marquissee, & Tomlinson, 2003) have found that successful differentiation allows educators to target specific learner needs and guides them in developing comprehensive academic programs. Product differentiation should be utilized prior to, during, and after instruction. Assessments are

often associated with end of unit testing; however, to be effective, they should be utilized prior to instruction to determine readiness for the material. Next, they should be given during the instructional period to determine the level of acquisition and if remediation needs to be conducted. Lastly, assessments should be completed at the end of each unit. Studies (Brimijoin et al.; Vansciver) reported that this can be done with testing, a culminating activity, or any activity that indicates the selected information has been acquired.

*Elements of Peer-Mediated Instruction and Intervention (PMII)*

From the time of the one-room schoolhouse, students teaching students has always been an explored form instruction to assist with diversity in the classroom. The one-room schoolhouse played home to students of various ages and ability levels. Indeed, the heterogeneity in these environments made the use of the one-room schoolhouse appealing in some aspects, especially, because older students often acted as facilitators of learning.

Hall and Stegila (2003) defined peer-mediated instruction:

Peer-mediated instruction and intervention is an alternative classroom arrangement in which students take an instructional role with classmates or other students. Several approaches have been developed: Some support students working in pairs or dyads and others allow students to work in small cooperative learning groups. (¶ 4)

For this instruction to be most effective, students must be taught instructional roles: to be systematic, to elicit responses, and to provide feedback.

Hall and Stegila (2003, ¶ 2) supported the use of these approaches as alternative practice activities, however, does not condone the use of peers for providing instruction in "new instructional content." Peer-mediated instruction provides alternatives to the traditional classroom instruction; students are held accountable for the material. Students

are taught their role in the instructional process and through these roles assist peers in the comprehension of the material.

Research on peer-mediated instruction was conducted by Johnson, Johnson, and Stanne (2000). This research showed that because of the clear theoretical base, solid research validation, and clear procedural applications, PMII has become a reasonable choice for educating students with disabilities (Hall & Stegila, 2003). Peer-mediated instruction has several levels of intervention. Each intervention has provided a key feature in its previous successes. One of the major roles of peer-mediated instruction is it promotes active socialization as a means for learning. Indeed, this is often a rarity in the traditional classroom as educators often rely on instructional techniques that promote learning as independent phenomena (Hall & Stegila).

Hall (2002) described the critical features of peer-mediated instruction as follows.

*Students are taught roles.* During this phase, the teacher shows students how to help peers and provides the format in which succinct peer-mediated learning can take place.

*Students instruct.* Students provide instruction to other students once the teacher has determined that they have mastered skills necessary for success. One of the critical components of this feature is students do not present new concepts they merely reiterate key concepts that have already been explained, identified, and addressed by the teacher or facilitator. Moreover, students are used to assist peers and to further their understanding of concepts.

*Teachers monitor and facilitate.* Teachers ensure that students are receiving appropriate redirection by peers. Both students will act as tutor and tutee. Generally, these students will be required to become experts in certain tasks and then they must

demonstrate this proficiency to teacher and tutee.

*Academic and social goals.* Students learn and discuss academic goals and understand that learning is a social and cognitive activity. The goal of this type of instruction is for each peer partner to enhance each other's understanding of the concept and to develop critical thinking skills.

Peer-mediated instruction utilizes several models that carry out various functions. The first model discussed is the cooperative learning model. In this model, the teacher groups students; these groups act as a think tank (Hall & Stegila, 2003). The students share knowledge and ideas within the group. Normally, these groups consist of three to six students that work together to increase work and learning proficiency. Perhaps the most intriguing aspect of cooperative learning's design is that students learn how to socially acquire and analyze work, which supports the notion that learning is a social activity before it is a cognitive. Hall and Stegila (2003) found that "cooperative structures are used as incentive to encourage the pupils to learn the material" (p. 3).

Peer-mediated instruction is implemented through various designs. This literature review focused on two of the more widely researched forms of peer-mediated instruction: cooperative learning and PMII dyads. Cooperative learning is accomplished through team cooperative learning and group and regroup models. The PMII dyads model is achieved through the use of reverse roles, class-wide peer tutoring, and cross-age tutoring

Team cooperative learning is achieved when students remain in the same groups through an entire lesson (Johnson & Johnson, 1986). In this model, students are assigned and grouped by teachers. Team cooperative learning is divided into three subunits; for the purpose of this research, only two will be discussed. Student teams-achievement divisions and team games tournaments are the two subcomponents of team cooperative

learning.

*Student teams-achievement divisions.* Student teams-achievement divisions is a method in which the teacher initially presents a whole group instruction lesson. After the lesson is presented, students work in teams to ensure that each team member has mastered materials (Hall & Stegila, 2003). Students are graded and scored as a team.

*Team games tournaments.* Team games tournaments is a method in which teams compete in academic bowls and tournaments. This model is very similar to the student teams-achievement divisions method; however, students participate in weekly games as opposed to quizzes.

Another form of cooperative learning is the group and regroup design. In this format, students are assigned different groups during the various parts of each lesson. During the lesson, the learning environment is changed; students are placed in either homogenous or heterogeneous groups (Maheady, Harper, & Mallette, 1991). The group-regroup model also has several designs, however, this literature review will examine four: jigsaw, team-assisted individualization, numbered-heads together.

*Jigsaw.* The jigsaw method is one in which the students are placed in a three- to six-member heterogeneous learning group where one member becomes an expert on each section of the lesson. Teachers may assign each student a section to master and share with the rest of the group. Once the material is mastered, students share with their group members.

*Team-assisted individualization.* The team-assisted individualized method is a method in which the students participate in cooperative learning along with individualized instruction. Teachers provide lessons and students conduct peer checks with their teammates (Maheady et al., 1991).

*Numbered-heads together.* Students are divided into heterogeneous groups of high-, low-, and average-achieving students. Each student is given a number and the groups are evenly subdivided. Once the teacher discusses the lesson, only the number of the student the teacher calls can answer the question. This is supposed to support discussion among the groups while encouraging students to become socially active.

PMII dyads is a form of peer-mediated instruction in which students are organized in pairs (Hall & Stegila, 2003). Groups are formed in which students act as the tutor or the tutee, depending on which type of dyad formation is selected. Three methods are institutionalized in the creation of these PMII dyads: reverse-role tutoring, class-wide peer-tutoring, and cross-age tutoring.

*Reverse-role tutoring.* In reverse-role tutoring, older students with disabilities tutor younger students with no disabilities. One of the major benefits of this model is students have the opportunity to develop interpersonal skills. Older students learn to how to facilitate learning. Younger students learn skills. Additionally, students with disabilities gain required practice in certain academic skills.

*Class-wide peer tutoring.* Class-wide peer tutoring is a dyad model in which the teacher creates pairs. In this model, students are all in the same class and being taught the same material. Students are instructed on how to assist each other in the role of tutor and tutee. Students swap roles so each will have a chance to serve tutor and tutee (Hall & Stegila, 2003). Benefits of using this model include direct practice of academic skill, the group earns points as a single unit, and students are engaged in social learning.

*Cross-age tutoring.* This method is very similar to the reverse-role tutoring. However, students with disabilities instruct younger students with the same or similar disabilities. The younger and older students benefit socially. The older student builds

confidence by acting as the tutor. The younger student builds confidence by witnessing the older students with disabilities in a supporting role and they become trusting in their ability.

### *Theoretical Framework for Mixed-Methods Methodology*

The 19th and 20th centuries played host to the fervent debate about quantitative and qualitative research paradigms. Arising from these debates were extremists, who contend that certain research paradigms have intrinsic value over others. Quantitative extremists express assumptions that are consistent with a positivist philosophy; these assumptions are executed with the ideology that one reality can be developed from a single set of circumstances. Qualitative extremists reject positivism; they believe that social constructs are the basis for interpreting reality. Additionally, qualitative extremists believe by manipulating certain occurrences, social change can or will occur regardless of the set of circumstances. The major differences that exist between the two sets of paradigm extremists are the level of logic and justification. Unfortunately, much of the quantitative-qualitative debate has caused more confusion than benefit. Rather than extract the benefits of both paradigms, researchers in many instances have developed the notion that one is more superior to the other.

Quantitative research (Glense, 1999; Zimmerman, 2005) is developed with the rationale that selected variables have an intrinsic affect on the outcome of any given occurrence. This notion suggests that certain facts produce one single reality, also known as naïve reality. In stark contrast, qualitative research is based on principles derived from constructivism. Zimmerman (2005) wrote that qualitative research is developed with the underlying assumption that the researcher is committed to “exposing social manipulation and changing oppressive social structures” (p. 19). Though the purpose of these two

formats may provide significantly different results, they possess great utility in the discovery and affects of information. Quantitative research provides information that is objective and separated from feelings or beliefs of the individual (Zimmerman).

Qualitative research provides information that is subjective and includes the beliefs of individuals, often considered as one-sided. Together the theoretical underpinnings of both methodologies can provide great insight into problem situations and possibly support a comprehensive resolution (Zimmerman).

Both quantitative and qualitative have specific philosophies that make each paradigm unique in its ability. The use of both paradigms would seemingly have a positive effect on educational research. According to Kingsbury (2006), effective educational research includes a mixed methodology approach:

A strong model would measure students at several points across time, match individual students in the treatment group to students in the control group, take into account the effectiveness of a program's implementation, and use achievement measures developed specifically for the students in the study. (p. 3)

The writer concurred with this method for educational research and further asserted that educational research would seemingly benefit from the pedagogy associated with positivism and constructivism.

Researchers continue to debate about the efficacy of quantitative and qualitative methodologies. With quantitative designs, researchers seek to understand the relationship of certain phenomena. Qualitative designs require the researchers to identify the meaning of data based on their ability to use literal interpretation. As an active researcher, the benefits of both paradigms are attractive. Readers must understand that no research paradigm is superior to another for conducting education research or understanding educational institutions. With the vast differences associated with learning, teachers, and



the administration of educational programs, the writer dare make the assertion that effective research needs comprehensive, multifaceted research strategies that provide a continuum of meaningful inquiry.

### *Summary*

Federal accountability standards have made the participation of students with disabilities in state assessments mandatory. The literature review documented several issues to be addressed in this study: student achievement, instructional interventions, and state accountability. These areas are the centerpiece for this study and provide a myriad of implications for students with disabilities and their achievement on state assessments. The literature reviewed for this study provided a contextual background of the extent of the problem, interventions that conceptually aid the problem, and theoretical background to assist the researcher for creating a framework for study. It is evident through the literature that the existence of this problem is widespread and must be addressed to remedy the mathematical deficits experiences by students with disabilities.

### Chapter 3: Research Methodology

Student achievement is the cornerstone of public education. When underachievement is observed, educators are charged with identifying and implementing interventions that yield effective solutions. This is accomplished when teachers have the appropriate resources and understand research-based strategies that assist all learners in meeting specific academic goals (NCTM, 2000). The underachievement of students with disabilities poses a great problem for administrators and teachers alike. The researcher intended to solve this problem by employing the proposed interventions. Furthermore, it was the researcher's goal to aid students at the time of this study and those in the future in effectively gaining the necessary competencies for greater achievement on state assessments by exposing the instructional approach that provided the greatest benefit to students with disabilities.

To solve the problem, the researcher utilized a quasi-experimental mixed-methods approach. This design was selected largely due to the research's lack of randomization. This method is frequently used in educational organizations because this setting prohibits forming artificial groups (Creswell, 2002). In this research, students were selected based on groupings that had already been formed; the assignment of groups was performed but not participants to groups.

Quasi-experimental mixed-methods methodology best answered the research questions in this study. Components of quantitative research assisted the researcher in understanding the effectiveness of the interventions, while components of qualitative research aided the researcher in understanding those outcomes. Combined methodologies for the purpose of this study were deemed critical to this action research. Action research seeks to improve conditions within a particular setting (Charles & Mertler, 2002). As was

the case, the researcher believed that the nature and significance of this study might be beneficial for various educational settings similar to the target organization's structure.

### *Research Design*

This research utilized multiple methodologies. This combination is termed, mixed-methods methodology. In mixed-method designs, qualitative and quantitative research are employed. Qualitative research seeks to explore phenomena in a naturalistic setting through interpretive data analysis. Quantitative research seeks to explain phenomena through empirical data analysis.

This design was selected to better understand the mathematics achievement of students with disabilities using the selected interventions and to understand how students respond to those interventions. Trochim (2006, ¶ 1) defined this as complimentary: Complimentary designs “clarify and illustrate results from one method with the use of another method.” This research was designed to identify if participation in the selected interventions had an affect on student achievement and to what extent students responded to the selected interventions.

Creswell (2002) described this design as a dominant-less dominant design. The dominant-less dominant design is achieved when one methodology plays a larger role in the study. In this research, quantitative methods had a strikingly larger role. It was the researcher's hope that utilization of both paradigms would aid the reader in understanding the concepts of differentiated and peer-mediated instruction, as they relate to mathematics achievement, within the confines of empirical and interpretative data.

### *Variables*

The researcher identified three critical variables that had potential to affect the outcomes of this study:

1. The amount of time for implementation of procedures. School and district initiatives supersede the implementation of this applied dissertation. To that extent, there were limits on time that may affect the outcome of this study.

2. Changes in educational programming. Students participating in the selected interventions receive instruction based on their IEP goals and objectives. Because of this, it was a possibility that adjustments in the course of the study would need to take place based on IEP goals.

3. Student attendance. The researcher has no control over student attendance. Frequent failure to participate in the selected interventions due to absenteeism could have affected the outcomes of this study.

#### *Assumptions*

During the course of this project, it was assumed that the basic guidelines of NCLB and IDEA would remain intact. Furthermore, it was assumed that there would be no changes in curriculum or standards throughout the course or this project. Moreover, the researcher assumed that students with disabilities would be required to participate in state assessments in Georgia. It was assumed that measurement techniques were valid and significant.

#### *Sampling Selection and Subject Characteristics*

The participants in this research were considered a convenience sample. A convenience sample includes groups of individuals accessible to the researcher (Creswell, 2003). This procedure was selected to save time, save resources, and ensure the confidentiality required by this population. Moreover, the researcher selected this population due to the scope of involvement at the target organization.

*Students.* The population for this study consisted of exceptional learners in

seventh-grade special education pull-out or resource mathematics classes. During this study, the middle school had 24 students enrolled in resource mathematics. Of the 24 students enrolled in resource mathematics, 3 were 12 years old, 15 were 13 years old, and 5 were 14 years old. There were 6 Black males, 9 White males, 1 Black female, 5 White females, and 1 Hispanic female.

The population considered accessible for this study consisted of students that were enrolled at the middle school upon the implementation of this study. Students met the following criteria: (a) received special education services, (b) enrolled in a special education resource mathematics class, and (c) were willing to participate in the study.

Each student participated in the special education program under the exceptionality of OHI, MID, EBD, or LD. Additionally, each participant participated in a cross-categorical pull-out program for mathematics or resource program. This type of programs serves the needs of several types of exceptionalities simultaneously. These students leave the general education classroom for part or all of the school day to attend class in the special education or resource room.

*Researcher.* The researcher served as one of the primary data collection instruments. Student observations were conducted, attitudes were documented, engagement was established, and overall response of exceptional learners to differentiated and peer-mediated instruction was reported. According to Tashakkori and Teddlie (2003),

The researcher in a qualitative study is an active participant in the interpersonal environment of the unit that is being observed. The researcher's main objective was to measure document the behaviors and interaction patterns as they occur in the natural setting. (p. 106)

Considering the researcher's participation in this study, it was seemingly appropriate to

document the background of this participant to increase the level validity.

The researcher's perceptions in regards to the abilities of exceptional learners have been shaped by experience as an exceptional needs teacher. From 2004 to the time of this study, the researcher served as an exceptional needs teacher at the middle school. In addition, the researcher served as a local education authority (LEA) at the middle school since 2006. The LEA acts as a representative on a child's IEP team that is knowledgeable in both designing and implementing special education programs. During the time of this study, the researcher also served on the Central Eligibility Committee for the district in which the research took place. This committee makes determinations regarding student eligibility for special education services.

The researcher received a bachelor's degree from the State University of New York at Albany in criminal justice; a master's degree from the State University of New York at Albany in curriculum development and instructional technology; and received special education certification and training at Armstrong Atlantic University. In addition, the researcher was concurrently enrolled in a postgraduate educational leadership program at the University of Georgia.

The researcher had knowledge of both curriculum development and exceptional student education. With this background, the study was commenced with the expectation that learning is a social construct that can be manipulated by way of differentiated and peer-mediated instruction to have a positive effect on student achievement.

Through this study, the researcher (a) identified, examined, and discussed ways in which differentiated and peer-mediated instruction was applied in the resource classroom and (b) identified if there was a relationship between implementing the strategies of differentiated and peer-mediated instruction and student achievement. The researcher

acted as a participant by implementing the strategies of differentiated and peer-mediated instruction in a seventh-grade mathematics resource. The researcher modeled the key principles utilized during differentiated and peer-mediated instruction and examined student performance on the Criterion Referenced Competency test. This was accomplished by compiling CRCT scores for the 2006-2007 school year.

*Peer-debriefing participants.* To ensure that reliability and validity were present in this research, two special education colleagues were enlisted to provide *peer debriefing* on quantitative and qualitative instruments developed and utilized for this project. Mills (2003) defined peer debriefing “provides researchers with the opportunity to test their growing insights through interaction with other professionals. This is generally someone that will be able to help reflect on situations by listening, prompting, and providing insights throughout the process” (p. 77).

The researcher met with peer-debriefing participants two times. The first meeting was to discuss the reliability and validity of data collection instruments. The next meeting was to discuss (a) content, (b) validity, and (c) implementation of the plan.

### *Instrumentation*

The CRCT mathematics subtest was utilized for the pretest and posttest. For the pretest, the researcher employed the use of the CRCT administered in Spring 2002. This test attempted to establish equivalency among the groups in the form of a covariate.

*CRCT pretest.* The CRCT mathematics subtest was composed of two sections containing 60 multiple-choice questions. The test covered five mathematical domains: data analysis and probability, geometry, algebra, number operations, and mathematical process skills. The purpose of the CRCT was to measure student acquisition of and understanding of the knowledge, concepts, and skills set by GPS (Georgia Department of

Education, n.d.). Information from the CRCT provided information at the student, class, school, system and state level. These scores were used to determine student strengths and weaknesses. Specifically, how well they understood the concepts and content presented at the respective grade level. The CRCT was administered to students in Grades 1 through 8.

Domain descriptions were provided by the Georgia Department of Education. These descriptions outlined the curriculum standards for seventh-grade students. These standards were selected due to the grade level of the research participants.

*Algebra* refers to students' skill in developing an understanding of linear relations and fundamental algebraic concepts.

*Data analysis and probability* refers to students' skill in developing an understanding of data analysis by posing questions, collecting data, analyzing the data using measures of central tendency and variation, using the data to answer the questions posed, and understanding the role of probability in sampling.

*Geometry* refers to students' skill in further developing an understanding of plane and solid geometric figures using constructions and transformations, exploring the properties of similarity, and further developing their understanding of 3-dimensional figures.

*Mathematical process skills* are integrated across the four domains. Mathematical process skills refers to students' dexterity in applying concepts and skills in the context of authentic problems and understanding concepts rather than merely following a sequence of procedures. Process skills are used to acquire and apply content knowledge.

*Number operations* refers to students' skill in developing an understanding of the concept of rational numbers and applying them to real world situations.



*Process skills* include solving problems that arise in mathematics and other contexts, reasoning and evaluating mathematical arguments, communicating mathematically, making connections among mathematical ideas and to other content areas, and representing mathematical ideas in multiple ways.

*Administration.* Participants were given 2 hours to complete the pretest. To ensure that testing conditions were exactly the same as they would be during the actual CRCT administration, the researcher allowed additional time to those students whose IEPs dictate this requirement. Students in both groups received the pretest during their regularly scheduled math class. To ensure that accommodations outlined in the students' IEP were carried out, the researcher administered the test over two class periods.

*Scoring.* The pretest was scale scored based on the number of correct items or number of test items. Scores ranged from 0% to 100%. These scores were reported and used as the covariate.

Reliability is one of cornerstones of quality testing and assessment. Reliability is an instrument's ability to give the same or comparable result for the same student every time (Georgia Department of Education, 2006). The pretest has a reliability of 0.92, which is acceptable in the social sciences (Creswell, 2002). Reliability measures to what extent the testing instrument is useful (Georgia Department of Education).

Validity refers to the degree to which evidence and theory support the interpretation of test scores entailed by the recommended uses of the tests (Georgia Department Education, 2006). The Georgia Department of Education set up item review committees to review test items. Committee members evaluated, revised, and rewrote items they deemed unsatisfactory or inappropriate. In addition, these tests were field tested and deemed valid. Furthermore, the CRCT selected for this research was similar to

the forms administered in previous years.

*CRCT score reports.* For the posttest, students participated in the Spring 2007 CRCT administration. At the time of this study, the test, reliability, and validity information were not available. This measure was put in place to preserve testing integrity. In light of this, the researcher used CRCT score reports to determine student performance. These results are provided as scale scores. A scale score is reported for each content area. The process converts the number correct on the test or raw score to the CRCT scale. Because the scale scores are equivalent across test forms within the same content area and grade, students obtaining the same score have demonstrated the same performance with respect to the Georgia GPS (Georgia Department of Education, 2006). Because reliability and validity information was not available, the researcher forwarded a copy of a sample CRCT score reports to peer-debriefing participants. The educational score reports were deemed an acceptable method for determining student achievement on the CRCT. In Table 4, there is a summary explaining how CRCT scores are reported.

Table 4

*CRCT Performance Criteria*

Performance standards	GPS-based CRCT
Does not meet standard	Below 800
Meets standard	800-849
Exceeds standard	850 and above

*Multiple Intelligence Survey.* The purpose of this survey was to aid the researcher identifying students' best mode for learning to carry out the functions of differentiated

instruction. This survey was adapted with the permission of Sopris West Educational Services. The survey consists of 70 semantic differential questions. A semantic differential format asks respondents to choose between two or more opposite positions (Babbie, 2004). This questionnaire asks respondents how often they like to participate in specific activities. The numbered categories are rated as follows: 1 = *almost never*, 2 = *sometimes*, 3 = *often*, 4 = *almost always*. The researcher adapted the survey to omit all open-ended questions. The survey identifies student preferences of the seven multiple intelligences, as mentioned in the literature review: language, music, math or logic, physical, artistic, social, and self. The researcher hand scored the results of the multiple intelligence survey. This was executed by adding the sum of all points in a given section. The section with the highest score will be deemed the students preferential learning style. Students' top two learning styles were identified and reported. This survey is author owned, and report only informal data with regard to reliability and validity. To address this issue, a copy of the survey was forwarded for peer debriefing. After a review by these reviewers, the survey was deemed valid, reliable, and appropriate for use in this study.

*Field log.* A researcher-created Field Log was developed (see Appendix A). This Field Log was utilized to document student responses to the selected intervention. Additionally, the Field Log documented outcomes of the implemented interventions. Its design included four sections: description of activity, organization of students, assessment of lesson, student behaviors, and researcher reactions or feelings to behavior. Through observation, the researcher sought to understand how students react to the selected intervention.

The format of this Field Log (see Appendix A) was submitted for peer debriefing.

Peer-debriefing participants reviewed the Field Logs (see Appendix A) and agreed that their use would provide sufficient information in regards to student response, thus, deeming the instrument valid and reliable.

*Student response tally sheet.* This instrument (see Appendix B) was created to support observations documented in the Field Log. The researcher preidentified behaviors which were deemed reflective of student engagement. Once the researcher observed preidentified behaviors had taken place a check was placed by the student's or group's name. The frequency of the following preidentified behaviors was documented during differentiated instruction: participation in discussion and staying on task. The selected preidentified behaviors for the peer-mediated instruction participants are functioning in assigned roles and staying on task.

Participation was achieved when participants (a) asked a question, (b) offered a solution to a posed question, or (c) dialogued in a classroom discussion. Participants received a check by their name if they contributed to classroom discussion in any way.

On-task behavior was scored as follows: (a) *always on task*, (b) *sometimes on task*, or (c) *needed continuous* redirection. Participants who were *always on task* did not receive teacher redirection and completed each task without teacher intervention. Participants who were classified as *sometimes on task* need redirection on some tasks but not all. Participants that *needed continuous* redirection are off task on every assignment presented.

Functioning in assigned roles is the final component listed on the Student Response Tally Sheet. Evidence of these responses was evaluated in the following ways:

1. Students understood roles by asking probing questions that prompted further dialogue with no guidance from the facilitator.

2. Students understood roles by asking probing questions but needed further direction from teacher.

3. Students had difficulty understanding roles and *needed continuous* assistance from teacher.

The format of this student response tally was submitted for peer debriefing. The peer-debriefing participants reviewed the Student Response Tally Sheets and suggested changes be made to provide clarity and to outline the behaviors that will be specifically observed. These changes were made rendering this instrument reliable and valid.

*Assignment completion tally sheet.* This instrument (see Appendix C) was created to document the frequency in which students completed classroom assignments in response to the selected interventions. This tally sheet was divided into two sections. In one section, the number of assignments completed for participants in differentiated instruction was documented. In another section, the number of assignments completed for participants in peer-mediated instruction was documented. These sheets listed each student code number, group assignment, date of the intervention, and task completion. Assignment completions were coded in three ways: 1 for assignment complete, 2 for assignment incomplete, 3 for no assignment recorded. For the purpose of this study, the notation assignment completed indicated that the entire assignment was completed with all items finished. The notation assignment incomplete indicated that students failed to complete assignment in its entirety. For the notation, no assignment recorded indicated a student did not turn in an assignment for the class period. On days where multiple assignments are given all items will be listed on that day.

The format of the assignment response tally was submitted for peer debriefing. Peer-debriefing participants reviewed the student response tally and agreed that the

format was sufficient to document assignment completion, rendering the document valid and reliable.

*Interview guide.* Interviews were conducted upon CRCT testing. These interviews were conducted to provide more in-depth information regarding student readiness for CRCT testing and effects of differentiated and peer-mediated instruction. An interview guide (see Appendix D) was developed and used during the student interviews. The interview guide consisted of 13 questions that inquired about the students' attitudes and opinions of mathematics instruction, instructional receptiveness, and student engagement. This interview was developed with the intent of determining to what extent differentiated and peer-mediated instruction affected students' views about mathematics (see appendix D). Student interviews were conducted to provide additional support to classroom observation. It was believed that student interviews would provide a more detailed account of how students perceive the selected interventions.

The interview guide was forwarded to peer-debriefing participants. Suggestions were made to incorporate additional questions to understand student perceptions as they relate to differentiated and peer-mediated instruction. The researcher agreed and made these revisions deeming the instrument valid and reliable.

#### *Data Collection Procedures*

Preliminary to all procedures, the researcher conducted a literature review to examine the extent and significance of the problem. In the literature review, the foundation for this applied dissertation was set, and the theoretical underpinnings for the stated problem, interventions, and selected methodology were outlined. Specifically, the literature review focused on, federal legislation that encourages the participation of students with disabilities in state assessments, the mathematics achievement of students

with disabilities, features of differentiated and peer-mediated instruction, and the theoretical framework for the mixed-methods design.

Prior to intervention implementation, permission to conduct study at the target organization was requested and received from the superintendent of schools. The superintendent was informed about the scope and timeline of the project. Criteria for student selection were shared with district and administrative staff.

The following procedures were employed to carry out the functions of this research. A formal proposal and application was submitted to Nova Southeastern University. Once permission to conduct study was received from the university and the dissertation committee, parental consent forms were distributed. Parental consent is necessary for students under the legal age of 18. Two copies of the parental consent requests were sent, one form was sent via U.S. postal mail and the other was sent via the targeted participants. This measure was designed to increase rates of participation and ensure that parents received the appropriate documentation.

Upon receiving parental consent, adolescent or child assent forms were disseminated to target participants. Based on the participants' age, they received either a child assent or an adolescent assent form. The child assent form was for participants aged 12 years and under and the adolescent assent form was for participants' aged 13 through 17 years. These assent forms were distributed during regularly scheduled mathematics classes.

Upon receiving permission from students and parents, the researcher assigned interventions to math classes. One mathematics class was assigned to differentiated instruction while the other was assigned to peer-mediated instruction. After this assignment, students participated in the CRCT pretest. The pretest took the form of a

previously administered CRCT. The purpose of this pretest was to establish group equivalence and to determine if differences actually existed in the nonequivalent groups.

In the next procedural step, participants assigned to the differentiated instruction group participated in a multiple intelligence survey. This survey was selected to determine students learning preferences and strengths. This instrument was used to develop differentiated instruction lessons, grouping students homogeneously and heterogeneously, and providing student preference indicators to assist the researcher in carrying out the principles and goals of differentiated instruction. Differentiated instruction for the purpose of this study was defined as instruction that is adapted through content, process, or product; and is provided to students based on their learning profile, readiness, and interests. Simultaneously, the researcher randomly assigned students in the peer-mediated instruction group to a partner. The model of peer-mediated instruction that was utilized for this study is peer-mediated dyads.

Once this phase was completed, the selected interventions were implemented. Each group received the selected interventions during mathematics instruction. Each segment lasted approximately 1 hour. The selected interventions were performed 3 times per week. Implementation of these interventions lasted approximately 15 weeks. The researcher ensured that state curriculum and school objectives were being met by aligning lessons with the state and school curriculum guide.

Student observations began at the onset of the intervention implementation and lasted through the duration of this study. During these interventions, the researcher documented student behaviors, including participation in discussion, staying on task, assignment completion, and functioning in given roles. These behaviors were identified and documented through Field Logs (see Appendix A), Student Response Tally Sheets



(see Appendix B), and assignment completion tally records (see Appendix C).

Upon completion of the selected interventions, students participated in the CRCT state assessment. During this phase, the CRCT test was administered to students across the state of Georgia. The mathematics portion of the CRCT was administered on April 18, 2007; the researcher received the testing results on May 28, 2007.

Once the results of the state assessments were received, the researcher interviewed each participant individually to inquire about results of CRCT scores and their beliefs regarding differentiated and peer-mediated instruction. In addition, the researcher inquired about the students' views in regards to testing preparedness and mathematics achievement. Furthermore, the students' responses to the differentiated and peer-mediated instruction were assessed by examining interest levels, willingness and eagerness to participate, and perceived comprehension of mathematical concepts. The completed researcher created-survey was utilized as a part of this process.

*Research Question 1.* What is the difference in achievement for students receiving differentiated instruction to those receiving peer-mediated instruction? To answer this question, the results of the CRCT posttest and pretest were examined. An analysis was conducted to determine the extent of differences in student achievement.

*Research Question 2.* How does the implementation of differentiated instruction yield differences in achievement across exceptionalities, including LD, MID, OHI, and EBD? A thorough literature review was conducted which placed this question in context. To answer this question, the researcher reviewed results of the CRCT posttest. Specifically, the researcher examined the results of students across exceptionalities to determine if there were significant differences in participant achievement based on the intervention of differentiated instruction and the students' identified disability. Indicators

that reveal differences in achievement were examined and documented via data analysis.

*Research Question 3.* In what ways will the implementation of peer-mediated instruction yield differences in achievement across exceptionalities, including LD, MID, OHI, and EBD? The researcher reviewed results of the CRCT posttest. Specifically, the researcher examined the results across exceptionalities to determine if there are significant differences in participant achievement based on the intervention of peer-mediated instruction. Indicators that reveal differences in achievement were examined and documented via data analysis.

*Research Question 4.* How do exceptional learners respond to differentiated instruction? To answer this question, the researcher utilized field logs (see Appendix A), student response tally sheets (see Appendix B), and assignment completion tally sheets (see Appendix C). To clearly demonstrate how this was achieved, the researcher outlined the operational definition of respond, and how the conditions for this term were met. Students were measured based on their participation in discussion, ability to stay on task, and assignment completion.

To determine participation in classroom discussion, a student response tally sheet (see Appendix B) and field log (see Appendix A) were maintained on each student to document the number of times they participated in classroom discussion. This participation was assessed by documenting the frequency of students asking a question, offering a solution to a posed question, or contributing dialogue in a classroom discussion.

To determine on-task behavior, the researcher used a student response tally sheet (see Appendix B) to determine how often a student was off-task and had to receive redirection from the teacher. The students were placed into three classifications on this

sheet: (a) *always on task*, (b) *sometimes on task*, or (c) *needed continuous* redirection.

Participants who were *always on task* did not receive teacher redirection and completed each task without teacher intervention. Participants classified as *sometimes on task* needed redirection on some tasks, but not all. Participants who need continuous redirection are off task on every assignment presented.

To determine the assignment completions, the researcher kept an assignment tally sheet (see Appendix C) that documented how often students completed given assignments. Grades for these assignments were not recorded for the purpose of this study. These assignments were collected as a means to understand if participation in differentiated instruction provided participants with the perceived notion that they have the competencies to fully complete classroom assignments.

The last step to answering this question consisted of student interviews. These interviews probed participants about their attitudes and opinions regarding differentiated instruction and to what extent differentiated instruction helped them understand mathematics. In addition, the researcher inquired about how students perceived CRCT scores; specifically, did participants believe the selected intervention assisted them in mathematics comprehension? Moreover, these interviews sought to understand interest levels, in the interventions, as reported by the students.

This question and procedural process was formulated as a complementary step to understand if student response explained student achievement outcomes. To that end, the researcher documented if observed responses were indicative of greater student achievement.

*Research Question 5.* What are the differences in response to differentiated instruction for students with disabilities classified as LD, MID, OHI, and EBD? To

answer this question, the researcher utilized various portions of the literature review that focused on the behavioral characteristics of participants listed in each classification. The researcher then disaggregated data recorded during student observations through field logs (see Appendix A); the data was categorized based on student classification. The researcher then identified trends among various exceptionalities to determine if students display similarities or differences in how they respond to differentiated instruction based on their classification in the special education program at the target organization. An examination of student interviews was conducted to determine if students across exceptionalities respond similarly to differentiated instruction and to understand if these differences explained student achievement.

*Research Question 6.* How do exceptional learners respond to peer-mediated instruction? To answer this question, the researcher utilized field logs (see Appendix A), student response tally sheets (see Appendix B), assignment tally sheets (see Appendix C), and student interviews (see Appendix D). To demonstrate how this was measured, the researcher outlined the operational definition of respond and what was measured as responses to peer-mediated instruction. Students were measured based on their (a) functioning in assigned roles, (b) staying on task, or (c) group completion of assignments.

To determine functioning in assigned roles, the researcher developed a field log (see Appendix A) and student response tally sheet (see Appendix B) that was created for each peer-mediated instruction group. The researcher went from group to group and document if the peer-mediated participants asked probing questions that assists their partner in better understanding concepts outlined in the lesson. The researcher documented if there was evidence that the group understood their responsibility in constructing and delivering concepts with and to their partner. Evidence of these

responses was evaluated in the following ways:

1. Students understood roles by asking probing questions that prompted further dialogue with no guidance from the facilitator.
2. Students understood roles by asking probing questions but needed further direction from teacher.
3. Students had difficulty understanding roles and needed continuous assistance from teacher. To determine on-task behavior, the researcher used student response tally sheets (see Appendix B) and field logs (see Appendix A) to determine how often groups were off-task and had to receive redirection from the teacher. The students were placed into three classifications on this tally sheet: (a) *always on task*, (b) *sometimes on task*, or (c) *needed continuous* redirection. Participants that were *always on task* did not receive teacher redirection and completed each task without teacher intervention. Participants that were classified as *sometimes on task* need redirection on some tasks but not all. Participants that *needed continuous* redirection are off task on every assignment presented.

To determine group assignment completion, the researcher maintained an assignment tally sheet (see Appendix C) on how often students complete given assignments. Grades for these assignments were not recorded for the purpose of this study.

The last step to answering this question consisted of student interviews. These interviews probed participants about their attitudes and opinions about peer-mediated instruction and to what extent peer-mediated instruction helped them understand mathematics. In addition, the researcher inquired about how students received CRCT scores; specifically, did participants believe the selected intervention assisted them in

mathematics comprehension? These interviews sought to understand interest levels and willingness in the interventions, as reported by the students.

*Research Question 7.* What are the differences in response to peer-mediated instruction for exceptional learners classified as LD, MID, OHI, and EBD? To answer this question, the researcher utilized various portions of the literature review that focus on the behavioral characteristics of participants listed in each classification. The researcher then disaggregated data recorded during student observations through field logs (see Appendix A); the data was categorized based on student classification. The researcher then identified trends among the various exceptionalities to determine if students displayed similarities or differences in how they responded to differentiated instruction based on their classification in the special education program at the target organization. An examination of student interviews was conducted to determine if students across exceptionalities responded similarly to peer-mediated instruction and to understand if these differences explained student achievement.

#### *Data Analysis Procedures*

*Quantitative analysis.* The purpose of this applied dissertation was to determine if differences in achievement exist between students when implementing the independent variable. This was measured by the performance on the dependent variable.

The analysis of data was conducted by measuring the results of the independent variables, differentiated instruction and peer-mediated instruction, and their impact or association with the dependent variables, state assessment scores. The researcher determined that a covariate in the form of a pretest was necessary to establish that these groups were equivalent at the onset and before an intervention was put in place.

The covariable was selected because these math classes were formulated before

the start of this study and they are considered nonequivalent groups. Trochim (2006) stated,

The Non-Equivalent Groups Design is probably the most frequently used design in social research. It is structured like a pretest-posttest randomized experiment, but it lacks the key feature of the randomized designs. In the NEGD, we most often use intact groups that we think are similar as the treatment and control groups. In education, we might pick two comparable classrooms or schools. (¶ 1)

Data was gathered from multiple sources, including observation, interview, surveys, and educational test. Data was gathered by utilizing a pretest/posttest design. The Statistical Package of the Social Sciences, Version 14.0, software was used to help analyze data. The researcher determined that the Analysis of Covariance (ANCOVA) provided the best analysis of this information. This aided in controlling biases presented in the quasi-experimentation design (Trochim, 2006). Traditionally, these measures are used when there is a source of uncontrolled variation that needs to be removed from the ANOVA, particularly for nonequivalent groups (Nicol & Pexman, 1999). After conducting the pretest, however, it was discovered that the groups were equivalent; therefore, a *t* test could be used to determine differences among the groups.

Descriptive statistics were conducted on Criterion-Referenced Pretest and Posttest scores. Descriptive statistics describe characteristics of a sample study or the relationship among variables in a study. For this project, both of these descriptive methods were utilized. This data was displayed in tables and charts.

To examine Research Question 1 (What is the difference in achievement for students receiving differentiated instruction to those receiving peer-mediated instruction?), a *t* test of means was conducted to assess if differences exist on the Criterion-Referenced Posttest scores by group (Peer versus Differentiated), the Criterion-Referenced Pretest scores did not need to be entered as a covariate; therefore, a

*t* test was performed. The assumptions normality and homogeneity of variance were assessed; power and effect size were reported. Criterion Reference Posttest scores were trichotomized (< 800 versus 800-849 versus > 850). A chi-square was conducted to assess if a relationship existed among the trichotomized scores and group (peer versus differentiated).

To examine Research Question 2 (How does the implementation of differentiated instruction yield differences in achievement across exceptionalities, including LD, MID, OHI, and EBD?), an ANOVA was conducted to assess if differences exist on the differentiated group Criterion Reference Posttest scores by disability (LD versus MID versus OHI versus EBD), Criterion Reference Pretest scores were entered as a covariate. The assumptions of normality and homogeneity of variance were assessed; power and effect size were reported.

To examine Research Question 3 (In what ways will the implementation of peer-mediated instruction yield differences in achievement across exceptionalities, including LD, MID, OHI, and EBD?), an ANCOVA was conducted to assess if differences existed on the Peer-Group Criterion Referenced Posttest scores by disability (LD versus MID versus OHI versus EBD). The assumptions of normality and homogeneity of variance, were assessed; power and effect size were reported.

*Qualitative data analysis.* Procedures in this section applied to qualitative data collection. Analysis criteria are used to assist in analyzing collected data. The researcher used the following criteria to analyze and interpret data:

1. Organized data into qualitative modules. This was accomplished by using charts or organizing methods. such as lists or computer spreadsheets.
2. Developed categorical and thematic units to determine how they apply to the



draft data analysis.

3. Provided data summarization based on coded student responses to selected interventions.

This data was interpreted using a combination of coding, categorizing, and identifying similar occurrences. Qualitative data, such as interviews and student observations, were open coded based on reoccurring themes and analyzed through descriptive statistics.

To examine Research Question 4 (How do exceptional learners respond to differentiated instruction?), the researcher used descriptive statistics to analyze the results of this question. The researcher developed participant codes for each subject. Once this information was completed, the frequency of each observed response was input based on previously established criteria, including participation in discussion, stayed on task, and turned in assignments. To code these events, the researcher open coded Field Logs, student interviews, and tally sheets. Babbie (2004) cited the following as the procedures for open coding:

Open coding is the part of analysis that pertains specifically to the naming and categorizing of phenomena through close examination of data. Without this first basic analytical step, the rest of the analysis and communication that follows could not take place. During open coding the data are broken down into discrete parts, closely examined, and compared, for similarities and differences, and questions are asked about the phenomena as reflected in the data. Through this process, one's own and other's assumptions about phenomena are questioned or explored, leading to new discoveries. (p. 377)

Open coding was conducted to report the frequency of specific responses to differentiated instruction and the rate at which they occurred. To analyze on-task behavior and assignment completion, a descriptive analysis was conducted based on student response tally sheets (see Appendix B) and assignment completion tally sheets (see Appendix C)

documenting the frequency in which participants displayed on-task or off-task behavior and frequency in which students completed assignments.

To examine Research Question 5 (What are the differences in response to differentiated instruction for students with disabilities classified as LD, MID, OHI, and EBD?), this question was answered utilizing the results presented in Question 4. The researcher disaggregated data presented in Question 4 based on the subjects' categorical placement in special education. A comparison of how students responded based on their exceptionality was examined open coded and reported.

To examine Research Question 6 (How do exceptional learners respond to peer-mediated instruction?), the researcher used descriptive statistics to analyze the results of this question. The researcher developed participant codes for each subject. Once this was completed, the researcher input the frequency of each observed response based on previously established criteria, including functioning in assigned roles, staying on task, and turned-in assignments. To code these events, the researcher open coded Field Logs, student interviews, and tally sheets. To analyze on-task behavior and assignment completion, a descriptive analysis was conducted based on tally sheets documenting the frequency in which participants displayed on-task or off-task behavior and frequency in which students completed assignments.

To examine Research Question 7 (What are the differences in response to peer-mediated instruction for exceptional learners classified as LD, MID, OHI, and EBD?), the results presented in Question 6 were used. The researcher disaggregated data based on the subjects' categorical placement in special education. A comparison of how students responded based on their exceptionality was examined open coded and reported.

### *Limitations and Delimitations*

This study was limited in its findings based on its participants being from one public middle school located in Georgia. Moreover, the fact that this study was based on a convenience sample may not statistically be representative of students in different geographic locations. Conclusions of this study could not be assumed or adapted for schools with different characteristics, as this may not be representative of all students or all differentiated instructional methods. Additionally, this study was limited to these seventh-grade students and could not be generalized to students at other age and grade levels. Due to the recruitment of one school system, the geographic location or the sample size could be limiting factors for the generalization of this study.

### *Summary*

This study investigated the effects of differentiated and peer-mediated instruction on mathematics achievement. To that extent, the researcher implemented differentiated instruction and peer-mediated instruction in seventh-grade resource classrooms to determine if differences exist among participants in the respective groups. Through the utilization of mixed-method methodology, a comprehensive outlook on student achievement and behavioral response was achieved.

## Chapter 4: Results

In this chapter, the results, analyses, and interpretation of the data collected are presented. The purpose of this applied dissertation was to determine if there were differences in the achievement and response of those students receiving differentiated instructions from those students receiving peer-mediated instruction. The study group began with 22 students from one middle school and lost 1 student due to withdrawal from the middle school. Each received mathematics instruction in a resource class. The students in this study were selected based on their participation in the special education program at the middle school. The implementation of the study was conducted from January 09, 2007, through May 15, 2007. The following is an analysis of the data obtained during this period. The seven research questions served as the centerpiece of this study and were designed to determine if there were significant differences in outcomes for students with disabilities based on instructional typology.

### *Overview of Results*

There were approximately 21 seventh-grade students registered for resource mathematics at the time of this study. Twelve of these students were enlisted in the peer-mediated instruction group. Nine of these students participated in the differentiated instruction group. According to the CRCT testing results, students in the peer-mediated instruction group had a mean pass rate of 41% and students in the differentiated instruction group had a mean passage rate of 22%. Though these frequencies do not reflect statistical significance, they reflected significance for each respective group due to the fact that 0% of the participants in the peer-mediated instruction group passed the CRCT in the previous year and only 11% of the participants in the differentiated instruction group passed the previous year. The following section details the statistical

differences within these frequency distributions.

This study utilized data collected from the state-developed CRCT assessment, Field Logs (see Appendix A), Student Response Tally Sheets (see Appendix B), Assignment Completion Tally Sheets (see Appendix C), and an interview guide (see Appendix D). These questions helped produce a framework that aided in answering the seven research questions. Questions 1 through 3 were answered twice, once during the pretest and once during the posttest analysis. This procedure was conducted to provide insight regarding student achievement status prior to the implementation of the research. For the purpose of this study, the posttest results were the primary results for review. However, differences were noted among the two examinations.

#### *Pretest Analysis*

The CRCT pretest was used to solicit equivalency between the two selected groups. Twenty-two students participated in the pretest; 12 (54.5%) were in the peer-mediated instruction and 10 (45.5%) were in the differentiated instruction. The mean number of items correct was 15.23 ( $SD = 5.34$ ) and the mean Pretest score was 0.35 ( $SD = 0.12$ ).

*Results associated with Research Question 1.* A  $t$  test was conducted to assess if differences exist on the pretest scores by instruction (peer-mediated versus differentiated). Preliminary analysis conducted through a one sample Kolmogorov Smirnov test revealed both pretest scores were normally distributed. Levene's test for equality of error variances was also not significant; the assumptions of normality and homogeneity of variance were met. Results of the  $t$  tests were not significant,  $t(20) = -1.94$ ,  $p = 0.07$ , suggesting that subjects receiving peer-mediated instruction ( $m = 0.30$ ,  $sd = 0.10$ ) and subjects receiving differentiated instruction ( $M = 0.40$ ,  $SD = 0.13$ ) did not

significantly differ on pretest scores.

*Results associated with Research Question 2.* An analysis of variance (ANOVA) on differentiated group criterion pretest scores by disability (OHI versus EBD-specific learning disability [LD]-MID) was conducted. The assumptions of normality and homogeneity of variance were met. Differentiated group pretest scores were not significantly different between the OHI group ( $M = 0.37$ ,  $SD = 0.16$ ) and the EBD-LD-MID group ( $M = 0.41$ ,  $SD = 0.10$ ),  $F(1, 7) = 0.241$ ,  $p = 0.639$ ,  $MS_e = .020$ ,  $\eta^2 = .033$ , power = 0.071.

*Results associated with Research Question 3.* An analysis of variance (ANOVA) on peer-group criterion pretest scores by disability (OHI versus EBD-LD-MID) was conducted. The assumptions of normality and homogeneity of variance were met (see Table 5). The peer-group pretest scores the OHI group ( $M = 0.22$ ,  $SD = 0.04$ ) were significantly lower than the EBD-LD-MID group ( $M = 0.39$ ,  $SD = 0.06$ ),  $F(1, 10) = 32.703$ ,  $p < .001$ ,  $MS_e = 0.003$ ,  $\eta^2 = .766$ , power = 0.999.

Table 5

*Means and Standard Deviations for Pretest Scores by Disability and Instruction Group*

Instruction group	OHI		LD-EBD-MID	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Peer mediated	0.22	0.04	0.39	0.06
Differentiated	0.37	0.16	0.41	0.10

*Note.* OHI = Other health impairment, LD = learning disability, EBD = emotional and behavioral disorder, and MID = mildly intellectually disabled.

### *Posttest Analysis*

Twenty-one students participated in the posttest; 12 (57.1%) were in the peer-mediated instruction and 9 (42.9%) were in the differentiated instruction. The mean posttest score was 788.95 ( $SD = 18.34$ ). Frequencies and percentages for participants' disabilities are presented in Table 6.

Table 6

#### *Frequencies and Percentages for Participants' Disabilities*

Disability	Pretest		Posttest	
	Frequency	%	Frequency	%
EBD	4	18.2	3	14.3
MID	2	9.1	2	9.5
OHI	11	50.0	11	52.4
LD	5	22.7	5	23.8

*Note.* OHI = Other health impairment, LD = learning disability, EBD = emotional and behavioral disorder, and MID = mildly intellectually disabled. Totals: Pretest = 22 and 100%; Posttest = 21 and 100%.

*Results associated with Research Question 1.* An independent samples  $t$  test was conducted to assess if differences existed on the posttest scores by instruction (peer mediated versus differentiated). Preliminary analysis was a one-sample Kolmogorov Smirnov test, which revealed both posttest scores were normally distributed. Levene's test for equality of error variances was also not significant; the assumptions of normality and homogeneity of variance were met. Results of the  $t$  tests were not significant,  $t(19) = 1.102$ ,  $p = 0.284$ , suggesting that the peer-mediated instruction ( $M = 792.75$ ,  $SD =$

17.30) and differentiated instruction ( $M = 783.89$ ,  $SD = 19.46$ ) do not significantly differ on posttest scores. While these results showed no statistical differences existed, the researcher conducted a frequency distribution to determine the percentages of students that had actually passed the CRCT test. This step was conducted because often when there is a small sample, as in this research, it is harder to determine statistical significance. The results showed that 5 (41%) of the 12 participants in the peer-mediated instruction group passed, while 2 (22%) of the 9 participants in the differentiated instruction students passed the CRCT test.

*Results associated with Research Question 2.* An analysis of variance (ANOVA) on the differentiated group criterion posttest scores by disability (OHI versus EBD-LD-MID) was conducted. Differentiated group criterion reference pretest scores were not entered as a covariate, although there were no significant differences on differentiated group pretest scores by disability. The assumptions of normality and homogeneity of variance were met. Differentiated group posttest scores were not significantly different between the OHI group ( $M = 792.00$ ,  $SD = 22.19$ ) and the EBD-SLD-MID group ( $M = 773.75$ ,  $SD = 10.31$ ),  $F(1, 7) = 2.264$ ,  $p = 0.176$ ,  $MS_e = 326.964$ ,  $\eta^2 = .244$ , power = 0.256. Although there was no significant statistical differences, the researcher conducted frequency distributions to determine the pass percentage of each group. This step was conducted because often when there is a small sample, as in this research, it is harder to determine statistical significance. According to the frequency distributions, the OHI group was the only group in differentiated instruction that had passing participants. Their pass rate was 40%. The EBD, LD, and MID groups had no students that passed.

*Results associated with Research Question 3.* An analysis of covariance



(ANCOVA) on peer-group criterion posttest scores by disability (OHI versus EBD-LD-MID) was conducted. Peer-group criterion reference pretest scores were entered as a covariate, as there were significant differences on peer-group pretest scores by disability (see Table 7). The assumptions of normality and homogeneity of variance were met. The peer-group posttest scores were not significantly different between the OHI group ( $M = 790.83$ ,  $SD = 21.22$ ) and the EBD-LD-MID group ( $M = 794.67$ ,  $SD = 14.12$ ),  $F(1, 9) = 0.648$ ,  $p = 0.442$ ,  $MS_e = 316.342$ ,  $\eta^2 = .067$ , power = 0.112. Although there was no significant statistical difference, the researcher conducted frequency distributions to determine the pass percentage of each group. This step was conducted because often when there is a small sample, as in this research, it is harder to determine statistical significance. In this examination, students who were classified as LD had a 100% pass rate in the peer-mediated instruction group. OHI students had a pass rate of 33%, EBD and MID students had a pass rate of 0%.

Table 7

*Means and Standard Deviations for Posttest Scores by Disability and Instruction Group*

Instruction group	OHI		LD-EBD-MID	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Peer mediated	790.83	21.22	794.67	14.12
Differentiated	792.00	22.19	773.75	10.31

*Note.* OHI = Other health impairment, LD = learning disability, EBD = emotional and behavioral disorder, and MID = mildly intellectually disabled.

*Results associated with Research Question 4. How do exceptional learners*

respond to differentiated instruction? The researcher used several methods. First, frequency distributions were conducted using the Student Response Tally Sheet and the Assignment Completion Tally Sheet (see Appendixes B and C). This question related to student behavioral responses as they pertained to participation in differentiated instruction classroom activities. On the Assignment Completion Tally Sheet (see Appendix C), the researcher recorded data for 45 assignments and documented the mean submission rates for the class. The mean submission rate for students submitting assignments in the differentiated instruction class was 26.8 assignments submitted which gave this group a 60% submission rate on all given assignments. On the Student Response Tally Sheet (see Appendix B), the researcher recorded the instances of students' participation in discussions and students attempts to stay on task. Participation was achieved when participants (a) asked a question, (b) offered a solution to a posed question, or (c) dialogued in a classroom discussion. Participants received a check by their name if they contributed to classroom discussion in any way. The mean instance for participation in discussion was 30 which gave this group 66.6% for participation.

On-task behavior was scored as follows: (a) *always on task*, (b) *sometimes on task*, or (c) *needed continuous* redirection. Participants who were *always on task* did not receive teacher redirection and completed each task without teacher intervention. Participants who were classified as *sometimes on task* need redirection on some tasks but not all. Participants that *needed continuous* redirection are off task on every assignment presented. Students were given a score of 1 if they were *always on task*, a score of 2 if they were on task sometimes, and a score of 3 if they were never on task. The range for participation was from 45 to 135 points. Forty-five suggested that the students were on task on every task. One hundred and thirty-five suggesting that the students were off task

frequently or never on task. The mean task score for this group was 82 which gave this group 54% for on-task behavior.

This question was also answered utilizing an open-ended interview guide (see Appendix D). This interview guide consisted of 13 questions that inquired about the students' attitudes and opinions of mathematics instruction, instructional receptiveness, and student engagement.

*Open-ended Question 1.* What did you think about math class? What did you like or dislike? Student responses to this question included,

I liked working in groups and sharing ideas.

Good one on one help.

It was fun, math was easier, I liked playing games, and I liked playing games on the computer.

It was easy, but I do not like math, the material was difficult.

It was okay I did not like doing all the work.

It was alright, I liked the class size, I did not like the teacher and location.

I didn't like word problems.

*Open-ended Question 2.* What makes math interesting? Student responses to this question included, "Working through problems, visual guides, activities, computers, nothing, and working with groups."

*Open-ended Question 3.* How can teachers make math easier to understand? Student responses to this question included, "providing examples, step-by-step instructions, math games, give students a chance to do it on their own, work with students more, and one on one help."

*Open-ended Question 4.* What do you remember most about math class? Student responses to this question included, "playing games, activities, working in groups, using manipulatives in geometry, and division."

Questions 5 through 9 required yes or no responses; for these questions, the

researcher used frequency distributions to report responses. For some questions, the students provided more detailed information to substantiate their responses.

*Question 5.* Was this year's math class different from your math class last year?

Eighty-nine percent of the participants reported that participation in the differentiated instruction math class was different from their previous math classes. Participants reported that they had more activities, more games, more group time, less bookwork, the differentiated instruction class was a little harder, and differentiated instruction was more in-depth. Eleven percent of the participants said they could not recall if their differentiated instruction class was different from their previous year's class.

*Question 6.* Were you able to do the assignments in your math class more easily?

With respect to this question, 78% of the students believed that assignment completion was a easier with differentiated instruction, 11% of the participants believed that assignment completion was easier sometimes, and 11% of the participants believed that assignment completion was not easier at all.

*Question 7.* Did the activities make your class more interesting? All (100%) of the participants reported that activities make math more interesting.

*Question 8.* Would you like to participate in a class similar to this in the future?

Sixty-seven percent of the participants reported that they would like to participate in a differentiated instruction class in the future, 22% of the participants reported that it does not matter, and 11% reported that they would not like to participate in a class like this in the future.

*Question 9.* Did you feel like mathematics was easier to understand this year?

Eighty-nine percent of the participants reported that math was easier to understand. Eleven percent of the participants reported that math was not easier to understand.

*Open-ended Question 10.* What activity did you enjoy the most and why? Student responses to this question included, "math competition, nothing, geometry manipulatives, groups, and socializing."

*Question 11.* Now that you have taken the CRCT test, do you feel you were prepared? All (100%) of the respondents believed they were prepared for the CRCT test.

*Open-ended Question 12.* Do you believe you could have been more prepared for the CRCT test? If so, how? Sixty-seven percent of the participants believed they could have been more prepared for the CRCT test. Students reported that they could have been more prepared by studying more, studying harder, and paying more attention in class. Thirty-three percent of the respondents believed they could not have been more prepared for the CRCT. Participants reported they believed that they went over all of the necessary materials in class.

*Question 13.* Were the materials you learned in class helpful to your understanding of concepts presented on the CRCT test? All (100%) of the respondents reported that the materials presented in class were helpful for preparing for the CRCT test.

*Results associated with Research Question 5.* What are the differences in response to differentiated instruction for students with disabilities classified as LD, MID, OHI, and EBD? The researcher used the Field Log (see Appendix A) to document the various observed behaviors, in addition to the disaggregated data of Student Response Tally Sheet (see Appendix B), and the Assignment Completion Tally Sheet (see Appendix C). Frequency distributions were conducted to determine which group participated in classroom discussion, completed assignments, and stayed on task more often in the various groups; the mean for each group is reported. According to the Student Response

Tally Sheet (see Appendix B), students classified as EBD participated in discussion 88% of the time, students classified as LD and MID participated in discussion 67% and students classified as OHI participated in classroom discussion 60% of the time. According to the Field Log (see Appendix A), although students classified as EBD had the highest percentage of participation, a majority of that participation included inappropriate comments that had to be redirected. According to the Student Response Tally Sheet (see Appendix B), on-task behavior for MID students was 100%, on-task behavior for OHI students was 57%, on-task behavior for LD students was 39%, and on-task behavior for EBD students was 33%.

According to the Assignment Completion Tally Sheet, students classified as MID had an assignment completion rate of 88%, students classified as OHI had a completion rate of 64%, students classified as LD had a completion rate of 50%, and students classified as EBD had a completion rate of 44%. According to the Field Log (see Appendix A), although students classified as MID had the highest completion rate, students with OHI had a higher degree of accuracy on assignments submitted.

*Results associated with Research Question 6.* How do exceptional learners respond to peer-mediated instruction? The researcher used several methods. First, frequency distributions were conducted using the Student Response Tally Sheet and the Assignment Completion Tally Sheet (see Appendixes B and C). This question related to student behavioral responses as they pertained to participation in peer-mediated classroom activities. On the Assignment Completion Tally Sheet (see Appendix C), the researcher recorded data for 45 assignments and documented the mean submission rates for the class. The mean assignment submission rate was 29 giving the group a 64% assignment completion rate. On the Student Response Tally Sheet (see Appendix B), the

researcher recorded the instances of students' participation in discussions and students attempts to stay on task. Participation was achieved when participants (a) asked a question, (b) offered a solution to a posed question, or c) dialogued in a classroom discussion. Participants received a check by their name if they contributed to classroom discussion in any way. The mean instance for participation in discussion was 27 which gave this group 60% for participation rate.

On-task behavior was scored as follows: (a) *always on task*, (b) *sometimes on task*, or (c) *needed continuous* redirection. Participants who were *always on task* did not receive teacher redirection and completed each task without teacher intervention. Participants who were classified as *sometimes on task* need redirection on some tasks but not all. Participants that *needed continuous* redirection are off task on every assignment presented. Students were given a score of 1, if they were *always on task*, a score of 2, if they were on task sometimes and a score of 3 if they were never on task. The range for participation was from 45 through 135 points. Forty-five suggested that the students were on task on every task. One hundred and thirty-five suggesting that the students were off task frequently or never on task. The mean task score for this group was 82 which gave this group 54% for on-task behavior.

On the Student Response Tally Sheet (see Appendix B), the participating students in the peer-mediated instruction group were also evaluated on their functioning in designated role. Evidence of these responses was evaluated in the following ways:

1. Students understood roles by asking probing questions that prompted further dialogue with no guidance from the facilitator.
2. Students understood roles by asking probing questions but needed further direction from teacher.

3. Students had difficulty understanding roles and *needed continuous* assistance from teacher.

Students were given a score of 1 if they were *always on task*, a score of 2 if they were on task sometimes, and a score of 3 if they were never on task. The range for participation was from 45 to 135 points. Forty-five suggested that the students understood their role in peer-mediated instruction. One hundred and thirty-five suggested that they did not understand their role in peer-mediated instruction. The mean for functioning in role for this group was 69 which gave this group 62% for understanding functioning in role.

This question was also answered utilizing an open-ended interview guide (see Appendix D). This interview guide consisted of 13 questions that inquired about the students' attitudes and opinions of mathematics instruction, instructional receptiveness, and student engagement.

*Open-ended Question 1.* What did you think about math class? What did you like or dislike? Student responses to this question included,

It was fun, I liked doing math projects with a partner.

It was okay, I liked having a fun teacher, I did not like the students in my class.

I liked it because of the challenge, I did not like the math competition.

It was very good.

I liked working with my friends.

I liked it, I believe I completed more work with a partner; however, I was distracted by my partners sometimes.

I liked that I could talk to my partner when I didn't understand.

I liked the socialization, but my partner depended on me too much, and did not try as hard.

I felt the class was harder because I didn't get a good partner.

*Open-ended Question 2.* What makes math interesting? Student responses to this question included, "working with different concepts, including subtraction,



multiplication, division, and addition; working out problems; playing games; how the teacher presents; learning about future applications; using numbers; and the challenge."

*Open-ended Question 3.* How can teachers make math easier to understand?

Student responses to this question included, "step by step, one-on-one time, using various strategies, and pictures."

*Open-ended Question 4.* What do you remember most about math class? Student responses to this question included, "teacher's presentation, the fun, watching movies on computer that were math related, working in groups, getting help from partner made it easier, interesting, activities with partner, felt free in class because I could talk, and covered more material."

Questions 5 through 9 required yes or no responses; for these questions, the researcher used frequency distributions to report responses. For some questions, the students provided more detailed information to substantiate their responses.

*Question 5.* Was this year's math class different from your math class last year?

Eighty-three percent of the participants reported that participation in the peer-mediated instruction math class was different from their previous math classes. Participants reported that the classroom was arranged differently, in groups, it made it easier to learn by asking others for help. In addition, participants believed they covered more material by working with a partner. Seventeen percent of the participants say their peer-mediated instruction class was not different from their previous year's class.

*Question 6.* Were you able to do the assignments in your math class more easily?

With respect to this question, Eighty-three percent of the students believed that assignment completion was easier with peer-mediated instruction, 8% of the participants believed that assignment completion was the same, and 8% of the participants provided

no response.

*Question 7.* Did the activities make your class more interesting? Ninety-two percent of the participants reported that activities make math more interesting. Eight percent of the participants reported that activities do not make math more interesting.

*Question 8.* Would you like to participate in a class similar to this in the future? Ninety-two percent of the participants reported that they would like to participate in a peer-mediated instruction class in the future. Eight percent reported that they would not like to participate in a similar class in the future.

*Question 9.* Did you feel like mathematics was easier to understand this year? Seventy-five percent of the participants reported that math was easier to understand. Twenty-five percent of the participants reported that math was not easier to understand.

*Open-ended Question 10.* What activity did you enjoy the most and why? Student responses to this question included, “math competition, socialization, working on computer with partner, and flashcards with my partner.”

*Question 11.* Now that you have taken the CRCT test, do you feel you were prepared? Ninety-two percent of the respondents believed they were prepared for the CRCT test. Eight percent believed they were not fully prepared.

*Open-ended Question 12.* Do you believe you could have been more prepared for the CRCT test? If so how? Seventy-five percent of the participants believe they could have been more prepared for the CRCT test. Students reported that they could have been more prepared by, studying more, reviewing more problems, trying harder and not rushing through assignments in class, paying more attention in class, and asking for help. Twenty-five percent of the respondents believed they could not have been more prepared for the CRCT. Participants reported they believed that they went over all of the necessary

materials in class.

*Question 13.* Were the materials you learned in class helpful to your understanding of concepts presented on the CRCT test? One hundred percent of the respondents reported that the materials presented in class were helpful for preparing for the CRCT test.

*Results associated with Research Question 7.* What are the differences in response to peer-mediated instruction for students with disabilities classified as LD, MID, OHI, and EBD? The researcher used the Field Log (see Appendix A) to document the various observed behaviors, in addition to the disaggregated data of Student Response Tally Sheet (see Appendix B), and the Assignment Completion Tally Sheet (see Appendix C). Frequency distributions were conducted to determine which group participated in classroom discussion, completed assignments, stayed on task, and functioned in assigned roles more often in the various groups. The mean for each group was reported.

According to the Student Response Tally Sheet (see Appendix B), students classified as OHI participated in discussion 55% of the time, students classified as LD participated in discussion 34% of the time, students classified as MID participated in classroom discussion 44% of the time. According to the response tally sheet (see Appendix B), on-task behavior for MID students was 72%, on-task behavior for OHI students was 59%, on-task behavior for LD students was 61%, and on-task behavior for EBD students was 64%. According to the Student Response Tally Sheet (see Appendix B), functioning in an assigned role for OHI students was 56%, functioning in an assigned role for LD students was 67%, functioning in an assigned role for MID students was 62%, and functioning in an assigned role for EBD students was 71%.

According to the Assignment Completion Tally Sheet, students classified as OHI

had an assignment completion rate of 64%, students classified as EBD had a completion rate of 67%, students classified as LD had a completion rate of 63%, and students classified as MID had a completion rate of 67%. According to the Field Log (see Appendix A), accuracy on completed assignments was comparable for each group.

## Chapter 5: Discussion

With the call for higher accountability standards, federal, state, and district education personnel are developing action plans that attempt to increase student achievement. In the past decades, the field of education has undergone tremendous change in how students are taught, what strategies are considered best practices, and how best to teach diverse learners. Unfortunately, with the research geared towards student improvement, students with disabilities continue to have tremendous difficulty with state assessments, as outlined in the literature review. Federal laws were being enacted to address the lack of proficiency of this subgroup. With the growing trend to use various research-based instructional strategies, the researcher believed it was necessary to add to the research by implementing a study that was specifically geared towards students with disabilities.

The goal of this applied dissertation was to determine if students receiving different instructional interventions had differences in mathematics achievement based on their participation in peer-mediated and differentiated instruction. Moreover, it was the goal of this study to identify and document how students responded to the selected interventions and to understand their beliefs in regards to the selected interventions.

According to the NCTM (2000), in order for students to be successful, they must have multiple opportunities to study and learn mathematics. What this meant to the researcher was more than one instructional strategy could possibly offer support to students with disabilities; therefore, the principles of peer-mediated instruction and differentiated instruction were selected.

The problem addressed in this study was the underachievement in mathematics by exceptional learners on state assessments. This problem has been persistent without much

notable intervention. Though there has been much emphasis on researched-based instructional strategies, there have been no major studies on the effectiveness on differentiated and peer-mediated instruction as a means of reaching students with disabilities in a heterogeneous resource classroom setting or on state assessments.

Research conducted by Woodward and Brown (2006) affirmed the existence of this problem and further cited standards developed by the NCTM, which call for equity in mathematics education. According to Woodward and Brown, this principle stated, "All students should have access to a coherent, challenging mathematics curriculum" (p. 1). An examination of students with disabilities suggested this group had difficulty on state assessments without extensive testing modifications; moreover, these students do not exhibit high levels of success on either academic measures or everyday activities (Woodward & Brown). This became very evident when reviewing the literature and students' achievement on previous state assessments.

O'Connor and Williams (2006) suggested this problem persists in the resource classroom, specifically, because students are not educated at the appropriate level. One of the hallmark tenets of IDEA (2004) was that students must be provided instruction at their readiness level along with instruction that is intensive and individualized. In the resource classroom, these principles can be somewhat counterintuitive, especially since most pull-out or resource programs are heterogeneously grouped and students are on various grade levels. In this research, students represented the gamut of mathematical abilities. With the lowest learner having a first-grade readiness level while the highest learner had a sixth-grade readiness level. These extremes presented major difficulty for the researcher, in that, students being taught in this type of heterogeneous setting required a variety of remedial interventions that were somewhat counterproductive to focusing

primarily on the content standards of seventh-grade curriculum.

The researcher realized this problem from previous teaching experience; however, when actual observations were documented, the researcher noted it was very difficult to provide instruction to learners that varied so significantly in math skill, whether they were in differentiated or peer-mediated instruction. Some students had difficulty multiplying and dividing while some had problems adding and subtracting. This presented a major challenge for the researcher because not only did these remedial skills need to be addressed but the actual seventh-grade mathematics curriculum had to be addressed. What this meant for the participants was they needed to make significant gains to decrease previously identified deficiencies in mathematics. Whereas, students without disabilities are required to maintain proficiency in their respective grade level, students with disabilities must overcome past achievement, intellectual, and emotional barriers in addition to gaining a level of proficiency that proves successful on state assessments.

Providing support to these students presented a great challenge to the researcher because implementing individualized instruction for various skill sets required immense planning and grouping of the students. According to O'Connor and Williams (2006), instruction in mixed ability classrooms does not provide the student with the individual instruction that they need to become proficient. In concurrence with this observation, Moody et al. (2000) conducted a study on grouping students in resource classrooms and found that when students are grouped in mixed-ability settings, no evidence of increased achievement is observed.

In contrast, the researcher found in this study some students can benefit from specific types of instruction depending on their exceptionality. Moreover, the researcher found that students classified under certain exceptionalities benefited from specific

interventions more than others. It was noted in this study that mixed-ability classrooms did appear to stagnate the growth of some students in the resource classroom, but did not put a halt on all students making academic gains as previously suggested by the research conducted by Moody et al. The researcher would like to highlight that the research conducted by Moody et al. only evaluated students with LD which could explain the results of its findings and the differences presented in this study.

In exploring Research Question 1 (What is the difference in achievement for students receiving differentiated instruction to those receiving peer-mediated instruction), the researcher found that there was no statistical differences in the rates of achievement between the groups. However, the researcher conducted frequency distributions to determine the pass percentage of each group. This step was conducted because often when there is a small sample, as in this research, it is harder to determine statistical significance. In conducting a frequency distribution, it appeared that the peer-mediated instruction group of students had a higher mean pass percentage. Forty-one percent of the students in this group passed the CRCT assessment. This number is seemingly low; however, the researcher noted the 12 students that participated in the peer-mediated instruction class had no passing participants on the previous years' CRCT test. This suggests that this intervention helped almost half the group make satisfactory scores on mathematics state assessments. A frequency distribution was also conducted in the differentiated instruction group; although this group had a slightly lower pass rate on the CRCT, they still made gains that are notable. This group had a 22% pass rate on the CRCT which was up from 11% from the previous year.

This finding is consistent with research conducted by NCES (2005) which revealed that students with disabilities can make achievement gains in mathematics;



however, these gains are still well below state and national standards for proficiency. Based on these findings, the researcher posed the question, should students with disabilities be evaluated based on a standard level of proficiency or should students with disabilities be evaluated based on their ability to make academic gains. It was the researcher's belief that based on research conducted by NCES and results from this research, it would be more beneficial to states, districts, schools, and students if academic progress were monitored through a system of academic gains opposed to a standard level academic proficiency.

One of the major tenets of IDEA (2004) is that instruction must confer some educational benefit. While these instructional strategies did not show significant statistical differences when compared to each other, they did provide the hope that these instructional strategies can provide some educational benefit to exceptional learners. With the students in the peer-mediated instruction group increasing their pass rate on state assessments by 41% from the previous year's state assessment and students in the differentiated instruction group increasing their pass rate on state assessments by 11%, it undeniable that these strategies provided some benefit to students with disabilities.

Though these percentages reflected a continued problem in mathematics for exceptional learners, the researcher dare make the assertion that both of these interventions provided some positive benefit for both groups. The researcher contends that with greater implementation, these interventions would produce an even higher frequency of pass scores for students with disabilities. Keeping in mind that these interventions were only implemented a third of the school year, it was the researcher's belief that with more planning, development, and implementation, these strategies could prove vital for the success of exceptional needs student.

In exploring Research Question 2 (How does the implementation of differentiated instruction yield differences in achievement across exceptionalities, including LD, MID, OHI, and EBD?), the researcher found that there was no statistical difference between the groups. However, the researcher conducted frequency distributions to determine the pass percentage of each group. This step was conducted because often when there is a small sample, as in this research, it is more difficult to determine statistical significance. According to the frequency distributions, the OHI group was the only group in differentiated instruction that had passing participants. Their pass rate was 40%. The EBD, LD, and MID groups had no students that passed. This suggested that differentiated instruction is very beneficial to students classified as OHI. This finding was consistent with the literature. According to Harlson (2005), students classified as OHI, specifically, those with AD/HD, must be provided with instructional practices that employ mnemonics, use real life simulations, and use manipulatives. This type of instruction proved vital for OHI students in the differentiated instruction group. In fact, this study affirmed Harlson assertion that these students learn best through instruction that allows them to participate in curriculum through the use of relative activities as is the case with differentiated instruction.

For MID students the findings were consistent with research conducted by Maccini and Gagnon (as cited in Warger, 2002). In this research, it was found that students with cognitive disabilities have problems in processing, distinguishing relevant information, reasoning, and problem solving. This provided some explanation as to why students with impaired intellectual functioning have lower performance on state assessments than those categorized in other exceptionalities. Moreover, it was suggested that MID students have significantly below average intelligence and are significantly

below grade level (Georgia Learning Resource Center [GLRS], n.d.). These observations provided some insight regarding why students classified as MID performed poorly on the posttest.

According to Hall (2002), differentiated instruction is largely centered on the constructivist perspective. This perspective prompts participants to become active participants in learning and formulating ideas based on the information presented. Cawley and Miller (1989) conducted research with LD students and contended that these students should not be instructed using an instructional strategy based on constructing information and adjusting it based on their understanding. Cawley and Miller asserted that though instruction should simulate real life to some extent, it should be logical and defensible. According to Cawley and Miller, this method is neither logical nor defensible. In this research, LD students in the differentiated instruction group failed to pass the CRCT which affirmed Cawley and Miller's contention that LD students should not be taught using theories centered on constructivism.

Lastly, GLRS (n.d.) suggested that academic performance by students with EBD cannot be adequately explained by intellectual, cultural, sensory, or general health factors. In fact, the results from this group were somewhat unexpected due to the fact this group is generally only 1.8 grade levels behind students without disabilities while students with other disabilities experience much higher grade level deficits (Maccini & Gagnon, 2002). Data from the National Longitudinal Transition Study indicated EBD students often experience the lowest grade-point averages of students in all disability categories.

Bos and Vaughn (1998) attributed the lack of achievement of this group to lack of persistence, anxiety, and attention problems. Based on this observation the researcher

asserts that this group was unsuccessful on the CRCT because the areas that Bos and Vaughn described which are all critical for success with differentiated instruction and were observed throughout the course of this project. For students classified as EBD, the researcher placed more emphasis on behavioral readiness. This would consist of an evaluation of the students' behaviors and how they interact with and without student and teacher interaction. One of the major problems for this group was social interaction; as such, the researcher placed greater emphasis on behavior management and control.

In exploring Research Question 3 (In what ways will the implementation of peer-mediated instruction yield differences in achievement across exceptionalities, including LD, MID, OHI, and EBD?), the researcher found that there was no statistical difference between the groups. However, the researcher conducted frequency distributions to determine the pass percentage of each group. This step was conducted because often when there is a small sample, as in this research, it is more difficult to determine statistical significance. In this examination, students who were classified as LD had a 100% pass rate in the peer-mediated instruction group. OHI students had a pass rate of 33% pass rate in peer-mediated instruction, EBD and MID students had a pass rate of 0%. This suggested that peer-mediated instruction works very well with students with specific learning disabilities.

Maccini and Gagnon (2006) conducted research addressing the best ways to educate students with learning disabilities. In that research, the authors suggested that peer-instruction was one of the leading ways to instruct students with learning disabilities. This assertion was affirmed in this research with peer-mediated instruction yielding the greatest results for students with learning disabilities.

Constrastingly, Maccinini and Gagnon (2006) suggested that because LD students

have problems with higher level math, it makes performance on state assessments more difficult. According to this research, peer-mediated instruction provides LD students with the necessary skill and social interaction to prove success on state assessments.

Moreover, in a study conducted by Simmons, Fuchs, Fuchs, Mathes, and Hodge (1995), LD students receiving peer tutoring significantly outscored the explicit instruction or control group. These two studies coupled with this research should prompt further discussion regarding peer-mediated instruction as a means for education students with learning disabilities.

Though achievement was limited, students classified as OHI experienced positive results on the CRCT. According to GLRS (n.d.), one of the major problem areas for students with OHI is their inability to self-regulate, especially those with AD/HD, which was the only classification under OHI in this study. In the peer-mediated instruction group, achievement gains could possibly be attributed to participants having another individual present to provide assistance with self-regulation. The researcher observed in this research that many of the students provided peer monitoring to achieve progress.

As previously explored in Research Question 2, MID students have problems in processing, distinguishing relevant information, reasoning, and problem solving (Warger 2002). Due to these impairments, the researcher attributed MID students' lack of success on CRCT to an inability to appropriately reason with their partners regarding mathematical concepts. Furthermore, because this group generally experiences higher academic deficits than other groups, the findings of this study seemed consistent with research previously conducted by Maccini and Gagnon (2000) and Warger (2002).

In exploring Research Question 4 (How do exceptional learners respond to differentiated instruction?), to frame this question, the researcher used the Field Log (see

Appendix A), the Student Response Tally Sheet (see Appendix B), the Assignment Completion Tally Sheet (see Appendix C), and interview guide (see Appendix D). The researcher found that student assignment completion was 60%. This suggested that students needed more motivation to turn in assignments. With a little more than half of all assignments being completed, the researcher believed that more emphasis should have been placed on assignment completion to promote positive choice making. According to Morgan (2006), "Preference and choice-making are . . . two interventions that can help improve the daily school experiences of children exhibiting off-task behaviors" (p. 1). Moreover, Morgan asserted that this technique increases the rate of completion for desired academic tasks. Based on this suggestion, the researcher asserted that participants in the differentiated instruction group may have benefited from increased levels of task selection. Fisher et al. (1992) suggested this is accomplished by the teacher providing students with a set of tasks in which the students identify with the ones that will be most reinforcing. In this study, students did not select tasks they were given tasks that the researcher identified as complimentary to their learning styles, interests, and readiness.

Participants in the differentiated instruction group were on task 54% of the time; the researcher believed that had the interventions been in place for the entire school year, students would have had an easier time adjusting and would have understood the expectations of the differentiated instruction class.

Participants were engaged in classroom discussion 66.6% of the time, which suggested these students were interested in discussion to some degree. The researcher would recommend that in future studies emphasis be placed on student engagement which should enhance the levels of participation and possibly assignment completion. Morgan (2006) made the connection between task completion, student participation, and

engagement by suggesting that students that become more academically engaged exhibit a higher level of these activities. Teachers are critical in this area because it is their responsibility to ensure that students are competent and confident in the material that is being presented. Smith, Rook, and Smith (2007) stated, “Students engage in tasks in which they feel competent and confident, and in turn, avoid at all costs those in which they do not feel competent” (p. 43). This suggests students in this group were still uncomfortable with mathematics, which could to some degree be due to their previous failures in mathematics. Based on these findings, the researcher would suggest that more time is focused on student engagement along with making students more comfortable with the study of mathematics itself.

The researcher observed that prior to the study’s implementation many of the students had low expectations in their ability; as a result they often gave up, attempted less challenging problems, and created barriers to learning. Due to this occurrence, the researcher had to overcome these challenges and implement the interventions as framed by the literature. The researcher learned through the course of the study that many students had formed self-handicapping skills that tend to become obstructions in student achievement (Woodward & Brown, 2006). Based on this observation, it may be necessary to provide students with skills in self-determination. Self-determination theory is centered on intrinsic motivation and self-regulation (Eisenman, 2007). In this philosophy, students become self-sufficient and motivated by achieving higher levels of competency in mathematics. Intrinsic motivation is achieved when students feel comfortable and actually enjoy doing mathematics; in essence, mathematics success becomes an internal reward for the students. Self-regulation is achieved when students view success in mathematics as a way of reaching a personal goal (Eisenman). These two

principles, in conjunction, will ultimately provide a more successful experience in mathematics for students with disabilities (Eisenman; Smith et al., 2007; Woodward & Brown, 2006).

According to the interview guide (see Appendix D), students in the differentiated instruction group, enjoyed the activities and the presentation of various concepts in the differentiated instruction class. As outlined in the literature review, students should have multiple instances for taking in information. Students reported that they enjoyed, for the most part, working with various instructional outlets. This suggested that this form of instruction did have some benefits for students, although they might not have been readily observable based on the time constraints and limitations of implementing this study.

In exploring Research Question 5 (What are the differences in response to differentiated instruction for exceptional learners classified, including LD, MID, OHI, and EBD?), the researcher used the Field Log (see Appendix A), the Student Response Tally Sheet (see Appendix B), and the Assignment Completion Tally Sheet (see Appendix C). According to the Student Response Tally Sheet (see Appendix B), EBD students participated in classroom discussion 88% of the time, although the researcher noted that some of the participation responses for this group were inappropriate. According to GLRS (n.d.), this is consistent for students with EBD, they suggested that though EBD students may participate much of their interaction is negative. On a positive note, GLRS noted that differentiated instruction may provide the stimulating activities that are necessary to keep these students on task. For future implementation of this study, the researcher recommended that responses be redirected until appropriate responses are rendered.



It appeared the LD and MID students participated in discussion at an acceptable rate (67%); however, according to their achievement on CRCT test, it appears that the differentiated instruction provided for these students resulted in mediocre response and abysmal CRCT scores. This suggested greater emphasis must be placed on matching the learning styles, interests, and readiness of these students in the differentiated instruction to promote increased engagement (Tomlinson, 2003).

Interestingly, the group with the lowest classroom participation, OHI with a rate of 60%, had the highest achievement mean on the CRCT test for the differentiated instruction group. According to Harlson (2005), these students have a great deal of inattention. One of the major philosophies of differentiated instruction is to deliver content based on the learner's interests. Therefore, the researcher hypothesized that OHI students experienced the greatest achievement in this group due to the fact that they participated in activities that were centered around how they learn best, which in part captured a great deal of their attention, even though, they did not participate as much as other groups.

According to the response tally sheet (see Appendix B), MID students were on task a 100% of the time which suggested they enjoyed the activities presented in differentiated instruction. Although, there is documented evidence that these student often have deficiencies in self-help, communication, and academic skills, it appears that on-task behavior as evidenced in this study is very high for those students participating in differentiated instruction (GLRS, n.d.).

OHI students were on task 57% of the time which suggested they enjoyed the instructional strategies to some degree. For this group, the researcher focused on research conducted on students with AD/HD because this was the only category of OHI

represented in the study. Reid, Trout, and Schartz (2005) stated, “Children with AD/HD typically exhibit problems maintaining attention, sustaining effort, modulating motor activity, and organizing and finishing tasks” (p. 361). As a result, they are often off task and fail to complete assignments. Interestingly, these described behaviors did not totally halt the achievement of students in this category on state assessments. In fact, OHI students had the greatest pass percentage with the differentiated instruction intervention, which suggested that this instructional strategy may have some effect on achievement, specifically, for students with AD/HD.

LD students were on task 39% of the time which suggested they were not really interested in the activities and instructional methods in this class. According to Burns and Dean (2005), this should come as no surprise given 25% to 40% of students with LD also experienced significant attention difficulties. Reid (1996) contended that students with LD have long experienced deficits in attending to tasks or completing; in fact, this has been duly noted as a characteristic of this population. Reid asserted, “Students with LD are often described as inattentive, easily distractible, and off task during academic activities in the classroom” (p. 318). Self-regulation as a means to combat this problem has been linked to greater student achievement. Because differentiated instruction is based on a constructivist perspective, this skill is critical for success using this instructional strategy. The lack of its presence could explain why LD students in differentiated instruction were not as successful as those in the peer-mediated instruction group. Considering those students in the peer-mediated instruction group had a partner that aided in regulating off-task behaviors.

EBD students were on task 33% of the time which suggested they were not attentive to this instructional method of this class. Sutherland and Wehby (2001) reported

that students with EBD exhibit classroom behavior, such as disruptive and off-task behaviors, that affects their social and academic development and the behavior of others in the classroom. These results suggested that students in differentiated instruction should receive continued support on behavioral issues that may, in turn, increase their level of staying on task.

In exploring Research Question 6 (How do exceptional learners respond to peer-mediated instruction?), the researcher used the Field Log (see Appendix A), the Student Response Tally Sheet (see Appendix B), the Assignment Completion Tally Sheet (see Appendix C), and the researcher-developed interview guide (see Appendix D). It was found that students completed at a mean rate of 64%. This suggested that while student completed a majority of the assignments, there was still room for improvement for task completion. Participants were engaged in classroom discussion 60% of the time and were on-task 59% of the time.

Based on these findings, the researcher postulated that with a greater period of implementation, greater achievement would have taken place. In support of this assertion, Brownell and Walther-Thomas (2000) stated, when peer- and social-mediated instruction is properly implemented, it leads to greater task completion, higher levels of student engagement, and, ultimately, greater student achievement. During the course of this study, the researcher observed that students seemed somewhat overwhelmed by the autonomy of peer-mediated instruction. Interestingly, when students were given permission to discuss math topics with a partner, they were less inclined to engage in conversation than when they were not given permission. The researcher would recommend that emphasis be placed on teaching students how to positively interact with their partners to get the most out of peer-mediated instruction. Moreover, the researcher

would suggest that this instructional strategy be used throughout the course of the year to build students' familiarity with this concept.

In exploring Research Question 7 (What are the differences in response to peer-mediated instruction for exceptional learners classified as, including LD, MID, OHI, and EBD?), the researcher used the Field Log (see Appendix A), the Student Response Tally Sheet (see Appendix B), and the Assignment Completion Tally Sheet (see Appendix C). According to the results, OHI students participated in classroom discussions at a higher rate than other groups at 65%, MID students were on-task at a higher rate than other groups at 75%, EBD students had a higher rate of functioning in assigned roles at 66%, and EBD and MID students had a higher assignment completion rate both with a rate of 66%. According to GLRS, (n.d.), students classified as OHI benefit from being partnered with peers; this could possibly explain the response level of this group and why their participation in classroom discussion exceeded other exceptionalities in this group.

Interestingly, although LD students were not the highest achievers in any of these categories, they managed to have the highest achievement scores, which suggested that in some instances student behavioral response is not always an indicator of student achievement. In fact, in comparison to all exceptionalities within the peer-mediated instruction group, these students had the lowest response levels. This finding was consistent with the nature of students with LD. Generally, students with learning disabilities have average or above average intelligence in combination with a significant area of deficiency (GLRS, n.d.). Due to this fact, the researcher reviewed LD student records and determined that each of these students had at least average intelligence in math; however, their areas of weaknesses manifested in reading comprehension and basic reading skills. This discovery provides some insight as to why these students may have

benefited so significantly from peer-mediated instruction during mathematics instruction.

### *Limitations*

Several limitations were experienced through the course of this research. First was the small sample size; because this study took place at one middle school, it was difficult to get results that showed great statistical significance. To combat this problem, univariate descriptive statistics were used to try to help explain some of the dynamics of this study. The short time frame of this study was another limitation; if implemented in the future, more reliable results may yield to a longer implementation period.

### *Implications*

The study should be replicated on a larger scale to determine if the results achieved are generalizable in other districts. Moreover, through these findings, it appeared that the interventions may provide benefit if continued at the middle school. This continuation would provide more accurate results regarding the utility of the selected interventions. Furthermore, an examination should be conducted regarding the utility of these interventions for each exceptionality. It was discovered that certain exceptionalities have greater benefit from various instructional strategies.

Literature suggested that students with disabilities are not experiencing great achievement in mathematics. To that end, interventions must be implemented that provide some positive benefit for these students and to ensure the NCTM's equity principle is carried out (Woodward & Brown, 2006).

### *Recommendations*

This research employed quantitative and qualitative quasiexperimental methodologies. This combined action research indicated that more elaborate studies need to be conducted to precisely define the benefit of differentiated and peer-mediated

instruction for exceptional learners. The findings of this study and literature review postulated that students with disabilities can make gains in mathematics if the right combination of instructional techniques, motivation, and engagement are present. To that extent, the researcher makes the following recommendations:

1. Application of this research should take place in several districts. By conducting this research in various locations, more reliable results would be garnered and students across geographic locations would be targeted.

2. Application of this research should be conducted in the elementary, middle, and high school settings. This research would be invaluable if it provided data as it pertains to each grade level. Researchers could determine if instructional techniques were more instrumental at various grade levels.

3. Application of this research should be conducted in homogeneous classroom settings. This research was conducted in a heterogeneous classroom making it difficult to determine the results on specific exceptionalities. Understanding the nature and receptiveness of each exceptionality to the interventions could prove vital to student achievement.

4. Educational policy makers should evaluate whether students with disabilities should make annual achievement gains or a standard level of proficiency. Due to the nature of assessing students with disabilities, it seemed more practical to evaluate this group based on academic gains opposed to a standard level of proficiency. The major tenets of IDEA (2004) recommended students with disabilities must receive instruction that confers some educational benefit. Receiving a passing score on standardized test does not, in itself, mark educational benefit. The researcher contended that educational benefit is achieved when there is a marked increase in student performance. It appeared

that national policy makers must consider the nature of educational benefit as dictated by IDEA. While educators envision that each child should have a standard proficiency level, it seems an absurdity to expect students who are classified as learning disabled, intellectually disabled, emotional disabled, and those having attention disorders to perform at the same levels as those students that do not have these same impairments. In fact, this expectation seems comparable to asking a wheel-chair bound student to run a marathon. While high expectations should be promoted for these students, consideration to their impairments must be given and realistic expectations must be set. The mere presence of increased achievement on state assessment is an indicator that students with disabilities can learn, just at different rates of proficiency than others.

In concurrence with this recommendation, The National Center for Learning Disabilities (2007) urged congress to promote a growth model factor when making AYP determinations. The growth model requires students with disabilities to be included in AYP counts, however, they are evaluated based growth opposed to grade level proficiency.

5. Application of this research should be conducted over an entire school year. Results would be more reliable if students received these interventions at the onset of the school year.

6. Application of this research should be conducted in conjunction with a program that utilizes the principles of self-determination, self-advocacy, and self regulation theory.

### *Conclusions*

The literature review highlighted several questions posed by Gronna et al. and Neill (2003) that follow:

1. Do these assessments accurately assess students with disabilities?
2. Is it ethical to compare students with identified disabilities with their normative counterparts?
3. Do state assessments accurately measure the academic progress of students with disabilities?

The researcher concludes, based on the findings of this study, state assessments accurately assesses students, however, state assessments fail to assess progress and educational benefit. Ethical considerations regarding the participation of students with disabilities in state assessments is debatable, but it seems somewhat counterintuitive to compare individuals that are know to have unequal academic abilities at the onset.

The findings from this study further suggested that various types of instruction have an affect on students with disabilities. More research needs to be conducted to determine how best to teach students with disabilities. Formulating an action plan for increased student achievement was the main goal for this study. According to O'Connor and Williams (2006), one of the biggest problems that special education leaders have is their failure to develop plausible instructional action plans that best meet the needs of the students.

While the interventions utilized in this study provided some hope in advancing the achievement of students with disabilities, it appears that factors, such as self-monitoring, self-determination, and self-regulation are all necessary to promote the principles of these instructional strategies. Trainor (2007) stated, "self-determination is central to student involvement because fruitful participation requires youth to set goals, self-assess progress, and realign goals accordingly" (p. 3). Moreover, self-determination theory includes the necessary elements of motivation, self-regulation, and self-monitoring



(Trainer). As a value added component to differentiated and peer-mediated instruction. the researcher suggests that the philosophical foundations of self-determination be explored prior to, during, and after various instructional strategies are employed.

Through observation, the researcher discovered that many of the deficiencies present in this study were not solely attributable to students' inability to complete or understand tasks but also on their unwillingness, at times, to complete tasks. This suggests that in order for these students to progress, they must understand the necessity of being self-determined, self-monitored, and self-regulated.

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Appendix A

Field Log

Date \_\_\_\_\_ Time \_\_\_\_\_ Instruction Type \_\_\_\_\_

1. Content of Lesson. Describe the main academic areas that were part of the lesson. Include a descriptive label, a brief description of the tasks for each mathematical area, the number of minutes spent on each task, the percentage of class time devoted to each task, and the amount of class time that was *not* spent on mathematics instruction (e.g., nonacademic time: taking role, etc.). Also, discuss whether the student demonstrated an understanding of the content.

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2. Organization of Students. How were students organized during the course of the lesson? When and for how long did students meet as a whole class, divide into pairs or small groups, work individually at their seats, etc.? Describe the activities that students engaged in during each organizational “phase” of the lesson. How did the students interact with one another? Did students work collaboratively, or were some students more active than others? During whole-class discussion, did a few students dominate the discussion, or did everyone participate?

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3. Assessment of Lesson. How did students perform on classroom informal and formal assessments? Did students seem engaged in activities?

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4. Student Behaviors Did student behavior appear to interfere with the effectiveness of the lesson or the understanding of particular students? If so, how? Where the students on task/Did they participate/Did they understand their role in the given setting/Did they turn in assignments

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5. Researcher’s Reaction or feelings.

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Appendix B

Student Response Tally Sheets

Week Of \_\_\_\_\_

Differentiated Instruction

Student Code	Participation in Disc.					Stayed on Task				
	M	T	W	TH	F	M	T	W	TH	F

Peer-Mediated Instruction

Student Code	Functioning in role					Participation in Disc					Stayed on Task				
	M	T	W	TH	F	M	T	W	TH	F	M	T	W	TH	F

Key:  
 Participation (Y=yes N=No)  
 On Task Behavior (1 =always on task 2=sometimes on task 3=never on task)  
 Functioning in roles (1=understood role 2=understood role somewhat 3=did not understand role)

Appendix C

Assignment Completion Tally Sheets

Week Of \_\_\_\_\_

Differentiated Instruction

Student Code	Assignment Completion				
	M	T	W	TH	F

Peer-Mediated Instruction

Student Code	Assignment Completion				
	M	T	W	TH	F

Key: 1 =Assignment complete 2=Assignment Incomplete 3=No assignment recorded

Appendix D  
Student Interview Guide



Student Code \_\_\_\_\_ Participant ID \_\_\_\_\_

Group Assignment \_\_\_\_\_

Data \_\_\_\_\_ CRCT Score \_\_\_\_\_

1. What did you think about math class? What did you like? What did you dislike?
2. What makes math interesting?
3. How can teachers make math easier to understand?
4. What do you remember most about your math class?
5. Was this year's math class different from your math class last year?
6. Were you able to do the assignments in your math class more easily?
7. Did the activities make your class more interesting?
8. Would you like to participate in a class similar to this in the future?
9. Did you feel like mathematics was easier to understand this year?
10. What activity did you enjoy the most and why?
11. Now that you have taken the CRCT test, do you feel you were prepared?
12. Do you believe you could have been more prepared for the CRCT test? If so how?
13. Were the materials you learned in class helpful to your understanding of concepts presented on the CRCT test