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Differentiated Mathematics Instruction: An Action Research Study

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DIFFERENTIATED MATHEMATICS INSTUCTION: AN ACTION RESEARCH STUDY

by

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ABSTRACT

The purpose of this action research study was to evaluate the relationship between two third grade mathematics classroom; one with differentiated pedagogy and other with traditional pedagogy. To fulfill these purposes, the study tested the hypothesis utilizing an independent *t*-test. The *t*-test was used to identify statistical differences among variables. The participant-researcher utilized a differentiated mathematics instructional strategy of small group instruction, collaborative group instruction, and online instruction with one classroom and traditional lecture style pedagogy with the other classroom over a five week period in preparation for a Post-Assessment. Quantitative data included Mathematics Pre- and Post-Test scores which were given to students to gage their mathematical problem solving abilities before and after the comparison study.

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CHAPTER 1

Introduction

Globalization of the economy, diverse populations, and rapid changes in technology are posing many challenges for educational systems. Throughout time, education has been an area that has seen numerous reform efforts trying to meet the needs of an ever changing society. The massive reform efforts in the United States have intended to close the achievement gap among the different subgroups in America and between the United States and other countries (Zhao, 2009). Despite the numerous reform efforts to improve educational standards, schools systems are struggling to meet the needs of 21st Century learners and employers. As we try to meet the needs of these diverse learners, schools are in need of intensive restructuring. The term "21st Century" has educators and administrators searching for ways to prepare students for the future and the educational system is evolving faster than ever (Nichols, 2015). The identified problem of practice for my Dissertation in Practice (DiP) focuses on the deficit that exists in public school students in demonstrating high levels of mathematics reasoning as measured by state assessments.

"To have an equal opportunity to pursue success, particularly financial success, citizens need equal access to the skills necessary to that pursuit, and schools are charged with providing everyone with these skills" (Weber, 2010, p 152). Educators today not only have to enable students with basic skills but critical thinking and process skills to utilize not only in school but in their daily lives. Some 21st Century skills that have been

identified as important for all learners are critical thinking, communication, collaboration, and creativity (NEA, 2016). These skills are not new to education but tend to be the basis of great teaching. Educators and administrators need to incorporate these skills in classrooms and learning communities around the country. "Students do not learn alone, but rather in, diverse communities, interacting with their teachers, in the company of their peers, and bringing with them the values and teachings of their families" (Katz & Porath, 2011, p. 32). Educators and administrators cannot change the environment that students are born into, but we can change a student's life by providing the best education possible. It is important that as educators and administrators, we emphasize instructional strategies that will produce learners who are productive citizens. "It is clear that when teachers and administrators focus on things they can control, such as instructional strategies, opposed to things outside of their control, such as socioeconomic status and demographic factors, students perform better" (Clayton, 2011, p. 682). Katz and Porath (2011) argue that for all students to learn, students must be recognized as having diverse needs, and a classroom that allows all students to learn and develop a sense of belonging. The heart of instruction has to focus on meeting the diverse needs of the students not teaching the standards and teaching to the test.

> Research reveals how even well-intentioned reforms fail to address the most urgent issues precisely because such reforms are undertaken as a pre-made package without the knowledge of local issues, and their relation to the broader political, cultural, and economic context of society. (Valdiviezo, 2014, p 75)

Instruction today is challenging because it does not begin on the first page of the curriculum guide, but rather where students are in regards to their ability (Tomlinson,

2001). Educators must understand the diverse ability levels of the students in their class to make quality instructional decisions. This understanding allows educators to implement instructional strategies conducive to their students' strengths and weaknesses. Marzano, Pickering, & Pollack (2001) stated that the individual instructional strategies that a teacher uses have a powerful effect on student learning.

To meet the needs of all students and utilize instructional strategies responsive to each student's strengths and interests, we must explore alternatives to traditional instruction. Mathematics is the key to opportunity, for students it opens doors, enables informed decisions, and provides knowledge to compete in a technological economy (National Research Council, 1989). For people to function in this global society, mathematics play an integral role in basic knowledge. People need to have a complex understanding of numbers and procedures that are used in daily activities. "All students must have a solid grounding in mathematics to function effectively in today's world" (Ball et al., 2005, p. 1056).

The students at Sunshine Elementary showed greater achievement in reading and writing, however a gradual decline in mathematics achievement was shown on the Palmetto Assessment of State Standards (PASS) and Measures of Academic Progress (MAP). When differences in students' abilities are significant, educators must make accommodations and differentiate instruction to make teaching and learning more successful (Tomlinson, 2000). When children do not learn the way we teach then we must teach the way they learn (Kellough, 1999). Differentiated instruction was used in this research study as an instructional strategy to improve mathematics achievement in third grade students compared to traditional lecture style instruction.

> The teacher in a differentiated classroom understands that she does not show respect for students by ignoring their learning differences. She continually tries to understand what individual students need to learn most effectively, and she attempts to provide learning options that are a good fit for each learner whenever she can. She shows respect for learners by honoring both their commonalities and differences, not by treating them alike. (Tomlinson, 1999, p. 12)

This instructional strategy will allow the researcher a significant opportunity to address the diverse needs of the learners. Traditional lecture style instruction negates to engage my students in content and knowledge of mathematics. Standing in front of the classroom spraying students with information does not meet the individual needs of all of students. Slavin, Madden, & Stevens work (as cited in Kuntz & McLaughlin, 2001) noted that the best possible mathematics program for mainstreamed classrooms would be one that combined cooperative learning with individualized instruction. Good mathematics instruction engages all students as active learners (NAEYC & NCTM, 2002). Using a more diverse technique for delivering mathematics instruction allows students the opportunity to build their knowledge by engaging in multiple mathematic activities. "Basic skills with numbers continue to be vitally important for everyday uses. They also provide a crucial foundation for the higher-level mathematics essential for success in the workplace which must now also be part of a basic education" (Ball et.al, 2005, p. 1056). Often students have a negative attitude toward mathematics because they are used to sitting in their desk and having to do work on their own. Making mathematics instruction more student centered allows students to really take ownership of their own learning. Effective math instruction allows children to develop positive attitudes toward math

instead of negative ones (Clements, Sarama, & Dibiase, 2004). The major focus on mathematics instruction in elementary schools is the development of proficiency in computation and of skills in applying computational ability to solving problems (Fleischner, 1985).

Dr. Carol Ann Tomlinson (1999) provides the following example of differentiated classrooms:

> In differentiated classrooms, teachers begin where students are, not the front of a curriculum guide. They accept and build upon the premise that learners differ in important ways. Thus, they also accept and act on the premise that teachers must be ready to engage students in instruction through different learning modalities, by appealing to differing interests, and by using varied rates of instruction along with varied degrees of complexity. (p. 2)

Students who are taught through differentiated methods not only learn mathematics effectively, but they also become motivated students who view themselves as successful mathematicians (Lawrence-Brown, 2004). Making the most of the little time that can be used on a daily basis for mathematics is crucial for students. Having students engaged in learning which meet their individual needs is of upmost importance. Differentiated math instruction based on student readiness meets the needs of students who are below grade level, as well as those who exceed benchmarks. When applied correctly, differentiation in mathematics ensures student success (Grimes & Stevens, 2009). Students who are instructed using differentiated instruction can work independently or collaboratively on activities that allow practice and review of mathematic concepts. Teachers are able to work closely with children individually or in

small groups providing a more differentiated style of instruction consistently each day. This individualized instruction allows our students to receive tailored instruction to best meet their needs (Boushey & Moser, 2014). Utilizing small group instruction, collaborative learning, and online activities allows the educator to cater the learning goals to the individual students' strengths and weaknesses. Grouping has to be flexible and continually changing based on the content and the individual students' needs. Differentiated mathematics groups are no longer rigid groups that follow the whole year but should be ever constantly changing based on informal and formal assessments of student progress.

Background- Community and District

Daisy School District, located in Clover, serves a diverse range of students. There are approximately 9,620 students in the district. The District has 20 schools: nine elementary schools, one intermediate school, one charter school, four middle schools, four high schools and one adult education center. Based on Clover's Department of Education Website, Daisy School District received an Absolute Rating of Excellent on the Annual Yearly Progress (AYP) Report Card and a C based on the Federal Accountability Rating System. Based on the South Carolina Palmetto Achievement Test of State Standards (SCPASS), 71% of our students received Met or Exemplary on the ELA portion of the test. Sunshine Elementary received an overall AYP Report Card Absolute Rating of Average and a C based on the Federal Accountability Rating System. Based on the SCPASS, 55% of our students received Met or Exemplary on the Mathematics portion of this test. These statistics are below Elementary Schools with Student's Like Ours (61%), meaning Poverty indexes are not 5% below or above. This

also places us below Elementary Schools in the State (76.9%) in Mathematics (Clover Annual Report Card Summary, 2014).

Based on Measures of Academic Progress (MAP) for Mathematics, students in Sunshine Elementary also show a deficit. In fall of 2014, 45.3% of third grade students, 62.8 % of Fourth grade students, and 39.7% of fifth grade students were Proficient in Mathematics (South Carolina Department of Education, 2014). Based on test scores from these assessments, educators need to evaluate instructional strategies which are most effective in meeting individual students' needs. Diverse student populations make finding effective instructional strategies a challenge faced by many administrators and educators.

Sunshine Elementary is a rural school in Clover. Sunshine Elementary is a Title I school. Title I provides federal funding to schools that have low poverty levels. The funding is meant to help students who are at risk of falling behind academically (Meador, 2015). Poverty rates for rural families are higher across all categories and more enduring than their urban counterparts. Rural African American families and their children are not empowered by the educational system or provided educational services in a culturally sensitive context (Kea, 2009). Sunshine Elementary has an 89% Free/Reduced Lunch Status. Farrigan and Parker (2012) stated in the United States, people living in poverty tend to be clustered in certain regions, counties and neighborhoods rather than being spread equally around the Nation. "Rural children are less likely than non-rural children to be in center-based care other than Head Start during the pre-kindergarten year" (Kea, 2009, p. 12). Students at Sunshine come to school exhibiting deficits because of the poverty level and lack of pre-kindergarten experience.

Statement of the Problem

The overarching goal of action research is to improve practice immediately within one or a few classrooms or school. The mathematics needs of our general population in being left behind in the goal of making all learners literate. The purpose of my action research study is to examine the effects of differentiated mathematics instruction and traditional lecture style instruction on the achievement of third grade mathematics students. The specific purpose of this study was to examine the utilization of small group instruction, collaborative groups, and the use of online games/activities as a framework to differentiate learning of mathematics in third grade students.

The challenge for classrooms and schools is finding the best instructional strategies that meet the needs of the diverse student population. The Daisy School District implemented High Progress Literacy Classrooms in response to Read to Succeed. Teachers rework their daily English Language Arts (ELA) schedule and have arranged use of time so that all students can be highly engaged with text reading and writing at least 75% of classroom instructional time (HPLC Implementation, 2015). Educators' daily schedules reflect the large chunk of instructional time dedicated to reading, writing and research, leaving a small section of time for mathematics instruction.

McMillan (2004) describes action research as being focused on solving a specific classroom or school problem, improving practice, or helping make a decision at a single local site. Kea (2009) states the systematic lower achievement of particular groups of students is an alarming sign for politicians about the crisis of the educational systems, and it is an important justification behind investments in reforms and research in mathematics education. Clover and the Daisy School District are creating independent

readers and writers but failing to inspire the mathematicians. Teachers must apply instructional methods that make math accessible and understandable to all students (Grimes & Stevens, 2009). We as educators must step back and make hard choices based on the needs of the students that make their educational journey in our rooms daily. Mathematics no longer is memorizing facts but actually having a deep understanding of what the numbers, signs, and answers mean. Educators must improve mathematics knowledge by focusing on alternative instructional strategies which hold effective mathematics instruction at its core.

Research Question

What is the difference in mathematics achievement in third grade students who have received differentiated mathematics instruction when compared to third grade students who received traditional mathematics instruction?

Purpose of the Study

The purpose of my action research study was to examine the effects of differentiated mathematics instruction and traditional lecture style instruction on mathematics achievement of third grade students. The specific purpose of this study was to examine the utilization of small group instruction, collaborative groups, and the use of online games/activities as a framework to differentiate the learning of third grade students. Effective instructional strategies enable diverse learners to construct their own knowledge and cultivate talents in an effective manner (Darling-Hammond, 1993). Schools are faced with the challenge of implementing state standards with a single requirement for all learners. The problem facing educators is all learners need to have the same outcome but instructional strategies need to meet the diverse needs of their learners.

This study will examine two of the most predominant instructional strategies for teaching mathematics: Traditional lecture style and differentiated instruction.

To date, there is very little research conducted on differentiated instruction in the elementary levels. Hayes and Deyle (2001) claim that it is difficult to determine the possible effects of differentiated instruction on the achievement of students because the effects of differentiation may differ in each school. Smit and Humpert (2012) argue that students who receive differentiated instruction do not experience poorer achievement, however, clear positive results from differentiated instruction still have to be found.

Overview of Design of Study

Action research is defined as any systematic inquiry conducted by teachers, or others with a vested interest in the teaching and learning process or environment for the purpose of gathering information about how their particular schools operate, how they teach, and how their student's learn (Mills, 2011). Action research is the appropriate format for my study to allow a deeper understanding of the diverse learning needs of students and strategies that would make instruction more effective. This research will provide insight to my school and district to facilitate mathematics teaching and learning that will meet the diverse needs of the student population. Action research allows teachers to study their own classrooms, in order to better understand them and to be able to improve their instructional quality or effectiveness. It focuses on the unique characteristics of the population with whom the action must be taken. This in turn increases the effectiveness for the practitioner (Parsons & Brown, 2002). Educators must be willing to step up and find the best practices that work for their classrooms. Making sure that each classroom is different and that the differences reflect the individual needs

of the students within. “True school improvement must begin within the four walls of the classroom. Teachers must be able and willing to critically examine their own practice as well as how their students learn best” (Mertler, 2014, p. 12).

The purpose of this quantitative study is to compare instructional strategies and their effectiveness in mathematics achievement of third grade students. The study is designed to determine the impact that varied pedagogical methods have on mathematic abilities of third grade students in a rural school setting. The researcher will investigate and compare how a math class of third grade students performs when receiving differentiated instruction. The comparison group is from another class in Sunshine Elementary that will receive traditional lecture style instruction.

The researcher will utilize small group instruction, collaborative groups, and the use of online games/activities as instructional tools to facilitate differentiated instruction. Sunshine Elementary School shows a deficit in the students’ mathematics test scores when compared to other students in the State of Clover. The action research study attempted to determine if a differentiated instructional model compared to the traditional lecture-style instructional model strengthens student achievement in third grade students during the fall semester by utilizing a pre- and post-test for mathematics.

Many of the students at Sunshine Elementary come with an early learning deficit versus other children who may live in other areas of the county. The classes will be comprised of students who are similar in makeup and dynamics. The students will receive a mathematics pre-test so that the teacher/researcher can compare the scores prior to the instructional unit and students will also receive a mathematics post-test so that scores can be analyzed after the instructional unit.

Theoretical Base

The theoretical base for this study is rooted in the works of Gardner (2004), Vygotsky (1993), and Tomlinson (2001). Gardner (2004) is known for his theory of multiple intelligences. Gardner believed that when teachers know how students learn and at what intellectual level, teachers can better instruct students' individual needs. Utilizing small group instruction, online activities, and collaborative activities to facilitate differentiated instruction allows the researcher to accommodate each child's intelligence.

The social aspects of collaborative learning are tied to Vygotsky's (1993) sociocultural theory. According to Vygotsky, children learn by working together as well as developing concepts by using concrete objects to construct meaning. One of Vygotsky's theories that is highly recognized by teachers is the zone of proximal development (1993). The zone of proximal development is the gap between what a learner has already mastered and what he or she can achieve when provided with educational support (Vygotsky, 1993). Utilizing collaborative groups in differentiated instruction allows students to work together to share ideas and explain their ideas.

Tomlinson (2001) discussed the importance of differentiated instruction and accommodating the instructional needs of all children. In classrooms without differentiated instruction, students do not have opportunities to share and express ideas beyond the traditional realm of study. Tomlinson's (2001) theories create the foundation for differentiated instruction, allowing online activities, collaborative learning, and small group instruction to deliver instruction to meet the diverse needs of learners.

Definition of Key Terms

The key terms and definitions, essential for this study, are provided:

Action Research is any systematic inquiry conducted by educators for the purpose of gathering information about how their particular schools operate, how they teach, and how their students learn (Mertler, 2014).

Small Group Instruction typically refers to a teacher working with a small group of students on a specific learning objective. These groups consists of 2-4 students and provide these students with a reduced student-teacher ratio. It allows teachers to work more closely with each student, reinforce skills learned in the whole group instruction, and check for student understanding. (Meador, n.d.).

Collaborative/Cooperative Learning is the instructional use of small groups so that students work together to maximize their own and each other's learning. Class members are organized into small groups after receiving instruction from the teacher. Then they work through the assignment until all group members successfully understand and complete it (DeJesus, 2012).

Differentiated Instruction is a clear and solid method to modify instruction. A teaching philosophy that allows students to have multiple options for taking in information, making sense of ideas, and expressing what they learn (Mann & Willis, 2000).

Math achievement is using research-based teaching methods to ensure all students can show mastery of grade level skills being taught (Byrnes, 2001).

Whole Class Instruction is typically teacher led. The teacher teaches the entire class the same lesson regardless of the specific needs of the students in the class (Meador, n.d.).

Limitations

This study was limited to third grade mathematics classes in an elementary school, which could possible yield different results in a middle school or high school setting. The study was conducted in a single geographical area. The sample consisted of a high percentage of minority students from low-income families. These factors limited the generalizations of the study to third grade students, to school districts in other regions with other populations. The assessment is multiple choice, open ended questions would allow students a change to elaborate or explain their answers.

Significance of the Study

The curriculum in schools have become standards based, which means all students are expected to achieve equally and meet high standards despite their varied abilities. Educators are therefore challenged to meet the diverse needs of the student populations. The only way to meet the objective of the standards based curriculum is to personalize or differentiate the instruction (Lawrence-Brown, 2004). Educators must face the challenges of changing from traditional lecture style instruction to instructional methods that meet the diverse needs of their students.

Differentiated instruction is believed to be an effective instructional strategy because it advocates beginning where individuals are rather than with a prescribed plan of action, that disregards student readiness, interest, and learning profile (Tomlinson, 2005). This study is significant and contributes to the existing research because it provides educational leaders with a comparative study of differentiated instruction and traditional instruction. Society has become more diverse and complex, which is also

represented in our classrooms. Schools need to adopt learning strategies that enable all students to meet high standards.

Summary of the Chapter

The purpose of this action research study is to examine the effects of differentiated mathematics instruction and traditional lecture style instruction on two third grade mathematics classes. The participant-researcher will utilize a differentiated mathematics instructional strategy of small group instruction, collaborative group instruction, and online instruction with one classroom and traditional lecture style pedagogy with the other classroom over a five-week period in preparation for a Post-Assessment. Quantitative data will include Mathematics Pre- and Post-Tests which will be given to students to gage their mathematical problem solving abilities before and after the comparison study. The pre- and post-test data will help the participant-researcher to gain a more in depth understanding of the student's mathematical problem solving abilities. Chapter 2 contains a literature review that compares and contrasts different points of view, research outcomes, and establishes the relationship of the study. Chapter 3 provides a description of the participants, methodology, and instrumentation. Chapter 4 includes a detailed statistical analysis of the data and an interpretation of the findings. Chapter 5 contains of summary of and interpretations of the findings, implications for social change, and recommendations for action and future plans.

CHAPTER 2

Review of Literature

Introduction

This review of literature presents reforms that have led to the massive changes in the public school system. The literature presents a view of differentiated instruction, traditional lecture style instruction (whole class) and mathematics instruction. The discussion will analyze the elements of small group instruction, collaborative/cooperative groups, and online games. Significant works of theorists will be evaluated in detail on the topics of differentiated instruction and lecture style instruction (whole class).

Relation of Literature to Research Problem

Research has provided evidence that the education system is failing at meeting the growing needs of diverse school populations. Research is provided on education reform efforts to meet the diverse needs of students. In this literature review, I explore an instructional approach, differentiated instruction, to effectively meet the needs of third grade students in mathematics instruction. Research regarding online games, collaborative groups, and small group instruction, as it pertains to higher achievement in math, is presented.

Darling-Hammond (1993) believed that the job of instruction is to enable diverse learners to construct their own knowledge and to cultivate talents in an effective manner.

Kluth & Straut (2001) argued that standards should be flexible, present a wide range of concepts and skills, and educators need to adapt the curriculum to meet the individual needs of learners. No Child Left Behind (NCLB) (2001) resulted in massive changes in our public school systems. "Without teachers who have sophisticated skills for teaching challenging content to diverse learners, there is no way that children from all racial and ethnic language and socioeconomic backgrounds will reach the high academic standards envisioned by the law" (Darling-Hammond, 2007, p.48). This reform increases accountability for schools, educators, and school districts. Therefore, the instructional strategies that educators incorporate into their classrooms can have a significant impact on student achievement.

> Mathematics is everywhere: it is experienced and practiced by every culture and must be incorporated into school mathematics curriculum. Instead of instilling fear and loathing, math education should foster a great understanding of how mathematics is applied in our increasingly technologically-driven world. Mathematics instruction should reflect/embrace the cultural diversity of our classrooms, and of our increasingly interconnected world. (Brandt & Chernoff, 2015, p. 33)

Derman-Sparks (1990) explained that ultimately, teachers, school leaders, parents, and students must acknowledge that students from all cultures and backgrounds have the potential to be high ability learners. Curriculum which does nothing to counteract biases which dominant-culture children encounter in their daily lives does little to help these children live effectively and fairly with diversity.

My identified problem of practice for my DiP focuses on the deficit that exists in many United States public school students in demonstrating high levels of mathematics reasoning as measured by state assessments. In particular, Sunshine Elementary shows a deficit in students' mathematics test scores when compared to other students in the State of Clover. Daisy School District implemented High Progress Literacy Classrooms which schedules English Language Arts for 75% of the school day. Students are being given daily instruction across the curriculum in English Language Arts but leaving mathematics behind.

One goal of this review of literature is to enable teachers to find different instructional strategies that can be utilized in classrooms for differentiated instruction. These instructional strategies can help to promote mathematical reasoning and achievement through collaborative learning, small group instruction, and online game/activity program. In order to reach this goal, an action research study designed to analyze alternative instructional techniques in mathematics education is proposed.

My action research study will focus on differentiating mathematics instruction to promote higher achievement in third grade students.

Research Question

What is the difference in mathematics achievement in third grade students who have received differentiated mathematics instruction when compared to third grade students who received traditional mathematics instruction?

Research Purpose

The purpose of my action research study is to examine the effects of differentiated mathematics instruction and traditional lecture style instruction on the achievement of

third grade mathematics students. The specific purpose of this study is to examine the utilization of small group instruction, collaborative groups, and the use of online games/activities as a framework to differentiate the learning of third grade students. The post-test data will be analyzed to determine if there is a statistically significant difference in the achievement of third grade students taught by differentiated instruction or traditional lecture style instruction. Sunshine Elementary School shows a deficit in our students' mathematics test scores when compared to other students in the State of Clover. The action research will attempt to determine if a differentiated instructional model compared to the traditional lecture-style instructional model strengthened student achievement in two third grade groups during the fall semester by utilizing a pre- and post-test for mathematics.

Research Problem

No longer can we allow our students to sit idle in their desks with a worksheet. We must provide an engaging environment, where students are immersed in their own learning. Finkelstein argued (as cited in Springs, 2014) that in the nineteenth century teachers were of two types: the intellectual overseer, who stressed memorization and punished failure in assignments, and the drillmaster, who had the students repeat material in unison. As educators, we can no longer afford to be the intellectual overseer or the drillmaster. We must provide education that is diverse based on our student's strengths and weaknesses. We must provide varied opportunities for students to be active in the learning practice promoting their strengths in each task.

> The major impact of the Pestalozzian theory was its emphasis on relating instruction in the early years to objects in the real world, on learning by doing,

> and on the importance of activity, as opposed to sitting at a desk. (Springs, 2014, p. 147)

Students need to practice learning in multiple ways throughout the day to apply their knowledge to learning.

Education Reform Efforts

The No Child Left Behind (NCLB) Act of 2002 created a sense of urgency in the education system to aggressively analyze the classroom instruction and student achievement. NCLB caused massive changes to begin in public school systems around the nation. Public schools have been placed under a great deal of pressure to demonstrate that they are providing students with a thorough and efficient education through improved test scores (Noddings, 2005). NCLB (2001) brought about testing requirements for reading and math which caused educational systems to design standards based curriculum that would emphasize reading and math instruction. With the accountability and testing requirements put into place by NCLB, school systems had a shift regarding instructional approaches that were being utilized in classrooms around the country.

President Barack Obama placed more accountability on the states by allowing them to compete against one another, looking for better curriculum, assessments, better technology, and a commitment to providing the most efficient education for all students. Race to the Top held students accountable for more rigorous standards to better prepare them for college and careers, and teachers are using newer and better classroom assessments to tailor their instruction to students' needs (US Department of Education, 2015). Race to the Top also saw college and career ready standards (21st Century Skills) adopted across states to align expectations for college and workplace.

Mathematics Instruction

Lubienski (2002) explained there is much we do not know about how schools fail in their support of children of color and those in poverty, particularly in elementary mathematics classrooms. Given this, scholars are calling for in-depth examinations of the instructional practices, particular to mathematics, that contribute to less opportunities to engage quality mathematics for students of color.

> Mathematics education researchers seek answers to important questions that will ultimately result in the enhancement of mathematics teaching, learning, curriculum, and assessment, working toward ensuring that all students attain mathematics proficiency and increasing numbers of students from all racial, ethnic, gender, and socioeconomic groups who attain the highest level of mathematics achievement. (National Council of Teachers of Mathematics, 2014, p. 6)

The focus has been on improving mathematics instruction so that all students meet the high standards as measured by state-administered achievement tests, it is crucial that students at risk for mathematics difficulties, who vary considerably in ability, achievement, and motivation, develop the necessary mathematical knowledge to meet grade-level benchmarks (Jitendra et.el., 2013). Creating mathematically literate citizens is rarely questioned by educators; however, there are different interpretations of the meaning of the term. Mathematical literacy can be seen as the ability to solve problems, reason about and analyze numerical information, and know the meaning of important mathematical vocabulary (Oxford Learning, 2010). Traditional math instruction results in the class doing the same assignment and practicing the same problems, usually receiving

no feedback until the next school day (Poncy, Fontenelle, & Skinner, 2013). Many children who would not be identified as having special educational needs are low-attaining in mathematics (Butterworth, Varma, & Laurillard, 2011). Difficulties in mathematics often have a marked impact on their educational prospects (Gross, 2007). Bynner and Parsons (1997) found that most adults with serious numeracy difficulties had already shown difficulty with mathematics by the age of seven. The development of suitable interventions is made more challenging by the fact that there are many reasons why children may experience mathematical difficulties: environmental factors, broader cognitive difficulties such as problems with language, spatial awareness or working memory, and more specific weaknesses in some or all aspects of mathematics (Gifford & Rockliffe, 2012). The traditional structure in elementary and middle school mathematics classrooms has consisted of textbook driven lesson, rote memorization, and focus on skill practice (Project Grad, 2008). The National Council of Teachers of Mathematics (2000) has greatly influenced mathematics instruction, by promoting more meaningful instruction or standards based instruction. These standards describe skills that students will need to perform effectively in the 21st Century. Knapp, Zucker, Aldelman, and Needles (1995) argued that theorists suggest that instructional strategies that emphasize conceptual understanding of mathematics ideas and procedures across a wide area of content present the most promise for mathematics instruction in schools with students that come from homes in the lower economic ranges.

It is important for teacher of mathematics to expose student's strengths and scaffold them into higher mathematical thinkers and learners. Instead of traditional question and answer "ping pong," the teachers allow time for thinking and not to expect

the pupils to answer correctly immediately. Teachers turned the pupils into real partners in the discourse, communicating, responding to their peers and exposing their difficulties (Margolin & Regev, 2011). Instructional strategies, such as differentiated instruction, allow instructional time to be utilized to better meet the individual needs of students. Math teachers are able to work closely with children individually and in small groups consistently each day. This individualized coaching allows students to receive tailored instruction to best meet their needs (Boushey & Moser, 2014). According to Margolin and Regev (2011)

> A meaningful mathematical discourse in which the teacher can observe each pupil's engagement in the task, identify his zone of proximal development as well as misconceptions and relate to them in order to afford construction of concepts and ideas, can occur in small groups. In a whole class discussion only few pupils have the opportunity to articulate their thoughts or to expose their misconceptions publicly and the teacher can't really know about the others' understanding and relate to their difficulties. (p. 18)

In more differentiated mathematical groups, students can be taught strategies that can be applied when working independently. Van Luit and Nnaglieri (1999) noted that explicit strategy instruction occurs when "students are taught to flexibly apply a small repertoire of strategies that reflect the processes most frequently utilized by skilled math students" (p.99).

Differentiated Instruction

Students in today's schools are becoming more academically diverse. There are more students identified for more exceptionalities in special education, more

> students whom English is not their first language, and more students struggling to read. There is a need to ensure challenge for advanced learners when accountability pressures focus on basic competencies, and a growing economic gap exists between segments of the student population. (Tomlinson, Kay, & Lane, 2008, p. 1)

"The lack of early literacy and numeracy skills can have a profound impact on school readiness and overall academic performance. Children need high quality learning experiences to succeed in school" (Kea, 2009, p. 11). Which brings about the question does traditional classrooms meet the growing needs of diverse school populations? "The differences in students are significant enough to make a major impact on what students need to learn, the pace at which they need to learn it, and the support they need from the teachers and others to learn it well" (Tomlinson, 2000, p 6). We no longer can afford the leisure activity of teaching down the middle, we as educators, have to find our student's strengths and build on those strengths.

> When teachers believe unequivocally in the capacity of their students to succeed through hard work and perseverance, it's natural to provide work that complements the capacity of each student to think, problem solve and make meaning of important ideas. 'Teaching up' communicates clearly that everyone in the class is worthy of the best curriculum the teacher knows how to create. (Tomlinson, 2013, p. 8)

Educators need to effectively meet the needs of their students in the most feasible way possible. "Students will learn best when supportive adults push them slightly beyond where they can work without assistance (Tomlinson, 2013, p. 7). The key is to providing

opportunities for students to grow in their learning and practices. As Tomlinson (2013) stated, "achieving the goal of maximum academic growth is dependent upon effective instructional practices working in concert with an effective curriculum, as well as effective assessment, and classroom leadership and management" (p. 9). Educators must promote the individual strengths and goals of each student to build a stronger learning community. "When students learn and grow in their own ways, differences are pronounced. When we decide we want to value differences, we make decisions that expand diversity rather than seek conformity and inappropriate uniformity" (Guild & Garger, 1998, p. 7).

Differentiated learning is a predominant instructional strategy that educators employ to facilitate the diverse needs of students. "Differentiation provides one method by which teachers can provide appropriate challenge at appropriate levels for all learners in a heterogeneously grouped mathematics classroom where the range of abilities and interests can be wide" (Reed, 2004, p.120). In terms of differentiation, creating understanding focused curriculum asks teachers to realize their students will approach understanding at varied levels, will need different support systems to increase their current level, and will need a range of application to connect the understanding with their own life experiences (Tomlinson, Kay, & Lane, 2008). Student's diverse needs are being met inside of one classroom because the teacher is attending to the challenges and strengths of the students. Students in a differentiated classroom utilize their strengths and are motivated to persevere even when tasks become more difficult. Lawrence-Brown (2004) describes differentiated instruction as a strategy that recognizes and supports a

classroom as a learning community populated with peers that must be nourished as individual learners.

Differentiated learning leads to students being engaged in tasks that are based on their individual level. Engagement in the classroom results when a student's attention is attracted to an idea or a task and is held there because the idea or task seems worthwhile. Students become engrossed because the task is enjoyable, or because it seems to provide them with the power of competence of autonomy, or because it links with an experience, interest or talent that is significant to them, or because it is at the right level to challenge and stimulate rather than to frustrate or bore them (Tomlinson, 2013). The teacher sets the foundational goals by guiding students to meet their own independent challenges. Students begin to build stamina and self-reliance when faced with mathematical adversity. Teaching to the lower level of a class perpetuates the problem of low mathematics achievement, along with boredom and disengagement on the part of the middle and high-end learners. Teaching to the middle level causes the less-prepared students to struggle and fall farther behind, while the better prepared students, who remain unchallenged, lose their motivation to learn (Rimm & Lovance, 1992). The key components of modifications to the mathematics curriculum should attend to four broad principles: The teacher should:

Provide content with greater depth and higher complexity

Nurture a discovery approach that encourages students to explore concepts

Focus on providing complex open-ended curriculum

Create opportunities for interdisciplinary connections (Stepanek, 1999).

Providing a diverse educational experience that meets the needs of all students is important to mathematics classrooms. Educators must move forward, rapidly and visibly, in the successful implementation of classroom-level strategies that provide differentiated curriculum, instruction, and assessment; strategies that when implemented effectively, result in challenging and supporting all students within the regular, mixed-ability, heterogeneous classroom (Tomlinson, 2001). In an effective heterogeneous classroom (one where curriculum and instruction are properly differentiated), students and teachers, are more likely to view their differences as assets that strengthen the whole school (George, 2010). The consensus in recent research in learning seems to support the position of constructivists who argue that the best learning comes when students build their own mathematics, language skills, or science knowledge by arguing, challenging, explaining, solving problems, and having keys to creating learning environments that effectively accommodate the diversity typical of today's classroom, especially where the needs of able learners must be accommodated (Tomlinson, 2000). Teachers in differentiated classrooms accept, embrace, and plan for the fact that learners bring many commonalities to school, but that learners also bring the essential differences that make them individuals. Opportunities for challenge and extended learning must be open to all students whenever possible (Stepaneck, 1999). Gamoran & Weinstein (1998) found that heterogeneous classes were most effective when teachers used differentiated instruction. High quality instruction relied on individualization, varied expectations (but at a high level for all students), and complex authentic assignments. In order to prepare students for success in and out of the classroom, teachers must differentiate the mathematics instruction to meet the needs of all learners and provide students with varied

opportunities to learn and grow (Smith, 2010). Gardner (1997) suggested using "several entry points," which means approaching a topic in several different ways to allow students more exposure to the topic" (p. 202). Hockings (2009) argues that "student-centered learning has the potential to engage a more academically diverse student body than the more conventional teacher-centered approaches" (p.83). Todd and Curliss (2003) argued:

> Educators should provide all learners with opportunities to obtain optimal levels of learning. Many, if not most, classrooms include learners with mixed abilities. These learner differences particularly in, mathematics classes, may be significant. In order to attain optimal levels of learning for all students, instructional leaders must move beyond the one-size-fits-all conception of curricular and instructional practices. Rather, the curriculum should include a sequence of learning activities constantly being developed in response to learner readiness, which includes the point at which a student enters a particular study and the pace at which the student acquires new knowledge and skills. (p. 53).

Educators use the differentiated instruction to build stronger thinkers and learners. Differentiating learning environments helps to broaden the education of all learners. However standardized assessments are not driven to protect these differentiated thinkers and learners. Educators feel torn about differentiated instruction based on standardized assessments.

There are opponents of differentiated instruction that state that it is not an appropriate instructional strategy. Stahl (1999) contends that there is no research that proves that determining a student's learning style and matching instruction to it has any

effect on learning. Stahl (1999) further argues that there are no studies that prove the implementation of Gardner's multiple intelligence model improves achievement. Martel (2006) theorizes that studies have shown that instruction is effective when matched with knowledge, skills, and performance levels only. He states that "there is no evidence that matching instruction to instructional level or learning style has any effect on learning" (para. 6).

Traditional Lecture Style Instruction (Whole Class)

Traditional lecture style instruction is another predominant instructional strategy that teachers utilize in classrooms around the United States. Traditional lecture style instruction places the teacher in the front of the room delivering the information to students. There are theorists that believe traditional, whole class instruction is the best instructional strategy for educators to utilize. Whole class instruction is an effective tool in identifying students' prior knowledge and experiences that will affect the ability to learn new concepts (Valentino, 2007). Snow (2003) concludes that teachers rely primarily on whole class instruction and that other forms of instruction do not result in significant improvement in student achievement. "Whole class instruction is teacher centered and supports the notion: one group of students, one set of outcomes, and one instructional plan" (Craft, 2002, p. 1). Teachers may be more effective using whole class instruction due to the familiarity of whole class instruction (Lloyd, 2008).

Abrami, Yipping, Chambers, Poulsen, and Pence (2000) stated "whole class instruction is uniform opposed to differentiated instruction and the whole class is taught by a single set of instructional goals. Whole class instruction still stands as an important tradition that has been in place since the one room schoolhouse" (p. 162). Ebeling (2000)

argues that schools in the United States are not designed for one on one instruction and teachers are assigned a group of students that should be taught in that group. In Japan, whole class instruction is utilized but the teacher is not a dispenser of knowledge but a guide for discussion of students (Nagasaki & Becker, 1993).

Small Group Instruction with Teacher

Part of the process of differentiation is to provide a more diverse learning environment. Small group instruction is one of the instructional approaches that is utilized in my action research. "A myriad of instructional and management strategies invite teachers to break classes into smaller learning units. Subdividing the class enables the teacher to think about variation in student need and to create groups that attend to student learning differences" (Tomlinson, 1999, p. 6). Kameenui (1993) states "the identification of children as diverse learners itself suggests that multiple perspectives and approaches will be necessary to accommodate the needs of children who possess differences in abilities and learning histories, and who will be schooled in various instructional contexts" (p. 11). Small group serves as a structure that offers opportunities to meet with a student or students to support them as they work to acquire new learning and to support them as they transition to their own independence (Serravallo, 2010). Small groups provide opportunities for students to watch the teacher demonstrate, opportunities for the student to practice with teacher support, and opportunities to practice independently, offering a bridge to independence (Serravallo, 2010). Vygotsky (1978) asserts that new learning occurs when the child accepts the challenge to take on new competencies, not repeat old ones. Engaging students in the small-group instruction makes the small groups more similar to conferences than mini-lessons as each child is

responded to as an individual. The teacher gives one-on-one attention and tailors the focus of the lesson to the individual's needs. The teacher also differentiates by changing how he interacts with each child and the type of output expected (Tomlinson, 2001). In linking the small group, the teacher reiterates what was taught and encourages the children to practice independently. This is an important part of the conference because it is essential that children transfer what they've done in the small group to their independent work (Serravallo, 2010). Small group instruction offers time for the teacher to assess students continuously instead of just through formal assessments. Goodman (1985) notes:

> Evaluation provides the most significant information if it occurs continuously and simultaneously with the experiences in which the learning is taking place. Teachers who observe the development of language and knowledge in children in different settings become aware of important milestones in children's development that tests cannot reveal. (p. 10)

During small group learning, teachers' verbal behaviors could be categorized as encouraging student initiatives, helping students with their learning tasks, facilitating communication among students, giving feedback on task performance, and praising individual student's effort (Gillies, 2006). Teacher's mode of teaching also changes during small group instruction, it is not the lecturing type of teaching. This small group setting provides the opportunities for teachers to observe and provide more individual feedback. "When students work in cooperative classrooms where teachers use more facilitative learning behaviors, they too engage in more positive helping behaviors with their peers than do students who work in groups where cooperative learning is not

strongly endorsed" (Gillies, 2006, p. 275). Manouchehri and Enderson (1999) claim that small group discussions encourage students to develop a more reflective stance as they take ownership of their contributions and learn to justify them in the face of questions from others. We must remember that decisions about grouping are preliminary and that what matters most comes next. Given poor instruction, neither heterogeneous nor homogeneous grouping can be effective; with excellent instruction, either may succeed (Gamoran, 1992). Research suggests that small group activities were more effective for social support and the benefits of discussion, while being more inclusive (Howe and Mercer, 2007). Small group interactions that encourage and prompt students to think aloud as they do mathematics, with peers providing feedback on their strategy use, is known to improve student learning (Van Luit & Naglieri, 1999).

Collaborative Learning

Another differentiated instructional strategy that I encompassed in my action research study is collaborative learning. Collaborative learning is now accepted as an important teaching-learning strategy that promotes positive learning outcomes for all students, including students with a range of diverse learning and adjustment needs (Johnson & Johnson, 2002). The open discussion that occurs in groups enables participants to clarify ideas and perspectives in a context that is free of the perpetual scrutiny of the teacher and the wider class group (Howe, 1990). Collaborative groups also help students to work with diverse students and begin to maximize their opportunities to develop positive attitudes toward different racial and cultural groups. According to Banks (1992), problems related to diversity will intensify rather than diminish as the ethnic texture of the nation deepens. Educators must make efforts to change the problems

related to racial and ethnic diversity into opportunities and strengths. If schools are to achieve their goals of maximizing human potential, improving the quality of life for all students, and promoting the ideals of freedom, justice, and dignity for all, they must meet the challenge of helping students develop more positive attitudes toward different cultural, racial, and ethnic groups. When children are part of a group with a common goal, it makes it more likely that they will reach out to peers when they encounter difficulty. Small collaborative groups give children the chance to hear other students' thinking (Serravallo, 2010).

> School must be a forum where children can express and negotiate meanings, where each child is engaged and supported in growing toward an understanding of his or her power to participate in the community. Then the knowledge gained can be functional and meaningful. (Berghoff & Egawa, 1991, p.130)

If a differentiated classroom is student-centered, students are the workers. The teacher coordinates the time, space, materials, and activities. Her effectiveness increases as students become more skilled at helping one another and themselves achieve group and individual goals (Tomlinson, 1999).

> Pupils attain a better understanding of their classmates' needs, their points of view, and a better perception of problems. That is why when children help a classmate they gain a great understanding of their own perspective on the problem at hand. (Gillies, 2006, p. 278)

Callaghan et al. (2011) points out that collaborative activities oriented towards a common goal require children to focus their attention on the task, monitoring each other's attention

in order to comprehend and anticipate their partner's action. The National Council of Teachers of Mathematics (NCTM) suggested a shift away from the traditional emphasis on individual paper and pencil mathematics toward interactive, discussion-based mathematics classrooms (2000). Learning is a social endeavor, and a student's ability to participate in the society of the classroom determines, in part, his ability to construct useful concepts. A student's ability to construct useful concepts determines his ability to take part in the society of the classroom. Thus, discussions among members of the classroom are ultimately tied to learning (McCrone, 2009). Wagner (1994) defines instructional interactions as follows:

> An instructional interaction is an event that takes place between the learner and the learner's environment. Its purpose it to respond to the learner in a way intended to change his or her behavior toward an educational goal. An instructional interaction is effective when the environmental response changes the learner's behavior toward the goal. Instructional interactions have two purposes: to change learners and to move them toward an action state of goal attainment. (p.8)

Collaborative learning is one differentiated learning strategy than fosters students to search for deeper understanding. Laird, Shoup, Kuh, and Schwarz (2008) identified "that students who use deeper learning strategies, combine a variety of resources, discuss ideas with others, reflect on how individual pieces of information relate to larger constructs or patterns, and apply knowledge in real world situations" (p. 470). Students who are only learning on the surface level, is due to instruction provided by teachers, which resulted in students memorizing, reproducing, and repeating information without

much understanding (Smith, Gordon, Colby, & Wang, 2005). Hill and Woodland (2002) suggested that deep learning is not a one-sided process, but a two-way exchange between effective teaching and receptive learning. "When the students are more active in the learning process, the material becomes more relevant and more significant for them, they remember it better, understand it, and as a result their achievement improve" (Offir, Yev, & Bezalel, 2008, p. 1181).

Technology in Mathematics

Chisholm (1998) asserted that integrating technology in the classroom is important for several reasons: the preparation of children for a technological society, the assurance of equal opportunities and participation in society, the empowerment of human capabilities within all children, especially those of a minority who are currently marginalized. "As we move into the 21st century, the growing variety of technologies that have become available to the general public has changed the way society conceptualizes technology integration, whether at school or for personal uses" (Allsopp, McHatton, & Farmer, 2010, p.57). In the United States, billions of dollars have been invested in purchasing technology-related resources (New Media Consortium, 2014). Computers and their associated technology can revolutionize the way we teach and learn and offer tremendous potential learning. People approach technology with different means, different strengths, and certainly different interests (Guild & Garger, 1998). Technology has great potential to provide greater access to relevant contexts within which to situate the big ideas in mathematics (Allsopp, McHatton, & Farmer, 2010). Students enjoy using technology and it provides an interactive way for students to encounter learning in a fun and new way. Technology tools allow students to organize data, model mathematical

situations, and support calculation work. These functions decrease cognitive load by allowing students to focus more on mathematical reasoning, forming and testing conjectures, and evaluating various mathematical situations (National Council of Teachers for Mathematics, 2011).

Many educational justifications for the use of computers in schools center on the need to prepare students for the information age and life with computers. An integral part of this is that children love to work and play with computers (Yelland, 2002). NCTM (2008) wrote: “With guidance from effective mathematics teachers, students at different levels can use these tools to support and extend mathematical reasoning and sense making, gain access to mathematical content and problem-solving contexts, and enhance computational fluency” (p. 1). From an analysis of thousands of students in the Early Childhood Longitudinal Study found that using technology paired with mathematical reasoning was associated with statistically significant gains in mathematics achievement compared to reasoning without technology (Polly, 2008).

“Prior investigations indicate that instructional gaming can be an effective tool for enhancing both motivation and achievement in the learning of mathematics” (Allen, Jackson, Ross, & White, 1978, p.27). Computer games constitute an important part of young children’s lives out of school, and within school contexts, games are often used to consolidate practice or in order to motivate students to engage with conceptual material or ideas (Yelland, 2002). "To emphasize the equal positions of motivational and cognitive aspects of learning processes in multimedia learning environments, studies have proposed a potential relationship between learners' motivational processing and their mental effort investment" (Mayer, 2001, para. 3). Traditional mathematics curricula

typically use rote procedures that do not improve mathematical understanding and are not motivating to students (Woodward, 2011). Getting students engaged using real-world applications and technology is critical to improve their problem-solving skills and increase their productive dispositions (NRC, 2001). Slow and inaccurate computational skills has serious implications for later learning of higher level mathematical and technological skills essential for the vast majority of jobs in the 21st century (Mautone, DuPaul, & Jitendra, 2005). Academics interventions that alter the classroom environment, such as peer tutoring, task or instructional modifications, and computer-assisted instruction (CAI), may provide the conditions necessary for enhancing the academic performance of children (DuPaul & Eckert, 1998). DuPaul and Eckert (1998) state that computer-assisted instruction is presumably more cost effective than consequence-based interventions, and this is especially useful in general education classrooms where teachers must work with large classes and under difficult time constraints (p. 310). Mautone, DuPaul, and Jitendra (2015) argue:

> Computer Assisted Instruction requires minimal teacher involvement and preparation time. Teachers can adjust the computer software settings to each student's instructional level. Furthermore, many software programs allow the computer to monitor the student's progress and make instructional-level adjustments accordingly. In addition, while the student receives increased opportunities to practice the targeted skill and frequent feedback and progress-monitoring information from the computer, the teacher is free to focus on other students and/or classroom tasks. (pp. 310-311)

Various interactive web sites and mobile device applications allow students to model and create representations of mathematical situations (Arzarello, 2012). Since these representations of mathematical situations are digital, they can easily be manipulated, allowing learners to view multiple representations to compare and analyze in a short period of time (Zbiek, Heid, Blume, & Dick, 2007). Studies have demonstrated that by offering challenges, gameplay can be both enjoyable and motivating, as challenges are almost inherently motivational (Allen, 2007). Baker, D'Mello, Rodrigo, and Graesser (2010) summarize engaged concentration as a state of engagement with a task such that concentration is intense, attention focused, and involvement complete. Technology can support students' task exploration, create dynamic mathematical representations, and model mathematical situations. While concrete manipulatives or pictorial drawings could be used to explore the mathematical content, using technology provides learners with the ability to quickly generate and manipulate mathematical representations (Polly, 2014).

> Researchers of interactive learning environments have grown increasingly interested in designing these systems to become more responsive to differences in students' cognitive-affective states. They believe that the detection of and adaption to student cognition and affect may boost student learning gains and enhance the quality of students' overall learning experience. (Rodrigo, 2011, p.116)

Researchers believe that games that can detect and adapt to changes may become more effective at boosting student learning gains and the quality of students' overall learning experiences (Rodrigo, 2011). We think and understand best when we can imagine a

situation and that prepares us for action. Games present a similar situation through simulation, providing us the opportunity to think, understand, prepare, and execute actions (Gee, 2003). Games are built with clear goals and provide immediate feedback (Dickey, 2005). These games should present players with challenges that are matched to their skill level in order to maximize engagement (Kiili, 2005). "The key is to set the level of difficulty at the point where the learner needs to stretch a bit and can accomplish the task with moderate support" (Jalongo, 2007, p. 401). Gee and Shaffer (2010) state:

> Games require the kind of thinking that we need in the 21st Century because they use actual learning as the basis for assessment. They test not only current knowledge and skills, but also preparation for future learning. They measure 21st Century skills like collaboration, innovation, production, and design by tracking many different kinds of information about a student, over time. (p.3)

Games are frequently cited as important mechanisms for teaching 21st century skills because they can accommodate a wide variety of learning styles within a complex decision-making context (Squire, 2006). Dowker (2004) argued that the use of computers might reduce the impact of emotional communication or motor difficulties: software programs might therefore enhance children's confidence, so long as they do not replace teachers. "Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning" (National Council of Teachers of Mathematics, 2000, p. 11).

Summary

As our nation has become more culturally, ethnically, and linguistically diverse, so has our educational system. Demographers report that by 2020, one in every three

people will be what is now termed a minority (Sobol, 1990). Educators and students are engrossed in conversations about how our one size fits all delivery system-which mandates that everyone learn the same thing at the same time, no matter what their individual needs-has failed them (Sarason, 1990). Through test scores and classroom observation, students are screaming for help in mathematics instruction. The one size fits all classroom is no longer an option for learners to be productive in our global society. Education is facing many changes by having to adapt instructional strategies to better meet the needs of this society now and for the future. Whole group instruction is still a predominant teaching strategy for many classrooms. However, differentiated instruction is causing a shift toward meeting the needs of the individual learners through different instructional methods. There is an intense body of research and published works on traditional lecture style instruction (whole class) and differentiated instruction. The research presented methods utilized in my classroom to facilitate the differentiated instructional strategy: small group instruction, collaborative learning, and online activities. Jointly, the research review stressed the significance of the study, the rationale for the purpose of the study, and provided a theoretical basis for the research question addressed in this study.

CHAPTER 3

Research Design and Methodology

Introduction

This study investigated instructional strategies and the impact that each strategy has on student achievement. The purpose of this quantitative study was to compare instructional strategies with student achievement. The instructional strategies that were used were traditional lecture style (whole class) instruction and differentiated instruction. One group of students received traditional lecture style (whole group) instruction. The other group received differentiated instruction with flexible grouping utilizing, small group instruction, collaborative learning, and online math activities. Both classes will receive mathematics instruction from the My Math Textbook Series, adopted by the Daisy School District. However, the method of differentiated instruction will vary the presentation of instruction to meet the identified strengths and weaknesses of the group of students. The purpose of this study is to investigate which instructional strategy was most effective based on student achievement on a post-test after unit instruction, traditional lecture style instruction (whole class) or differentiated instruction.

Quantitative research is the best choice for this action research study after analyzing the question, purpose of the study, and problem of practice. The identified problem of practice for this Dissertation in Practice (DiP) focuses on the deficit that exists in many public school students who do not demonstrate high levels of mathematics

reasoning as measured by state assessments. Based on the research question, the study will compare the achievement of third grade mathematics classes one with traditional lecture style instruction (whole class) and differentiated instruction. In comparing the achievement of the two groups, the quantitative data will include the pre- and post-test scores from a mathematics assessment. The mathematics assessment will be taken from the My Math Series Assessment Masters, which was adopted by the Daisy School District.

"To have an equal opportunity to pursue success, particularly financial success, citizens need equal access to the skills necessary to that pursuit, and schools are charged with providing everyone with these skills" (Weber, 2010, p 152). Educators today not only have to enable students with basic skills but critical thinking and process skills to utilize not only in school but in their daily lives. Some 21st Century skills that have been identified as important for all learners are critical thinking, communication, collaboration, and creativity (NEA, 2016). These skills are not new to education but tend to be the basis of great teaching. Educators and administrators need to incorporate these skills in classrooms and learning communities around the country.

Instruction today is challenging because it does not begin on the first page of the curriculum guide, but rather where students are in regards to their ability (Tomlinson, 2001). Educators must understand the diverse ability levels of the students in their class to make quality instructional decisions. This understanding allows educators to implement instructional strategies conducive to their students' strengths and weaknesses. Marzano, Pickering, & Pollack (2001) stated that the individual instructional strategies that a teacher uses have a powerful effect on student learning.

The challenge for classrooms and schools is finding the best instructional strategies that meet the needs of the diverse student population. The Daisy School District implemented High Progress Literacy Classrooms in response to Read to Succeed. Teachers rework their daily English Language Arts (ELA) schedule and have arranged use of time so that all students can be highly engaged with text reading and writing at least 75% of classroom instructional time (HPLC Implementation, 2015). Educators' daily schedules reflect the large chunk of instructional time dedicated to reading, writing and research, leaving a small section of time for mathematics instruction.

Research Design and Approach

The participant-researcher utilized a differentiated mathematics instructional program utilizing small group instruction, collaborative group instruction, and online instruction with one classroom. Traditional lecture style instruction was utilized with the other classroom. Both groups received a five-week period of study in preparation for the Post-Assessment. Both groups received instruction from the My Math Series, adopted by the Daisy School District. However, the differentiated instruction was varied in the presentation based on the pre-test analysis of the student's strengths and weaknesses. Quantitative data included Mathematics Pre- and Post-Test scores which were given to students to gage their mathematical problem solving abilities before and after the treatment. The Mathematics test was taken from the My Math Assessment Masters that was adopted by our district for Mathematics Instruction. The test was used to gauge students' skill levels to determine their prior knowledge of the concepts in the chapter. The test scores were also utilized to determine class groupings for differentiated instruction.

Action research is defined as any systematic inquiry conducted by teachers or others with a vested interest in the teaching and learning process or environment for the purpose of gathering information about how their particular schools operate, how they teach, and how their students learn (Mills, 2011). Johnson (2008) stated, action research is characterized as research that is done by teachers for themselves. It is truly a systematic inquiry into one's own practice. "Action research is participative, since educators are integral members- not disinterested outsiders-of the research process" (Mertler, 2014, p. 20). "Action research in not done "to" or "by" other people; it is research done by particular educators, on their own work, with students and colleagues" (Mertler, 2014, p. 21).

Schmuck (1997) stated that the public, fueled by the mass media, has criticized schools for low levels of achievement in math, science, reading, writing, and history. Action Research is an important step for educators to guide the first steps toward school improvement. Because of the continued imposition of more traditional research findings, there is a real need for the increased practice of teacher initiated, classroom-based action research (Mertler, 2014). Action research is a way to examine issues within a school or district. Educators analyze their teaching and learning environments on a daily basis to meet the diverse needs of their students. McMillan (2004) describes action research as being focused on solving a specific classroom or school problem, improving practice, or helping make a decision at a single local site. Action research offers a process by which current practice can be changed toward better practice. This research seems like the appropriate format for my study because of the emphasis that it would eventually have on my teaching. The researcher is hoping to provide insight to the school and district to

facilitate mathematics teaching and learning models that will meet the diverse needs of the student population.

Mills (2011) stated that action research consists of four steps: (a) identifying an area of focus; (b) collecting data; (c) analyzing and interpreting the data; (d) developing a plan of action (p. 12). Action research usually refers to research intended to bring about change of some kind, whereas teacher research quite often has the goal only of examining a teacher' s classroom practice in order to improve it or to better understand what works (Dana & Yendol-Hoppey, 2014). To satisfy the daily questioning educators/researchers bring forth the action research process is used to gather data that can support their action plans. Educators are active in the role of researchers in the learning process. McLean (1995) stated the fact that action research is largely about examining one's own practice, reflection is an integral part of the action research process. Parsons & Brown (2002) stated that in order for teachers to be effective, they must analyze and interpret classroom information-that has been collected in a systematic manner-and then use that information as a basis for future planning and decision making. Mill's work (cited in Mertler, 2014) noted that teachers are encouraged to become continuous, lifelong learners in the classrooms with respect to their practice. This notion is central to the very nature of education-action research encourages teachers to examine the dynamics of their classrooms, critically think about the actions and interactions of students, confirm and challenge existing ideas or practices, and takes risks in the process. Action research is a great way for educators to examine various techniques to meet the needs of their students.

> This quantitative action research study will utilize a group comparative design. The general idea behind group comparison designs is that two or more groups, which differ on some characteristic or have somehow been exposed to different conditions, are compared on a single, common measure in order to see if the differing characteristic or condition may have resulted in different performance. (Mertler, 2014, p. 98)

The initial step of my study included questioning the techniques and procedures that are in use in my classroom, school, and district. Answers to questions of a professional nature often require much more information; however, human nature prompts us to try to find answers to those questions as quickly as possible (Mertler, 2014).

Action research is also a cyclic process- providing educators/researchers the opportunity to continue to build on research. here may never be a clear end to the study- teachers may continue to go through subsequent cycles of planning, acting and observing, developing a new plan, and reflecting, which seemingly spiral from one year into the next (Mertler & Charles, 2011). Many action research projects are completed several times in order to increase findings on a given topic. Most action researchers firmly believe that once through an action research cycle is simply not enough. It is critical to proceed through a number of cycles, where the earlier cycles are used to help inform how to conduct the later cycles (Melrose, 2001). To have a deeper understanding of your topic and research completing the research several times adds credibility to your action research. Bachman's (2001) downward spiral suggests that participants gather information, plan actions, observe and evaluate those actions, and then reflect and plan for a new cycle of the spiral, based on the insights that were gained in the previous cycle.

The purpose of this quantitative study was to compare instructional strategies with student achievement. The instructional strategies that were used were traditional lecture style (whole class) instruction and differentiated instruction. One group of students received traditional lecture style (whole group) instruction. The other group received differentiated instruction with flexible grouping utilizing, small group instruction, collaborative learning, and online math activities. Both classes will receive mathematics instruction from the My Math Textbook Series, adopted by the Daisy School District. However, the method of differentiated instruction will vary the presentation of instruction to meet the identified strengths and weaknesses of the group of students. The purpose of this study is to investigate which instructional strategy was most effective based on student achievement on a post-test after unit instruction, traditional lecture style instruction (whole class) or differentiated instruction

Setting and Participants

Daisy School District, located in Clover, serves a diverse range of students. There are approximately 9,620 students in the district. The District has 20 schools: nine elementary schools, one intermediate school, one charter school, four middle schools, four high schools and one adult education center. Based on Clover's Department of Education Website, Daisy School District received an Absolute Rating of Excellent on the Annual Yearly Progress (AYP) Report Card and a C based on the Federal Accountability Rating System. Based on the South Carolina Palmetto Achievement Test of State Standards (SCPASS) 71% of our students received Met Or Exemplary on the ELA portion of the test. Sunshine Elementary received an overall AYP Report Card Absolute Rating of Average and a C based on the Federal Accountability Rating System.

Based on the SCPASS, 55% of our students received Met or Exemplary on the Mathematics portion of this test. These statistics put us below "Elementary Schools with Student's Like Ours (61%)", meaning Poverty indexes are not 5% below or above. This also places us below "Elementary Schools in the State (76.9%)" in Clover in Mathematics (Clover Annual Report Card Summary, 2014).

Based on Measures of Academic Progress (MAP) for Mathematics students in Sunshine Elementary also show a deficit. In fall of 2014, 45.3% of third grade students, 62.8 % of Fourth grade students, and 39.7% of fifth grade students were Proficient in Mathematics. Based on test scores from these assessments, educators need to evaluate instructional strategies which are most effective in meeting individual students' needs. Diverse student populations make finding effective instructional strategies a challenge faced by many administrators and educators.

Sunshine Elementary is a rural school in Clover. Sunshine Elementary is a Title I school. Title I provides federal funding to schools that have low poverty levels. The funding is meant to help students who are at risk of falling behind academically (Meador, 2015). Poverty rates for rural families are higher across all categories and more enduring than their urban counterparts. Rural African American families and their children are not empowered by the educational system or provided educational services in a culturally sensitive context (Kea, 2009). Sunshine Elementary has an 89% Free/Reduced Lunch Status. Farrigan and Parker (2012) stated in the United States, people living in poverty tend to be clustered in certain regions, counties and neighborhoods rather than being spread equally around the Nation. "Rural children are less likely than non-rural children to be in center-based care other than Head Start during the pre-kindergarten year" (Kea,

2009, p.14). Students at Sunshine come to school exhibiting deficits because of the poverty level and lack of pre-kindergarten experience.

Sunshine Elementary is the school where I am a third grade teacher. The differentiated instruction group (N=13) were my third grade students, who were assigned prior to the beginning of the study. The traditional lecture style instruction group (N=15) were from a team member's class of third grade students, who were assigned prior to the beginning of the study. The student's in this study were third grade students with comparable socioeconomics demographics. Based on school wide mathematics PASS and MAP data, the students are not making significant gains in mathematics.

In conducting action research, the educator/researcher made sure to receive consent from the parents and students prior to beginning the research. Prior to action research, the parent of the participants received a parental consent form (Appendix A). According to Mertler (2014), parental consent form describes what the study is about and what the participants will be asked to do. The participants also received an assent form that is equitable to their reading level to describe the study and their responsibilities (Appendix B).

Mertler (2014) states that ethical treatment of students, colleagues, and data must be a key component of the design of action research. As an educator-researcher, it is important to make sure that the rights of the research participants are protected at all times. To protect the anonymity of the participants, the name of the school has been changed to a pseudonym. In addition, each participant has been assigned a number. The number and participant name list will be kept in a locked cabinet in the educator-researcher's room.

The researcher understands the ethical responsibility towards the participants. The participants were a part of the review of data from the pre-test. The researcher and participants discussed strengths and challenges to better meet the differentiated mathematics curriculum. In better understanding the individual strengths and weaknesses of each individual, the researcher utilized the data to build stronger differentiated learning groups. The participants felt a part of the action research plan and should know their part in promoting their strengths and building on their challenges.

Data Collection

The participant-researcher contacted the Superintendent of the Daisy School District prior to the study to discuss the purpose, question, and action plan for the study. The school principal was also contacted in person to discuss all details of the research study. The researcher designed a way to code the participants to insure accurate data were anonymously gathered from the third grade participants. The two third grade classes were assigned a letter, and each student was assigned a number. The letter and number code insured the confidentiality of the classes and students. The pre-test was administered prior to beginning the instructional unit and administered again after the instructional unit, with a five week period between the two administrations. The researcher recorded all test scores on a spreadsheet using the designated codes for the participants. A pre-test and post-test were administered to determine students' mathematical abilities before and after the intervention. The 15 question test provided several multiple choice questions that helped to gauge students' skill level based on each standard to determine the student's prior knowledge prior to starting the instructional unit. The pre- and posttest identified students' strengths and weaknesses before and after the instructional unit. The

posttest provided a measure of what the students had learned: a summary of student performance, and mastery of standards.

The materials for the study consisted of the third grade My Math textbook that was published by McGraw Hill for the class receiving whole group instruction. The group receiving differentiated instruction also used the My Math textbook, manipulatives, laptops, games, and activities. Data was collected by the participant researcher. All data was collected on site and over a five-week interval.

Data Analysis and Reflection

The purpose of collecting data was to determine if students receiving differentiated instruction are different in terms of their math achievement test scores than students receiving traditional lecture style (whole class) instruction. The independent *t*-test was used to determine if the post-test means are significantly different. The *t*-test determined whether the observed difference was sufficiently larger than would be expected solely by chance. The independent *t*-test was used because the members from each class were not related. The *t*-test for independent samples was used to determine whether there was a significant difference between mathematics scores for students in differentiated instruction compared to students in traditional lecture style (whole group) instruction.

Summary

Chapter 3 clarifies the purpose and goal of the study and the appropriateness of the comparative research design. This discussion explains why the quantitative method is selected for the purpose of this study. This chapter describes the population and the setting of the action research study, as an elementary school in a rural area. The purpose

of the study was to compare the mathematics achievement of two groups: one receiving differentiated instruction and the other traditional lecture style (whole group) instruction.

A pretest was given prior to the instructional unit, a posttest was administered after instruction, with an interval of five weeks. Chapter 3 includes a discussion of the procedures to conduct the study, collecting information, and analyzing the data. Chapter 4 presents and analyzes the data from the quantitative study. Chapter 5 presents a summary, conclusion, and recommendations for future research.

CHAPTER 4

Findings and Interpretations of Results

Introduction

The purpose of this quantitative study was to compare the achievement of two third grade mathematics classrooms; one with differentiated pedagogy and one with traditional pedagogy. This chapter presents the results of the data collected from the Pre- and Post-test for Unit One in the My Math Mathematics Series adopted by the School District. The findings relate to the research question that guided the study. Educators and administrators cannot change the environment that students are born into, but we can change a student's life by providing the best education possible. It is important that as teachers and administrators, we focus on the points of instruction that we can change. "It is clear that when teachers and administrators focus on things they can control, such as instructional strategies, opposed to things outside of their control, such as socioeconomic status and demographic factors, students perform better" (Clayton, 2011, p.682). Katz and Porath (2011) argued that for all students to learn, students must be recognized as having diverse needs, and a classroom created that allows all students to learn and develop a sense of belonging. The heart of instruction has to focus on meeting the diverse needs of the students not teaching the standards and teaching to the test.

"Differentiation provides one method by which teachers can provide appropriate at challenge at appropriate levels for all learners in a heterogeneously grouped

mathematics classroom where the range of abilities and interests can be wide" (Reed, 2004, p. 8). Differentiated math instruction based on student readiness meets the needs of students who are below grade level, as well as those that exceed benchmarks. When applied correctly, differentiated instruction in mathematics ensures student success (Grimes & Slavin, 2009).

Using a more diverse technique for delivering mathematics instruction allows students the opportunity to build their knowledge by engaging in multiple mathematic activities. "Basic skills with numbers continue to be vitally important for everyday uses. They also provide a crucial foundation for the higher-level mathematics essential for success in the workplace which must now also be part of a basic education" (Ball et.al, 2005, p. 1056).

The participant-researcher utilized a differentiated mathematics instructional program utilizing small group instruction, collaborative group instruction, and online instruction with one classroom. Traditional lecture style instruction was utilized with the other classroom. Both groups received a five-week period of study in preparation for the Post-Assessment. Both groups received instruction from the My Math Series, adopted by the Daisy School District. However, the differentiated instruction was varied in the presentation based on the pre-test analysis of the student's strengths and weaknesses. Quantitative data included Mathematics Pre- and Post-Test scores which were given to students to gage their mathematical problem solving abilities before and after the treatment. The Mathematics test was taken from the My Math Assessment Masters that was adopted by our district for Mathematics Instruction. The test was used to gauge students' skill levels to determine their prior knowledge of the concepts in the

chapter. The test scores were also utilized to determine class groupings for differentiated instruction. The pre- and post-test data helped the participant-researcher to gain a more in depth understanding of the students' mathematical problem solving abilities. The research findings that this chapter reports are based on analysis of the pre- and post-test data for the two grade three mathematics classrooms.

Research Topic

This study examined promoting higher achievement in third grade students utilizing differentiated mathematics instruction compared to traditional lecture style instruction. This is a quantitative action research study and data was collected using pre- and post-mathematics assessment scores.

Problem of Practice

The Problem of Practice for the action research study involves two rural, third grade mathematics classrooms, where students were showing deficits in mathematical reasoning. In particular, my school showed a deficit in our students' mathematics test scores when compared to other students in the State of Clover. My district is interested in enabling students to be engaged in reading, writing, and research for seventy five percent of their school day. However mathematics has to be kept within a small block of time. This small amount of time requires teachers to make the most of the instructional time to provide effective mathematics instruction. This information led me to look at an intervention method to enable other educators in my school/district to utilize differentiated mathematics instruction as a way to promote higher achievement in mathematics students.

Purpose of Action Research

The specific purpose of this quantitative study was to examine the utilization of small group instruction, collaborative groups, and the use of online games/activities as a framework to differentiate the learning of third grade math students. The post-test data was analyzed to determine if there was a statistically significant difference in the achievement of third grade students taught by differentiated instruction or traditional lecture style instruction. Sunshine Elementary School shows a deficit in our students' mathematics test scores when compared to other students in the State of Clover. The action research attempted to determine if a differentiated instructional model compared to the traditional lecture-style instructional model strengthened student achievement in two third grade groups during the fall semester by utilizing a pre- and post-test for mathematics.

Research Question

What is the difference in mathematics achievement in third grade students who have received differentiated mathematics instruction when compared to third grade students who received traditional mathematics instruction?

Action Research Data Collection Plan

A pre-test and post-test was administered to determine students' mathematical abilities before and after the mathematics instructional unit. The instructional unit was Unit 1 in the My Math, Third Grade Edition, which covered Place Value, Writing Multi-Digit Numbers, Compare and Order Numbers, and Rounding. The 15 question test

provided several multiple choice questions that helped to gauge students' skill levels on each standard to determine their prior knowledge of concepts addressed in the chapter.

The Pre-test/Post-test is located in Appendix C. The data was also used to determine grouping of students for differentiated instruction in the intervention class. The My Math Series has a Diagnose and Prescribe section that the participant-researcher utilized in determining grouping for differentiated instruction. The Diagnose and Prescribe chart provided leveled intervention recommendations that helped to address individual needs as new skills and concepts were presented in the chapter. The pre- and post-test responses helped identify students' strengths and weaknesses that helped to provide ongoing support during the instructional unit.

Quantitative Data

The third grade students in both classes at Sunshine Elementary School received the pre-test for the mathematics series, My Math, which is included in the teacher's edition for third grade. The differentiated instructional group of third graders received instruction through a differentiated mathematics instructional model utilizing small group instruction led by the participant-researcher, collaborative groups, and online/game activities during mathematics instruction. The participant-researcher used the small group instructional time to support the ongoing needs of the students based on their performance on the pre-test. The My Math Series provides differentiated instructional strategies in each lesson to help meet individual learning needs. The Differentiated Instructional suggestions were separated into Approaching Level, On Level, and Beyond Level activities based on the results from the pre-test for the chapter. The My Math Series also suggested problems during each lesson that would best meet the needs of each of the

learning groups. Collaborative groups were used for students to work with partners or their group on a game or activity that was based on the lesson or chapter. The online game activities were also tied to the skills and concepts addressed in the lesson or chapter. This allowed students multiple opportunities to practice concepts on a daily basis. The traditional lecture group of third grade students received instruction through a traditional lecture-style instructional model, using the My Math series. At the end of the five-week mathematics instructional unit, each class took the post-test. The scores on both the Mathematics Pre- and Post-Test were compared using an independent t-test to evaluate the differences of mean scores of the third grade students based on their instructional model.

Overview of Data Collection

Action research is defined as any systematic inquiry conducted by teachers, or others with a vested interest in the teaching and learning process or environment for the purpose of gathering information about how their particular schools operate, how they teach, and how their student's learn (Mills, 2011). This research was an appropriate format for my study because of the emphasis that it would eventually have on my teaching. The researcher will help to provide insight to the school and district to facilitate mathematics teaching and learning models that will meet the diverse needs of the student population. Action research allows teachers to study their own classrooms, in order to better understand them and to be able to improve their quality or effectiveness. It focuses on the unique characteristics of the population with whom the action must be taken. This in turn increases the effectiveness for the practitioner (Parsons & Brown, 2002). Educators must be willing to step up and find the best practices that work for their

classrooms. Making sure that each classroom is different and that the differences reflect the individual needs of the students within. “True school improvement must begin within the four walls of the classroom. Teachers must be able and willing to critically examine their own practice as well as how their students learn best” (Mertler, 2014, p. 12).

Schmuck (1997) stated that the public, fueled by the mass media, has criticized schools for low levels of achievement in math, science, reading, writing, and history. Action Research is an important step for educators to guide the first steps toward school improvement. Because of the continued imposition of more traditional research findings, there is a real need for the increased practice of teacher initiated, classroom-based action research (Mertler, 2014). Action research is a way to examine issues within a school or district. Educators analyze their teaching and learning environments on a daily basis to meet the diverse needs of their students. McMillan (2004) describes action research as being focused on solving a specific classroom or school problem, improving practice, or helping make a decision at a single local site. Action research offers a process by which current practice can be changed toward better practice. The researcher will provide quantitative data from the action research study to determine if a differentiated instructional method impacts student achievement more than the traditional lecture style method.

Ethical Research Action Plan

In conducting action research, the educator/researcher made sure to receive consent from the parents and students prior to beginning the research. Prior to action research, the parent of the participants received a parental consent form (Appendix A). According to Mertler (2014), parental consent form describes what the study is about and

what the participants will be asked to do. The participants also received an assent form that is equitable to their reading level to describe the study and their responsibilities (Appendix B).

Mertler (2014) states that ethical treatment of students, colleagues, and data, must be a key component of the design of action research. As an educator-researcher, it is important to make sure that the rights of the research participants are protected at all times. To protect the anonymity of the participants, the name of the school has been changed to a pseudonym. In addition, each participant has been assigned a number. The number and participant name list will be kept in a locked cabinet in the educator-researcher's room.

The researcher understands the ethical responsibility towards the participants. The participants were a part of the review of data from the pre-test. The researcher and participants discussed strengths and challenges to better meet the differentiated mathematics curriculum. In better understanding the individual strengths and weaknesses of each individual, the researcher utilized the data to build stronger differentiated learning groups. The participants felt a part of the action research plan and should know their part in promoting their strengths and building on their challenges.

Findings of the Study

The My Math Chapter 1 Pre-test and Post-test data were analyzed by performing an independent *t*-test. The Statistical Program for Social Sciences (SPSS) was used to analyze the data for the Pre- and Post-test to compare the achievement of the two third grade mathematics classes. Descriptive Statistics are appropriate for comparing outcomes

of two classes. The *t*-test for two independent samples were used to determine statistical difference of the mean math scores concerning mathematical achievement for groups receiving traditional instruction and differentiated instruction.

All students' pre-test and post-test scores for the mathematical assessment are shown in Appendix C. The differentiated instruction group (N=13) was associated with a pretest score *M*=56.92 (*SD*=20.35) and post-test score *M*=84.15 (*SD*=12.20). By comparison, the traditional lecture style group (N=15) was associated with a pre-test score of *M*=56.40 (*SD*=19.30) and post-test score *M*=82.00 (*SD=11.10)*. Based on the post-test means data, the third grade students who received differentiated mathematics was 2.15 (*SE= 4.40)* higher than the third grade students who received traditional mathematics instruction. The test revealed there was no statistically significant difference in mathematics achievement for third grade students who received differentiated instruction or traditional instruction (t= 0.49, df = 26, p > .005). Table 4.1 shows the two classes' average mean scores from the pre-test and post-test. In addition, it shows the average difference between the two groups. The assumption of homogeneity of variances was tested and satisfied via Levene's *F* test, *F*= .000, p=.998. See Table 4.2 for Levene's Test.

Table 4.1*Math Chapter 1 Assessment Results*

Group	Pretest Score- *SD*	Posttest Score-*SD*	Difference
Differentiated Instruction (N=13)	56.92- 20.35	84.15- 12.20	+27.23
Traditional Instruction (N=15)	56.40-19.30	82.00- 11.10	+25.60

Table 4.2 *Levene's Test for Equality of Variances*

Pretest Data	F	Sig.
Equal Variances Assumed	.000	.998
Equal Variances Not Assumed		

Interpretations of Results of the Study

Thus, the test revealed that there were not statistically significant differences among mathematics scores (achievement) and the type of instructional pedagogy in which the students participated.

Conclusions

The purpose of this action research study was to examine the effects of differentiated mathematics instruction and traditional lecture style instruction on two third grade mathematics classes. To fulfill these purposes, the study utilized an

independent *t*-test comparing pre- and post-test scores for mathematics. The *t*-test was used to identify statistical differences among variables. The assumption of homogeneity of variances was tested and satisfied via Levene's *F* test, *F*= .000, p=.998. See Table 2 for Levene's Test. The participant-researcher utilized a differentiated mathematics instructional strategy of small group instruction, collaborative group instruction, and online instruction with one classroom and traditional lecture style pedagogy with the other classroom over a five-week period in preparation for a Post-Assessment. Quantitative data included Mathematics Pre- and Post-Tests which were given to students to gage their mathematical problem solving abilities before and after the comparison study. The pre- and post-test data helped the participant-researcher to gain a more in depth understanding of the student's mathematical problem solving abilities. There was no statistically significant difference among mathematics score (achievement) gains and the type of instructional pedagogy in which the students participate.

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CHAPTER 5

Summary and Discussion

Introduction

The purpose of my action research study was to examine the effects of differentiated mathematics instruction and traditional lecture style instruction on third grade mathematics students. The research question that guided this study: What is the difference in mathematics achievement in third grade students who have received differentiated mathematics instruction when compared to third grade students who received traditional mathematics instruction? The research question was addressed in this research study.

The research design with regard to the third grade students utilized quantitative analysis techniques. Data consisted of pretest and post-test scores from the My Math Chapter 1 Form 1A Assessment. All scores were used to analyze student mathematical achievement. The chapter assessment analyzed standard form, expanded form, written form, place value, comparing numbers and rounding. The pre- and post-test data was analyzed using an independent *t*-test.

Focus of the Study

The purpose of this quantitative study was to compare instructional strategies and their effectiveness in mathematics achievement of third grade students. The quantitative study was designed to determine the impact that varied pedagogical methods have on

Mathematics' abilities of third grade students in a rural school setting. The researcher investigated and compared how a math class of third grade students performed when receiving differentiated instruction. The comparison group was from another class that received traditional lecture style instruction.

The researcher utilized small group instruction, collaborative groups, and the use of online games/activities as instructional tools to facilitate differentiated instruction. Sunshine Elementary School shows a deficit in our students' mathematics test scores when compared to other students in the State of Clover. The action research attempted to determine if a differentiated instructional model compared to the traditional lecture-style instructional model strengthens student achievement in third grade students during the fall semester by utilizing a pre- and post-test for mathematics.

Overview of the Study

Instruction today is challenging because it does not begin on the first page of the curriculum guide, but rather with, where the students are in regards to ability (Tomlinson, 2001). The No Child Left Behind Act (2001) has created the need for an aggressive look at classroom instruction and its effect on student achievement. It is critically important that educators investigate and evaluate instructional strategies that are dominating the education arena.

Katz & Porath (2011) argued that for all students to learn, students must be recognized as having diverse needs, and a classroom created that allows all students to learn and develop a sense of belonging. Although educators are bound by the mandated state standards as to the skills and topics to teach, the learning strategies that are implemented in classes are not dictated. Good mathematics instruction engages all

students as active learners (NAEYC & NCTM, 2002). Based on school wide mathematics PASS & MAP data, the students were not making significant gains in mathematics. Students who are taught through differentiated methods not only learn mathematics effectively, but they also become motivated students who view themselves as successful mathematicians (Lawrence-Brown, 2004).

Summary of the Study

The pre-test and post-test was used to answer the question: What are the differences in student achievement levels in mathematics between students taught with differentiated instruction and students taught with traditional lecture style instruction? In the pretest, the group receiving differentiated instruction had a statistical mean of 56.92. The group receiving traditional lecture style instruction had a statistical mean of 56.40. Based on the pre-test scores, the class receiving differentiated instruction showed a slightly higher score of 0.52. The original pre-test was given as the post-test at the end of the five-week instructional unit. The mean score of the group receiving differentiated instruction increased to a mean score of 84.15. The mean score increased by 27.23. The mean score of the group receiving traditional lecture style instruction increased to a mean score of 82.00. The mean score increased by 25.60. There was a difference (2.15) in the score increase of the group receiving differentiated instruction and the class receiving traditional lecture style instruction. However, the test revealed there was no statistically significant difference in mathematics achievement for third grade students who received differentiated instruction or traditional instruction (t= 0.49, df = 26, p > .005).

Implications of the Findings

This study examines differentiated instruction as it relates to mathematics achievement in third grade students. The study has implications for educational change because it can add to the discussion of providing professional development for differentiated instruction to assist in the challenges of meeting the needs of diverse learners. Findings of the action research study will be shared with the administration team and the school district to provide opportunities to enhance the instructional methods for teaching across grade levels. Even though there was not a statistically significant difference associated with the differentiated instructional pedagogy, this is a great instructional strategy to better meet the diverse needs of students through analyzing formative data.

After analyzing the action research data, the participant researcher was able to formulate an action plan. This action plan was designed to assist school staff members in future planning for staff development. Most importantly, this action plan provides staff members with continued support throughout the school year to improve consistency in differentiated instruction across the school. Utilizing differentiated instruction is a way to better meet the needs of all learners and provide them with an opportunity for success. Providing better instructional strategies in mathematics could lead to higher achievement in mathematics and other subjects in the elementary level, ultimately leading to higher achievement in high school, college, and careers.

Action Plan Development

The purpose of my action research study was to examine the effects of differentiated mathematics instruction and traditional lecture style instruction on third

grade mathematics students. The curriculum in schools have become standards based, which means all students are expected to achieve equally and meet high standards despite their varied abilities. Educators are therefore challenged to meet the diverse needs of the student populations. The only way to meet the objective of the standards based curriculum is to personalize or differentiate the instruction (Lawrence-Brown, 2004), Educators must face the challenges of changing from traditional lecture style instruction to instructional methods that meet the diverse needs of their students.

Educators and administrators cannot change the environment that students are born into, but we can change a student's life by providing the best education possible. It is important that as educators and administrators, we emphasize instructional strategies that will produce learners who are productive citizens. "It is clear that when teachers and administrators focus on things they can control, such as instructional strategies, opposed to things outside of their control, such as socioeconomic status and demographic factors, students perform better" (Clayton, 2011, p. 681). Katz & Porath (2011) argued that for all students to learn, students must be recognized as having diverse needs, and a classroom that allows all students to learn and develop a sense of belonging. The heart of instruction has to focus on meeting the diverse needs of the students not teaching the standards and teaching to the test.

School districts, utilizing administrators and Reading coaches, should provide goals and expectations for implementing differentiated instruction in the classroom. Professional development and ongoing support should be implemented by summer 2017 to ensure that differentiated instruction is being implemented effectively. Tomlinson (2000) stated that differentiated instruction can be accomplished through many different

instructional strategies. Regardless, of the strategies that teachers implement within their classrooms, providing a more differentiated instructional method will provide more efficient instruction for all learners. Administrators and Reading coaches, should provide any extra help or modeling of lessons to help make educators more comfortable implementing a range of instructional strategies. Differentiated instruction can be utilized to improve academic achievement, but educators and administrators are going to have to make a commitment to the time, training, and effort needed to for implementation.

Action Plan Timeline

The first step in the action plan would be to collaborate with teachers, the reading coach, and administrators to define roles and responsibilities for educators utilizing differentiated instruction. Educators will receive professional development on the differentiated instruction framework, language, and instructional strategies, roles of the teacher and students, and responsibilities that go along with successfully implementing differentiated instruction in their classrooms. The reading coach would help the participant researcher in the professional development sessions on differentiated instruction by promoting the vision for the school, teachers, and students. The second component of professional development is to provide training for teachers to analyze student data to analyze student's strengths and weaknesses. The teachers can then utilize the data to make informed instructional decisions to better implement differentiated instruction. The participant researcher suggests that at least one Professional Learning Team (PLT) meeting each month should be utilized to provide comprehensive grade level specific support with differentiated instruction. The PLT meeting would be a team-

oriented approach to implementing, improving teaching techniques, reviewing new data, and assessing best practices used in differentiated instruction. In addition, a ½ day Wednesday Professional Development should be devoted to differentiated instruction to support and monitor teacher implementation. This professional development would be utilized to introduce flexible grouping strategies, different teaching strategies utilized in a differentiated classroom, and continued support to the importance of making differentiated instruction a part of each classroom's instruction.

This action plan was developed with the intent that professional development would begin during the first days of school for the teachers in August, 2017. This would allow teachers to begin the year utilizing strategies to help their students get used to the differentiated classroom. Once the students have their Pre-tests or beginning of the year baseline data recorded, professional development in September, can focus on analyzing student data. Utilizing a ½ day Wednesday, Professional Development session would allow educators to make better informed decisions for their differentiated instructional classrooms. To foster an environment of team-oriented support, one PLT meeting a month should be utilized for teams to share ideas, concerns, and strategies that are working in their classrooms. To share the continued vision and importance of differentiated instruction to the school, one Wednesday professional development (½ day) would continue to provide support in creating and sustaining differentiated classrooms.

Table 5.1 *Action Plan Implementation Timeline*

Initiative	**Action to be Taken**	**Outcome**	**Completion Date**	**Personnel Involved**
Adopt a common framework, definition, and language for differentiated instruction across the school	Collaborate with teachers, coaches, and administrators to define roles and responsibilities for educators in differentiated instruction.	Educators will increase understanding of differentiated instruction framework, language, roles, and responsibilities through all curriculum areas in a two day workshop.	August 2017- Two Professional Development Days	Participant Researcher/ Reading Coach Teachers/Assistants
Staff will utilize student data to make informed instructional decisions to better encompass the strengths and weaknesses of their class through differentiated instruction	Provide training for teachers to analyze student data to make informed instructional decisions for differentiated instruction.	Educators will strengthen their understanding of how to read, translate, and use data in the implementation of differentiated instruction.	September 2017- ½ Day Wednesday	Participant Researcher/ Reading Coach Teachers
Collaborative grade level meetings – Professional Learning Team (PLT) to implement comprehensive, on-going, professional development to support differentiated instruction.	Use a team-oriented approach to improve differentiated instruction in classrooms Reflect on progress of implementing differentiated instruction Review new data Introduce and review best practices used in differentiated instruction.	Equip educators with strategies and tools to plan instruction to meet learning goals of their student's changing needs to maximize the potential for and quality of differentiation.	First Tuesday of Each Month- PLT Meetings during Planning Period 2017-2018	Participant Researcher/ Reading Coach/ Administrator/ Teachers
Support and monitor teacher growth and progress toward individual teacher's professional goals for creating and sustaining differentiated classrooms.	Use ½ day Wednesdays for Professional Development related to differentiated instruction.	Educators will continue to improve understanding, teaching strategies, analyzing ongoing assessment data, flexible grouping strategies, and quality professional support to improve consistency in differentiated instruction across the school.	2nd Wednesday of Each Month- ½ day Professional Development 2017-2018	Participant Researcher, Reading Coach, Teachers

Suggestions for Future Research

Based on the finding of this study, recommendations for future research that might further inform the processes for improving students' development of mathematics achievement.

1. Analyze student data beyond just one chapter, possibly a year to evaluate if there is stronger difference with an extended amount of time.
2. Further research is needed to determine how teachers feel about using differentiated instruction.
3. Replicating the study to include other subject areas, grade levels, and ethnicities to provide more data on the effectiveness of differentiated instruction in meeting the needs of all diverse learners.
4. Implementing other methods (qualitative) to address the effectiveness of differentiated instruction.
5. Further research is needed to see if teacher knowledge on differentiated instruction would impact student achievement.

Conclusions

The purpose of this action research study was to evaluate the relationship between two third grade mathematics classroom; one with differentiated pedagogy and other with traditional pedagogy. To fulfill these purposes, the study tested the hypothesis utilizing an independent *t*-test. The *t*-test was used to identify statistical differences among variables. The participant-researcher utilized a differentiated mathematics instructional strategy of small group instruction, collaborative group instruction, and online instruction with

one classroom and traditional lecture style pedagogy with the other classroom over a five week period in preparation for a Post-Assessment. Quantitative data included Mathematics Pre- and Post-Test scores which were given to students to gage their mathematical problem solving abilities before and after the comparison study. The pre- and post-test data helped the participant-researcher to gain a more in depth understanding of the student's mathematical problem solving abilities. There was no significant difference among mathematics scores (achievement) and the type of instructional pedagogy in which the students participated

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Appendix A

Informed Consent

Dear Parents/Guardians,

My name is Melinda Cannon. I am a doctoral candidate in the Education Department at the University of South Carolina. I am conducting a research study as part of the requirements of my degree in Curriculum and Instruction, and I would like to invite you to participate. This study is sponsored by myself.

I am studying Differentiated Mathematics Instruction in Fourth Grade students. If you decide to allow your child to participate, your child will be asked to participate in daily mathematics instruction in their regular classroom. Participation is confidential. Study information will be kept in a secure location. The results of the study may be published or presented at professional meetings, but your identity will not be revealed.

Taking part in the study is your decision. You do not have to be in this study if you do not want to. You may also quit being in the study at any time. Participation, non-participation, or withdrawal will not affect grades in any way.

We will be happy to answer any questions you have about the study. You may contact me at 843-527-4411 and/or mcannon@gcsd.k12.sc.us if you have study related questions or problems. If you have any questions about your rights as a research participant, you may contact the Office of Research Compliance at the University of South Carolina at 803-777-7085.

Thank you for your consideration. If you would like your child to participate, please complete the following page and return to me.

With kind regards

Melinda Cannon
69 Woodland Avenue
843-527-4411
mcannon@gcsd.k12.sc.us

letter continues

My child, _____, has permission to participate in the action research study by Melinda Cannon. I realize that all my child's information will be kept confidential. I also have the right to withdraw my child from the study at any point without negative effects. In signing below, I give my child permission to participate in the study.

Signature Date

Appendix B

Assent To Be A Research Subject

I am a researcher from the University of South Carolina. I am working on a study about differentiated mathematics instruction and I would like your help. I am interested in learning more about mathematics being taught in a more diverse way. Your parent/guardian has already said it is okay for you to be in the study, but it is up to you.

If you want to be in the study, you will be asked to do the following

Take a Mathematics pre-test and post-test

Talk with me individually about your strengths and weaknesses in mathematics.

Any information you share with us will be private. No one except me will know what your answers to the questions will be.

You don't have to help with this study. Being in this study isn't related to your regular classwork and won't help or hurt your grades. You can also drop out of the study at any time, for any reason, and you won't be in any trouble and no one will be made at you.

Please ask any question you would like to.

Signing your name below means you have read the information about the study, (or it has been read to your), that any questions you may had have been answered, and you have decided to be in the study. You can still stop being in the study any time you want to.

_____ _____

Printed Name of Minor Age

_____ _____

Signature of Minor Date

Appendix C

Test Results

Name	Standard Form	Expanding Form	Value	Written Form	Least to Greatest	Greatest to Least	Rounding	Pre-test	Post-test
A1					x	x	x	67	80
A2	x		x		x	x	x	60	93
A3	x	x			x	x	x	53	80
A4			x		x	x	x	67	93
A5		x	x		x	x	x	60	87
A6					x	x	x	67	93
A7	x	x		x	x	x	x	33	80
A8					x	x	x	80	87

table continues

Name	Standard Form	Expanding Form	Value	Written Form	Least to Greatest	Greatest to Least	Rounding	Pre-test	Post-test
A9	x				x	x	x	80	87
A10	x	x	x	x	x	x	x	20	87
A11					x	x	x	73	93
A12	x	x	x	x	x	x	x	20	47
A13	x				x	x	x	60	87
B1	x	x	x	x	x	x	WP	33	76
B2					x	x	x	60	94
B3		x	x	x	x	x	x	27	88
B4							X(H)	93	100
B5	x	x		x	x	x	x	47	76

table continues

Name	Standard Form	Expanding Form	Value	Written Form	Least to Greatest	Greatest to Least	Rounding	Pre-test	Post-test
B6	x	x	x		x	x	x	47	80
B7	x				x	x	x	60	70
B8			x		x		x	73	80
B9						x	x	73	100
B10					x	x	x	73	93
B11		x	x	x	x	x	x	60	70
B12		x	x		x		x	60	76
B13					x	x	x	73	88
B14	x	x	x	x	x	x	x	27	64
B15		x	x		x	x	x	40	76