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Accelerated Mathematics and High-Ability Students Math Achievement in Grades Three and Four.

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Accelerated Mathematics and High-Ability Students' Math Achievement in Grades Three and Four

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by

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ABSTRACT

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The purpose of this study was to explore the relationship between the use of a computer-managed integrated learning system entitled Accelerated Math (AM) as a supplement to traditional mathematics instruction on achievement as measured by TerraNova achievement tests of third and fourth grade high-ability students. Gender, socioeconomic status, and grade level were also considered. The population consisted of 624 students who were third and fourth grade high-ability students during the 2009-2010 school year. Data were gathered that covered a 1-year period for high-ability third and fourth graders. A series of independent samples *t*-tests were used to identify relationship among variables.

The researcher's investigation of the relationship between AM and mathematics achievement might assist educators in planning for use of technology as a supplement to the normal mathematics curriculum. The findings indicated measurable differences in the performance of high-ability third and fourth grade students who qualified for free and reduced priced lunch and participated in AM compared to high-ability students who qualified for free and reduced priced lunch and did not participate in the program. High-ability students who participated in the AM program and who qualified for free and reduced lunch scored significantly higher on the TerraNova math achievement test than students who did not participate in AM and who qualified for free and reduced lunch. There were also measurable differences in the performance of high-

ability fourth grade students who participated in the AM program compared to those who did not participate in the program. Fourth grade high-ability students who participated in the AM program scored significantly higher on the TerraNova math achievement test than fourth grade students who did not participate in the program. This study indicated no significant findings among gender, students in grade 3, and students who did not qualify for free and reduced price lunch who did and did not participate in the AM program.

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CHAPTER 1

INTRODUCTION

Many educators would agree that math is a critical skill students need to be able to master in the 21st century in order to become successful in our society. Math and technology are both important concepts educators need to focus on as they teach students in schools. Technology, when implemented correctly, can highly benefit students as they learn their math curriculum for the school year (Bielefeldt, 2005).

Technology has played an important role in our federal government's curriculum and assessment mandates since the 1957 Russian launching of Sputnik. Scanlon (1998) noted that shortly after passing the *National Defense Education Act*, legislators started encouraging mathematics and science instruction more than before. In the middle of the 20th century after Sputnik political leaders were afraid that the United States was falling behind other countries in math and science after. Assessment and accountability eventually became crucial parts of the government's attempt to monitor and regulate math and science progress (Scanlon, 1998). As a result of government involvement in the form of more rigorous accountability measures, schools started being evaluated by standardized test scores (Scanlon, 1998). This trend continues today with the passing of the *No Child Left Behind Act* (NCLB) and the *Race to the Top* (RTTT) grant, both of which emphasize student achievement. Since NCLB was passed in 2001, proficiency on achievement tests is stressed even more in our schools by administrators, school board members, and superintendents as well as many other various stakeholders (Espinosa, Laffey, Whitaker, & Sheng, 2010). A significant amount of pressure is placed on educators to make certain all students are proficient or above proficient on achievement tests each year. Nationally, students of all ability levels must make significant gains on the *TerraNova* achievement test from year to year or the school's Report Card for that particular year will be affected negatively (Barlow, 2005).

Race to the Top funding was implemented as a competitive grant program designed to encourage and reward states that created conditions for education innovation and reform, achieved significant improvement in student outcomes which includes making substantial gains in student achievement, closed achievement gaps, improved high school graduation rates, and ensured student preparation for success in college and careers (Learning Point Associates, 2010). States have the opportunity to receive significant funding if they implement ambitious plans in the following four educational reform areas:

1. Adopt standards and assessments that prepare students to succeed in college and in the workplace
2. Build data systems that measure student growth and success and inform teachers and principals how they can improve instruction
3. Recruit development of rewards and retaining effective teachers and principals
4. Turn around the lowest-achieving schools (Learning Point Associates, 2010, p. 7).

In March 2010 the United States Department of Education awarded Delaware and Tennessee grants in order to improve their comprehensive school reform plans. The grant awarded $100 million to Delaware and $500 million to Tennessee, which will be distributed over 4 years (Learning Point Associates, 2010). These states have the opportunity to use grant money awarded to them to promote student achievement in ways they may not have been able to afford in previous school years.

As the 2010 school year ended, Americans have been encouraged by federal, state, and local efforts to transform educational policies that boost student performance (Learning Point Associates, 2010). However some stakeholders in education believe that reauthorization of NCLB will be necessary to support long-term reform and accountability goals for student outcomes and improvement in order to fully work with the Race to the Top funding (Alliance for Excellent Education, 2010). Alliance for Excellent Education recommends that NCLB be revised because it currently has inconsistent accountability goals and measures that send mixed signals to educators and parents. While NCLB presently prioritizes the lowest-performing schools, too many low-performing schools have not received enough financial support. Also, there is limited accountability for the states' implementation of NCLB requirements. NCLB accountability framework will need to be updated to reinforce the transition to higher, common standards and improved assessments, while maintaining accountability for results (Alliance for Excellent Education, 2010). Regardless of what legislation is passed, educators are held more and more responsible for student achievement each school year. It is imperative schools and school systems implement effective programs in every core subject area in order to promote achievement for all ability levels of learners.

Technology can assist educators as they teach students important and necessary skills from the national curriculum (Willoughby, 2003). To ensure all students are benefiting in classrooms nationwide, differentiated instruction in reading and mathematics has become an important teaching strategy used by educators. Differentiated instruction allows students to learn in small groups based on their ability level, and teachers require students in the various groups to perform different levels of work depending on their abilities (Little, 2009). Related to differentiated instruction is the term individualized instruction. Individualizing instruction for all students is also a requirement for educators. Certain types of technology, like *Accelerated Math* (AM) by Renaissance Learning, can promote student math achievement by differentiating instruction. Many key instructional elements included in AM have been identified as factors relating to academic achievement. Kosciolek (2003) identified these elements as:

1. ensuring adequate practice time,
2. matching students' assignments to individual skill levels to encourage high success rates,
3. providing corrective instructional feedback frequently,
4. monitoring students' progress, and
5. encouraging students to monitor their progress toward meeting predetermined goals.

(p. 18)

This program can easily individualize instruction for students in the classroom by allowing teachers to assign objectives according to a student's ability (Kosciolek, 2003). This type of instruction ensures that students are working on mathematics at their individual skill level, and therefore they will not be able to move on to more difficult concepts until other objectives are mastered. AM can generate for students unlimited practice assignments that are individualized and consistently help students meet standardized goals. The program provides immediate corrective feedback and reduces paperwork for teachers by automatically scoring assignments and providing reports. Because the assignments are individualized, students have an opportunity to work at their own pace. The creators of AM say that the individualization of assignments prevents boredom and frustration for the students functioning considerably above or below grade level (Renaissance Learning, 2004). Students of all ability levels will benefit from the use of such a program in mathematics.

This study focused on a large rural school system in east Tennessee and its instructors' use of Accelerated Math, a computer-managed integrated learning system, as a supplement to the normal math curriculum. In this school system high-ability students were evaluated in mathematics achievement and comparisons were made between students who used the AM program to those who did not. Instead of unsystematically using the same objectives for every state, AM has developed different objectives that are listed in a library for each state (Renaissance Learning, 2004). The program is specifically aligned with the curriculum framework for every state. Curriculum alignment was performed by grade level for each state's modules. Data were gathered over a 1-year period from 2009-2010 to determine if the use of AM had a measurable impact on math achievement scores of high-ability students. This research might provide useful information in identifying effective methods of math instruction to assist in increasing achievement for students with a high ability in mathematics.

Statement of the Problem

In the early 21st century a school district's success is evaluated by state and national assessments, and stakeholders in school systems across the country have researched ideas to make changes to effectively address academic deficits of students. America's schools are focused on providing the education needed for students to succeed in the global economy of the 21st century. During this century it is important that students be proficient in mathematics because of the technology driven culture. For students to become mathematically proficient, major changes need to be made in instruction, materials, curriculum, assessments, and teacher training (Braswell, Daone, & Grigg, 2003). The decline of mathematics test scores in schools throughout the country has prompted national concern (Parette, Blum, & Boeckman, 2009). It is well documented that educators are examining their own school district's curriculum objectives and aligning them with state and national standards. Standards and achievement has been a focus at all levels. Given the ramifications of scoring below the proficient level as identified by the state, school officials are searching for scientifically-based programs and methods with a successful record of increasing standardized test scores (Thiel, Peterman, & Brown, 2008).

This study focused on investigating how to improve high-ability students' math scores at the elementary school level in east Tennessee using the AM program. The purpose of this study was to investigate the relationship between the AM program and high-ability student achievement test score gains on TerraNova test scores in comparison to other high-ability students who did not use the program. Since the implementation of NCLB, this school system has been determined to find a way to increase student achievement in mathematics. Research specifically focused on exploring results of using AM to increase high-ability student achievement. TerraNova math achievement test scores of high-ability students who used AM as a supplement to their regular math curriculum were compared to high-ability students who did not participate in the use of AM in their school.

The goal of the AM program is to improve student learning by providing individualized instruction for every student regardless of ability level. AM was designed to motivate students by allowing them to work at their own level in mathematics, as well as to monitor student progress and provide immediate feedback to the student and teacher (Betts et al., 2004). This type of program improves students' learning because it automatically modifies the instructional process as it assesses the on-going work of the students (Ysseldyke, Spicuzza, Kosciolek, & Boys, 2003). All ability levels of students are met with the correct use of AM (Renaissance Learning, 2004). Students continue to work where they are individually, whether they are working below, on, or above grade level (Riggins-Newby, 2004).

Definition of Terms

1. *Accelerated Math* (AM): is a curriculum-based instructional management system for mathematics. It is based on a number of principles that are referred to as Renaissance Learning Principles. These principles include the following: assessment of student skill level and provision of instruction matched to skill level, personalized goal setting, provision of significant amounts of practice time, and provision of direct and

immediate feedback to students and teachers on the students' performance (Betts, Tardew, & Ysseldyke, 2004).

2. *Adequate Yearly Progress* (AYP): a timeline of progress that would steadily close the gap between current levels of performance and the ideal proficiency rate each state has previously established (Hoxby, 2005).
3. *Computer Assisted Instruction* (CAI): The use of the computer to present instructional content to the learner (Rose, 2004).
4. *Criterion-Referenced Test* (CRT): A CRT measures a set of learning outcomes or objectives. This type of test determines whether a student has learned a particular skill. The skill is measured against specific criterion regardless of what other students know (TestMate Clarity, 1997).
5. *Curriculum*: the content of what is taught in the schools in every grade level. Meaningful curriculum is contextual to student, teacher, and community needs (Bain, Newton, Kuster, & Milbrandt, 2010).
6. *Gain Scores*: The difference in scale scores from one year to the next (Atkins, 2005).
7. *High-ability students*: students who have a high-ability in a certain subject area. They have unique intellectual needs that merit curricula, strategies, and resources that appropriately challenge them beyond what is provided by the normal curriculum (Shaunessy, 2003). For this study TerraNova math achievement scores for third and fourth grade students were used for the 2009-2010 school year. Students who scored proficient or advanced were considered to be high-ability.
8. *Integrated Learning System* (ILS): Integrated learning systems use computers for both instruction and management. The courseware includes a management

information system that monitors students' performance and provides diagnostic as well as prescriptive information based on students' progress (Jenkins & Keefe, 2003).

9. *Mastery Learning:* A system whereby the curriculum is broken down into skills and objectives and students must master one objective before moving to the next (Atkins, 2005).

10. *STAR Math Tests*: Standardized, computer adapted assessments created by Renaissance Learning, Inc. for use in K-12 classrooms. The assessment provides estimates of students' skills and comparisons of students' abilities to national norms. It is intended to aid with developing curriculum and instruction by providing feedback about student, classroom, and grade level progress. The software reports grade equivalents, percentile ranks, and normal curve equivalents (Renaissance Learning, 2004).

11. *TerraNova*: A national achievement test developed by CTB/McGraw-Hill and administered by the Tennessee Department of Education to all students in grades 3 through 8. School districts have the option of using it in grades 1 and 2. The test has 14 subtests; however, the major components include reading, language arts, mathematics, science, and social studies (Atkins, 2005).

Research Questions

The following research questions guided this study as they related to the AM program as a supplement to the traditional mathematics curriculum with high-ability students in grades 3 and 4 in a large rural county in east Tennessee.

1. Is there a significant difference between TerraNova math scores of high-ability students who participated in the AM program and TerraNova math scores of high-ability students who did not participate in the AM program?
2. Is there a significant difference between TerraNova math scores of high-ability students who participated in the AM program and TerraNova math scores of high-ability students who did not participate in the AM program in regards to gender?
3. Is there a significant difference between TerraNova math score of high-ability students who participated in the AM program and TerraNova math scores of high-ability students who did not participate in the AM program in regards to socioeconomic status?
4. Is there a significant difference between TerraNova math scores of high-ability students who participated in the AM program and TerraNova math scores of high-ability students who did not participate in the AM program in regards to grade level?

Significance of the Study

Educators face the dilemma of helping students of all ability levels succeed while incorporating effective forms of technology. Teachers cannot implement each and every new type of technology that is created. Educators must fully research each technology program to determine its effects in order to decide if the investment is worth the cost. Many researchers have found that using technology has positive links to achievement (Barlow, 2005; Espinosa et al., 2010; Little, 2009; Parette et al., 2009; Tester, 2003; Willoughsby, 2003). Other researchers warned that educators are investing too much money into technology, and lower-costing methods of instruction are just as effective in increasing achievement (Barlow, 2005; Lewis, 2007). The majority of researchers agreed that the importance of incorporating technology in schools is critical in the 21st century (Barlow, 2005; Espinosa et al.; Jenkins & Keefe, 2003; Keengwe & Onchwari, 2009; Lewis, 2007; Plowman, McPake, & Stephen, 2010). Using technology paired with differentiated instruction was the most effective way to significantly improve student achievement in mathematics (Jenkins & Keefe, 2003; Little, 2009).

Limitations and Delimitations

The population of this study consisted of high-ability students who were third and fourth graders during the 2009-2010 school year and had taken the TerraNova achievement test. These students attended 1 of 15 elementary schools in a large rural school system in east Tennessee. During the 1-year period for which data were collected, the control group of high-ability students received traditional mathematics instruction, while the experimental group of high-ability students received AM as a supplement to their regular math curriculum. Students' achievement was measured using the mathematics composite score on TerraNova achievement tests.

Eleven of the elementary schools participated in the AM program during the 2009-2010 school year, while 4 of the elementary schools did not participate in the math program. It is unknown the extent to which the Accelerated Math program was used by the teachers at the elementary schools where the program was available. It is also unknown if teachers who used AM as a supplement to the normal mathematics curriculum spent more time on math instruction than teachers who did not use the AM program. Because the students were not randomly assigned to groups, an ex-post facto research design was used to conduct the study. The instrument used in the assessment was the TerraNova achievement test.

Overview of the Study

This research study has been organized into five chapters. Chapter 1 includes an introduction, statement of the problem, definition of terms, research questions and hypotheses, significance of the study, limitations and delimitations, and overview of the study. Chapter 2 presents a review of literature and includes the following sections: introduction, student achievement, mastery, accountability, individualized instruction, technology and computer-assisted instruction, brain-based learning, high-ability students, Accelerated Math studies, and conclusion. Chapter 3 includes the research methodology. Information is provided on research design, population, instrumentation, a description of the school system's implementation of Accelerated Math, a description of the Accelerated Math program, data collection, and data analysis. Chapter 4 details the findings or results of the study. Chapter 5 includes the summary and interpretation of the results, and the conclusions that were made after interpreting the results of the analysis of the study. In addition, limitations and recommendations for practice and further consideration were given by the researcher.

CHAPTER 2

REVIEW OF LITERATURE

Introduction

Chapter 2 contains a review of literature related to the effects of the use of Accelerated Math, an individualized math instruction program, on high-ability students' math achievement as measured by TerraNova. Research has been conducted over the past several years to determine the effects of using technology to promote student success in mathematics. The required rigor of mathematics that is expected of students has increased significantly over time, and 21st century colleges expect four years of math as a prerequisite to admission (Willoughby, 2003). The ability to use technology intelligently and to recognize the limits of any technology use are critical for students of the early 21st century (Parette, Blum, & Boeckman, 2009).

At the end of the 20th century America took for granted its position as the world leader in the development of new technology (Thiel et al., 2008). Standardized test scores show student achievement in mathematics declining each year since the enactment of NCLB. The radical change in available technology has made stakeholders in education more aware of the importance of using technology in schools (Willoughby, 2003). Several legislative acts have been passed since the latter part of the 20th century to try to encourage higher student achievement in math. One act that George W. Bush's Administration supported was the *Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science Act* (COMPETES). COMPETES was enacted to improve the competitiveness of the United States in mathematics and science and allotted $43 billion to conduct research in technology (Lewis, 2007). The goal of COMPETES was to shift students from the bottom of achievement test scores in mathematics to the top. During George W. Bush's Administration in

2001, NCLB was enacted to help promote student achievement in all subjects. Specifically NCLB supported the goal of having all children become proficient in math and reading by the year 2014 (Barlow, 2005). NCLB has significantly increased pressure on teachers to make certain that students are learning mathematics. Correctly implemented technologies combined with differentiated instruction are effective ways to support student achievement in math (Little, 2009). Since the enactment of NCLB the education profession has increasingly recognized the need for scientifically based research and the monitoring of progress of children's attainment of educational skills (Parette et al., 2009). State and national standards have been created in response to increasing demands of accountability on educators in order to make sure students are achieving academically (Barlow, 2004).

Research regarding the use of technology in the classroom has shown both positive and negative effects on student achievement (Barlow, 2005; Bielefedlt, 2005; Espinosa et al., 2010; Little, 2009; Ozel, Yetkiner, & Capraro, 2008; Tester, 2003). Positive effects of technology include improved attitudes of learning, increased student achievement and engagement in math, and the ability to use technology to implement individualized instruction for students at their own ability level (Ozel et al., 2008). Technology can effectively impact learning (Bielefedlt, 2005; Little, 2009; Tester, 2003). Technology is more prevalent than ever in the 21st century and is linked in a positive way to student achievement (Espinosa et al., 2010). Computer math programs have helped students refine their achievement in a low-risk environment offering immediate feedback and automatic assessment (Tester, 2003). Several researchers have questioned the significant amount of money educators in the United States have spent on technology since the turn on the 21st century (Barlow, 2005; Little, 2009). Some research has shown that American schools have spent billions of unnecessary dollars on technology (Barlow, 2005). Little (2009) found that computer technology is no more effective than traditional, nontechnological instruction in reading and mathematics. Little determined that lower cost teaching practices are just as effective as higher costing technology programs. Barlow (2005) stated that before schools invest such a significant amount of money in the newest technology available, schools must ask if it is actually worth the investment. Although technology can be a costly way to promote learning, embracing technology to encourage math achievement is still a top priority in some school systems (Bielefedlt, 2005).

It is critical that technology be implemented in a valuable way in schools. Bielefeldt (2005) reported the National Educational Technology Standards essential conditions for effective use of technology. These standards state that schools need to use technology aligned with the curriculum as a way to enhance instruction, as a form of student assessment, as a resource used for students, and schools need to make certain teachers are knowledgeable in the specified area (Bielfeldt, 2005). Using technology in an effective manner is the key to student achievement in mathematics (Ozel et al., 2008). The presence of technology itself is not related to student achievement, and the use of technology may help or hinder academic learning depending on the nature of the use (Tester, 2003). To effectively integrate technology students and teachers must have equitable access to technology, teachers must receive adequate training in the use of technology aligned with curriculum standards, and technical support must be readily available for teachers (Ozel et al., 2008).

Student Achievement

In the 21st century teachers must focus on ways to increase their students' achievement. Out of 55 countries who participated in the Program for International Assessment (PISA) in 2009, that assesses the performance of 15 year olds in the core subject areas, the United States scored significantly below the average (Education Digest, 2010). In addition Fuchs (2004) published research regarding the relationship between technology and student achievement using data gathered from the PISA. Initial analysis indicated a significant positive relationship between achievement and computer access. However, factors such as family background and school characteristics negatively impacted student performance in reading and mathematics (Fuchs, 2004). Although teachers do not have the opportunity to choose students for their individual classroom, teachers do have the ability to change the classroom environment that students experience. Teachers are responsible for student success in all subjects. Unfortunately conditions such as family background or socioeconomic status outside of the classroom cannot be changed, but using effective forms of technology to change the environment inside of the classroom can happen (Corbett, Wilson, & Williams, 2005). Research has shown that teachers make the greatest difference in student achievement (Fuchs, 2004). Some researchers and analysts have suggested that current standardized tests now in place are absolutely the most accurate means of assessing students' achievement (Bos, 2009; Fuchs, 2004). Other researchers argue that the right tests need to be combined with tools that accurately measure student growth, as well as that teachers only account for a small percentage of student success (Berry, Daughtrey, & Wieder, 2010). Regardless of the types of tests used to measure student achievement, effective teachers who use instructional practices that promote student learning give students no other choice but success in the classroom (Corbett et al., 2005).

Using technology as a form of instruction can promote student achievement. Evidence has shown that technology high in pedagogical, mathematical, and cognitive fidelity improved student academic achievement when used in the classroom (Bos, 2009). The NCLB Act required teachers to promote student use of technology while increasing achievement (Barlow, 2005).

Technologies that provided teachers and students with standards referenced and research-based instruction strategies have been an effective way to enhance student achievement (Rigeman, 2005). However, there are a few barriers to math achievement in education. According to Education Digest (2010) attitudes of teachers, parents, and students make a difference in students' achievement in mathematics. A study conducted by Michigan State University has shown that American teachers have less knowledge in math than teachers in other countries due to a lack of professional development opportunities (Education Digest, 2010). Overall attitudes towards the subject of mathematics as well as restricted opportunities to learn more about effective ways to teach math are limiting students' math achievement. America should want students to achieve in mathematics to better prepare them for the future (Lewis, 2007). Addressing these barriers, as well as integrating effective instructional methods of technology can help promote student achievement. If math is seen as a way to problem solve teamed with teachers applying and using technology in their classroom, deep conceptual learning can and will take place (Bos, 2009).

Research has indicated mixed findings for the overall effects of technology use for improved student achievement (Bielefeldt, 2005; Kulik, 2003; Wenglinsky, 1998). Bielefeldt (2005) stated that these mixed finding are considered normal. Wenglinsky's (1998) analysis of the National Assessment of Educational Progress scores and Goolsbee and Guryan's (2002) study of e-rate subsidies also discovered mixed findings. There is evidence that the use of technology can have a significant positive effect on learning (Bielefeldt, 2005). Kulik's (2003) meta-analysis of controlled studies found large effect sizes for technology applications. What Works Clearinghouse (2010) reviewed middle school math programs and discovered substantial technology use in the classroom positively affected student achievement. There are some negative findings in relation to technology use and math achievement (Goolsbee & Guryan, 2002). Students' backgrounds with families that have lower socioeconomic status as well as pessimistic school character were found to be negatively related to students in some research studies (Goolsbee & Guryan, 2002; Wenglinsky, 1998).

Technology integration in math classrooms is important in the field of education because American society in the early 21st century is more reliant on technology than it was in previous decades (Little, 2009). Technology is also an essential part of the schools' curricula. The Principles and Standards for School Mathematics emphasize the importance of technology in K-12 classroom teaching and learning (Ozel et al., 2009). According to Kettler and Curliss (2003) technology such as calculators, interactive whiteboards, immediate response devices, and computers are all examples of devices that can help students succeed in math. Web-based applications provide flexible approaches for student learning. These types of technologies not only provided immediate feedback on student assessment and reduce the amount of grading and paperwork for teachers, they also assisted in increasing student achievement (Ozel et al., 2008). Immediate response devices (IRD) allowed students and teachers to interact. IRDs helped to improve student's engagement and instructional experience as well as allowed students to actively learn new objective in math (Kettler & Curliss, 2003). These devices did provide immediate feedback and allowed anonymity of responses. Teachers could gauge where students are academically in math, and by using these devices also motivate students as they increase their understanding in certain math objectives (Ozel et al., 2008).

Mastery

Student goals can either be mastery or performance oriented. Turner and Patrick (2004) studied motivational influences on student participation in learning. The researchers established two different types of goals: mastery and performance. Mastery goals focused on the student improving their competence, whereas performance goals focused on the student proving competence to others (Schraw & Aplin, 1998; Turner & Patrick, 2004).

Students with mastery goals want to increase their competence and are genuinely concerned about mastering the material presented to them. The standard for improvement is the student's past performance rather than focusing on the performance of others. Students with mastery goals feel putting forth effort and persisting with their learning is worthwhile, and they view mistakes as an opportunity to learn. Students exhibit mastery goals when they show interest and diligence when working on a task, and they also get excited when learning a new concept (Turner & Patrick, 2004).

Students with performance goals focus on demonstrating competence and avoid demonstrating their incompetence as they learn. They are concerned with how they perform in comparison with other students or in relation to established standards like grades or ACT scores. Students with performance goals desire to complete easy tasks in order to make themselves look capable by succeeding with very little effort (Turner & Patrick, 2004).

Classroom environments do affect student mastery. Patrick, Turner, Meyer, and Midgley (2003) conducted a study that researched how much classroom environment affected student mastery. The researchers found that students in a supportive classroom environment perceived their teachers as having more support and had a greater focus on mastery goals (Patrick et al., 2003). Students in supportive classrooms did not focus on performance goals as much as those in the nonsupportive classroom environment (Patrick et al., 2003).

Teachers do not choose their students, yet they must strive to motivate and educate students who differ in every way (Turner & Patrick, 2004). Teachers do control the classroom environment and have limited control on the types of instructional practices they use. The affordances and constraints of the classroom can radically change work habits that students develop and demonstrate over time (Patrick et al., 2003). Teachers can emphasize both mastery and performance goals for students in the classroom (Turner & Patrick, 2004).

Accountability

Accountability encompasses certain requirements of NCLB national mathematics performance, assessments, and state-specific accountability issues. *A Nation at Risk* foreshadowed the modern accountability movement (Walberg, 2003). In this publication the government called for higher academic standards for all schools throughout the nation. The report focused on student achievement as the main barometer of quality and laid the groundwork for the rigorous curricula and tests envisioned by promoters of the standards-based reform movement in the early 1990s (Walberg, 2003). *A Nation at Risk* had excellent intentions for our nation's schools, yet the publication lacked a way to ensure the recommendations would be implemented. In 2001 the creation of NCLB represented the biggest step in bringing accountability to school systems (Braswel et al., 2003). After NCLB was passed many states had to expend a considerable amount of effort to be in compliance with the new law.

Since the enactment of NCLB, schools in America have been held accountable for test scores. Students must meet certain requirements on achievement tests, and schools are held responsible for what students know. Achievement levels on standardized tests are performance standards set to provide a context for interpreting student performance. The standards are used to report what students should know and be able to do at the basic, proficient, and advanced levels of performance in each subject area at every grade assessed (Braswel et al., 2003). These standards are used to further understand trends in student achievement. Even if mandates are well implemented in schools, NCLB may not be able to raise student achievement. Even though teachers are held accountable they still may continue to do as they please. Despite policies regarding state standards, tests, and accountability, there is a large gap between what teachers teach and what is required of the standards-based reforms represented by NCLB (Walberg, 2003). For accountability to work it needs to happen first in the classroom with the teacher.

Several years after the implementation of NCLB, the United States has shown some progress. As reported by Braswell et al. (2003), all 50 states and 3 jurisdictions participated and met the minimum guidelines for reporting their results in 2003. Approximately 190,000 fourth graders from 7,500 schools and 153,000 eighth graders from 6,100 schools were assessed in mathematics in 2003. After evaluating the data, researchers found significant changes overall in math achievement between the years 2000-2003 (Braswell et al., 2003). There was considerable improvement among, lower, middle, and high performing students in grades 4 and 8. Out of the 50 states, 43 showed an increase in average fourth graders' scores, and 39 found eighth graders showing an increase in average scores on the math achievement test. Students in grade 4 made significant improvement in several areas. Nationally 26 of 50 states had higher average scores than the national average. In addition, 43 states had an increased percentage of students at or above the proficient level in 2003. Students in grade 8 also made positive changes towards improving achievement test scores in comparison to the previous years of 2000-2003. Eighth graders in 30 out of 50 states had higher scores than the national average, and 38 states had a higher percentage of students at or above proficient in 2003 in comparison to previous school years.

Many changes in education have been made since the enactment of NCLB. The United States has made some progress as schools are held more accountable than ever for student achievement. NCLB requires a statewide accountability system to ensure all schools and districts make adequate yearly progress (No Child Left Behind, 2004). The Tennessee accountability system implements the requirement of both NCLB and the *Education Improvement Act*. Value-added scores are an important component of the Tennessee accountability system. Tennessee's system includes sanctions and rewards, as well as the three levels of performance: advanced, proficient, and below proficient. Tennessee determines cut-off scores for grades 3 through 8 in the subjects of reading, language arts, and mathematics to determine the three levels of performance (No Child Left Behind, 2001). In order to meet adequate yearly progress (AYP) each school district and school must meet minimum performance standards classified as proficient in these categories: math, reading, language arts, writing, attendance, and graduation rate (No Child Left Behind, 2004). By the year 2013-2014, NCLB calls for all students to be proficient in these areas. Each year the minimum performance requirement to meet AYP increases and continues to increase over the next 3 years. If schools fail to meet the minimum requirement for 1 school year, they become known as *target schools* and no sanctions apply. Schools that fail to meet the minimum requirements for 2 consecutive years in the same category become known as high priority schools and sanctions are required that include free tutoring and school choice. If schools fail to meet the minimum proficiency requirement standards for 3 or more years in the same category, penalties may include total restructuring of the school.

Effective educators make use of information discovered through assessment by adjusting instruction to meet the needs of their students each day. Research has demonstrated that teachers who use performance data gathered to improve their teaching are more effective than teachers who do not use similar data (No Child Left Behind, 2001).

NCLB is not determined to be the best way to hold schools and teachers accountable for learning by all stakeholders involved in education. Public Education Network (PEN) found through a series of hearings that the public does not feel a sufficient explanation of data gathered from the testing is provided for parents, students, and the community (Public Education Network, 2006). The public claims that the school is the primary stakeholder to be held accountable for student success; however, they say that the community needs to share in this responsibility.

Individualized Instruction

In the 1950s educational concepts centered around three related forces: behavioral psychology, programmed instruction, and individualization (Rose, 2004). Individualized instruction emerged from a drive to replace the human teacher with a machine that delivered standardized content. This goal led to further developments in computer assisted instruction (CAI), computer managed instruction (CMI), and integrated learning systems (ILS).

Early 21st century schools in America have been raising standards to improve academic achievement for all levels of students. Teachers are able to meet high expectations by meeting specific needs of students, building student study skills, creating intellectually demanding assignments, and differentiating instruction (Southern Regional Education Board, 2009). Differentiating instruction is an effective teaching method now being used worldwide. In British Columbia, the three principles of learning for all subjects and grade levels include: learning requires active participation by the student, learning is an individual and group process, and students learn in a variety of ways and at different rates (Ministry of Education, 2009). According to Phillips (2008) differentiated instruction allows students to do work in class according to their individual needs, is a way to accelerate learning, and focuses on the needs of all students working below, on, or above grade level. Students benefit highly from learning when it is at their instructional level (Hsiao, Sosnovsky, & Brusilovsky, 2010). Differentiation provides students with systematic approaches to goals, learning with flexible and developmentally appropriate materials, and assessment (Ministry of Education, 2009). According to Little (2009), "Differentiated instruction is an approach to planning and teaching based on the premise that teachers must consider who they are teaching as well as what they are teaching" (p. 6). Individualized instruction can help students foster their own learning. Evidence of higher achievement test scores has indicated that individualized instruction has a positive effect on student achievement (DeStacio, Ansfield, Cohen, & Spurgin, 2009). Individualizing instruction for students has many positive benefits when done effectively.

Jenkins and Keefe (2003) have identified nine representative strategies that allow students to be engaged in material at their own level of development and to advance to more challenging levels when ready. These nine strategies are: individualized instruction, accelerated learning, style based instruction, technology-assisted learning, contract learning, authentic pedagogy, guided practice, cooperative learning, and topic study.

Individualized instruction is associated with B.F. Skinner's programmed instruction in which students work at an individual pace through predetermined curricula. This term has been modernized by technology, and adaptive instruction and individualized guidance instruction are two modern applications that allow for individualization through predetermined content and allow students to work at their own pace (Jenkins & Keefe, 2003).

Accelerated learning is another strategy that was started by Henry Levin, who said that low-achieving elementary students should have accelerated instruction rather than remediation. Accelerated learning schools are designed to bring all students into the education mainstream by building on their natural strengths and by stressing high expectations. Research recommends the use of tasks and learning strategies normally found in gifted and talented (GT) programs (Jenkins & Keefe, 2003).

Another strategy discussed is style based instruction where educators adjust learning environments to differences within and among students based on a formal assessment that determines the student's learning style. Teachers use contract activity packets (CAP) that replace whole group instruction to offer students choices in how they meet objectives (Jenkins & Keefe, 2003).

Technology assisted learning is a type of instruction that expands learning opportunities for more students. This form of learning allows students to use the computer to move through a prearranged curriculum at their own rate. An example of this type of learning is an Integrated Learning System (ILS) which provides a sequence of lessons that span traditional grade level objectives in reading or math. These systems monitor student performance and provide feedback of student progress (Jenkins & Keefe, 2003).

Contract learning is another strategy where the teacher and student design a learning activity with their own objectives, activities, timeframe to complete, and form of assessment. The teacher supervises as students work at an individual pace. Students also sign a contract that requires them to be responsible for their own learning (Jenkins & Keefe, 2003).

Developed at the University of Wisconsin, authentic pedagogy established a set of standards by which classroom practice can be evaluated to determine authenticity. Teachers evaluate students as they solve problems and create knowledge in real world type settings (Jenkins & Keefe, 2003).

Guided practice is a teaching strategy that involves students practicing various target behaviors under the supervision of the teacher. Teachers provide verbal feedback as students work as well as decide when to intervene and provide more one-on-one instruction. Scaffolding is a support used to help a student solve a problem in this form of teaching strategy (Jenkins & Keefe, 2003).

Another type of instructional strategy recommended is cooperative learning, where students work in small groups to accomplish an academic task. The teacher sets the task, establishes the procedure, encourages the students to work together cooperatively, provides resources, and monitors and supports the groups as needed (Jenkins & Keefe, 2003).

Topic study is an additional developmental strategy where students have the opportunity to inquire and study objectives that interest them individually. Students are able to focus on their own learning and use their individual ideas to determine outcomes (Jenkins & Keefe, 2003).

Research has shown that combining technology with differentiated instruction is an effective way to meet students' individual needs (Cobb, 2010; Hsiao et al., 2010; Stroud, 2009). Cobb (2010) found that teachers who focus on differentiating instruction with technology-based software see high success with student achievement. Differentiating instruction allows students to work at their own level, while direct instruction expects all students to work on the same level. Stroud (2009) reported that technology in the classroom is the best way to allow teachers to differentiate instruction. Programs that allow students to work at their own pace help students succeed in learning (Hsiao et al., 2010). Technology has made a huge impact on education and enhanced programs offering an individualized instruction path for students. Research has shown that allowing students to work at individual levels of instruction has a positive effect on student learning (Popescu, 2010). According to Bull, Alexander, and Ferster (2010), "The realization that students respond to technology in different ways can allow teachers to provide instruction that best meet their individual needs. Differentiating instruction while using technology is a must" (p. 36).

All classrooms have learners with mixed-abilities (Hsiao et. al, 2010; Kettler & Curliss, 2003; Olalere & Olumfemi, 2010). According to Kettler and Curliss (2003) the difference of abilities in mathematics may be even more significant. In order to ensure an optimal level of learning, educators must teach a curriculum that contains a sequence of learning activities being developed in response to learner readiness (Hsiao et al., 2010). Pacing for students needs to be individualized. Using a tiered objectives model is one way to determine that educators will teach one concept to the class, yet students develop the knowledge and skills related at different levels of complexity (Kettler & Curliss, 2003). Little (2009) suggested that math instruction for all levels of students should include differentiated instruction, the use of metacognitive strategies along with the implementation of instructional routines, progress monitoring, formative assessment, and computer assisted instruction. Olalere and Olumfemi (2010) agreed that computer assisted instruction that differentiates student learning has helped improve student achievement greatly. There are also benefits to using progress monitoring systems that assist in individualizing instruction. These systems keep teachers aware of student performance and progress, and teachers are able to make changes if students are having difficulty (Ysseldyke & Bolt, 2007).

Technology and Computer-Assisted Instruction

Technology is prevalent in early 21st century American schools (Parette et al., 2010; Plowman et al., 2010). The American culture during the 21st century is technology driven, and children are active users of various types of technology. By the time students begin school, children have already been exposed to a broad range of technologies (Plowman et al., 2010).

Integrating technology can be a challenge for educators. NCLB has required that students be proficient in technology literacy by the eighth grade. Lifelong learning skills mixed with technology are important 21st century skills, and educators have a responsibility to make certain these skills are learned (Parette et al., 2010). Those who successfully incorporate technology into instruction realize that technology tools assist in helping children but are not the full answer to help increase student achievement. Research has found that technology is beneficial to children if used appropriately (Keengwe & Onchwari, 2009). Technology being implemented in a developmentally appropriate way is problematic because America's society teaches an absolute reliance on technology (Parette et al., 2010).

One way to implement technology effectively in the classroom is computer-assisted instruction (CAI). Since the 1960s computerized technology has drastically changed the ways in which students interact with information (Rasanen, Salminen, Wilson, Aunio, & Dehaene, 2009). The most pressing need in education is the individualizing of instruction, and computers appear to be the answer to this need (Rose, 2004). Technology expands learning opportunities for students by enabling them to work individually and proceeding through a curriculum at their own rate (Jenkins & Keefe, 2003). Since the 1960s studies have found that CAI has had positive outcomes. Premathematical knowledge, counting skills, recognizing numbers, and learning numerical concepts are important concepts that come up on standardized tests each year. When used as additional practice, the largest gains in the use of CAI have been in elementary grade levels (Rasanen et al., 2009). Christmann and Badgett (2003) compared the academic achievement of elementary students who received traditional instruction to traditional instruction supplemented by CAI. The study found that in mathematics traditional instruction supplemented with CAI was more effective. The researchers found a mean effect size of 0.342 from 68 studies, and the effect size was positive because higher scores were attained by students receiving CAI. They discovered that the typical student using CAI instruction moved from the 50^{th} percentile to the 63^{rd} percentile in mathematics (Christmann & Badger, 2003).

When using CAI there are three requirements educators need to use to determine if technology tools are actually considered teaching tools (Rasanen et al., 2009). The technology tool must be a machine that presents information in the form of a task. It must also provide some means for the students to respond. In addition the tool needs to provide feedback to the student's response. It should adapt to the student's needs in order to maximize learning. The technology tool should provide feedback to the student if a mistake is made in order to minimize failure the next time the tool is used for instruction (Rasanen et al., 2009). According to Seo and Woo (2009) CAI can enhance student learning in an efficient and effective way in mathematics. Math concepts are hierarchically interrelated; therefore, math must consist of a review of previously learned skills. CAI programs allow both a review of skills and the teaching of new skills (Seo & Woo, 2009).

Beal, Qu, and Lee (2008) and Rose (2004) distinguished between CAI and Computer Managed Instruction (CMI). In CAI programs students interact directly with computers, while CMI provides management data for the teacher in addition to instruction (Rose, 2004). Rose (2004) has acknowledged that CAI and CMI are based on the belief that individualized instruction can be best monitored by a computer.

As CAI becomes increasingly integrated into classrooms, interest is growing in how students interact with computer based teaching systems. Researchers who create instructional software have recognized for some time that students do not always use the software correctly (Beal et al., 2008). Researchers have responded to this by adding features to software that detect inappropriate behaviors, like guessing, to make games more productive (Beal et al., 2008). One study found that student math achievement was related to appropriate use of software. The study demonstrated that even with a limited content area and short training time, very specific intervention effects can be identified as positive (Beal et al., 2008).

CAI and CMI programs became known as Integrated Learning Systems (ILS) in the 1980s and 1990s. Integrated Learning Systems use computers for both instruction and management (Jenkins & Keefe, 2003). ILS includes a management information system that also monitors student performance and gives feedback regarding each student's progress.

Brain-Based Learning

During the 1980s and 1990s thousands of American teachers became interested in learning about brain-based multiple intelligences introduced by Howard Gardner. Research has shown that in our classrooms today all learners are diverse, and these students' special needs need to be met in order for educators to enhance student learning (Connell, 2009). The interest in Gardner's multiple intelligences led to more research in the field of brain-based learning (BBL). Technology has been found to be one way to boost BBL in the classroom (Tate, 2009).

BBL is based on specific strategies that can be used to enhance a student's ability to learn. One component of BBL is understanding that emotions influence student learning. Teachers are more likely to gain and keep the attention of students when they engage students' brain-based emotional systems (Connell, 2009). During the 1990s, also known as the "decade of the brain" (Connell, p. 29, 2009), researchers worked with schools to apply brain-based learning principles and to change educators' mental modes of teaching and learning. After 4 years of work with 2 schools, Kaufman et al. (2008) reported moderate success in helping schools move from an information delivery approach to a more learner centered approach to teaching.

Since the 1990s educators and psychologists such as Armstrong (2009), Caine, Caine, and Cromwell (1999), Chapman and King (2003), Jensen (2005), and Sousa (2006) have been leaders in the BBL movement. These authors have helped disseminate neurological research into research-based academic practices. Armstrong (2009) and Jensen (2005) found that although all students can learn, each brain is unique and every student has his or her preferred learning style. Connell (2009) suggested building a "learning and the brain" community in the classroom (p. 38). Educators building this type of BBL community should create a learning atmosphere that welcomes all types of learners as well as uses effective research-based BBL strategies to enhance student learning.

Brain-based learning has been found to have a strong connection with technology. According to Kaufman et al. (2008) accelerated learning is part of BBL and "an educational delivery method utilizing brain research to define optimal learning opportunities" (p. 51). BBL strategies include: creating patterns and relevance for content taught, chunking information into sizeable units, allowing students to participate in service learning, recognizing all students' diverse learning styles, knowing the importance of variability in teaching styles, and moving from a teacher-centered to a student-centered classroom (Kaufman et al., 2008). Technology has the ability to promote a BBL classroom when used appropriately. Several studies have found that results can be influenced by BBL strategies but are not guaranteed unless used effectively (Connell, 2009; Kaufman et al., 2008).

Technology is one strategy that is most effective in teaching the brain when delivering instruction (Tate, 2009). Teachers who use technology to teach with all students not only have classrooms where students excel academically but also where learning is fun.

High-Ability Students

Educating students with mixed-ability levels can be a challenge. Special needs of high-ability students are not always met by educators in the classroom. High-ability students acquire skills more quickly than other students (Siegle, 2004). NCLB was designed to focus on at risk students in order to protect those who were at the highest risk from failure. The education of high-ability students has been sacrificed by NCLB guidelines that do not allow them to excel in mathematics or science (Phillips, 2008). High-ability students can be gifted in mathematics, but today most schools do not offer gifted and talented (GT) programs (Mulrine, 2007). High-ability students' unique intellectual needs merit curricula, strategies, and resources that appropriately challenge them beyond what is provided in the general education curriculum (Shaunessy, 2003). Technology is an excellent way to challenge students who have a high ability in mathematics. The social and emotional development of GT students can be influenced by genetics, experience, history, family values, and perceptions. Technology allows GT students freedom of expression, control, power, and the feeling of being connected. Teachers can use technology in the classroom to help individualize instruction for GT students daily (Cross, 2004). The implementation of technology with gifted students should be designed to meet their individual needs (Shaunessy, 2003).

Educators have the ability to use technology to increase the efficiency of the educational process. When integrated effectively, technology promotes learning for all levels of students. America's demand for technology in the early 21st century classroom must meet educators' needs to effectively and efficiently communicate to and with students who have diverse learning needs (King-Sears & Evmenova, 2007). Computers and other forms of technology can be used to enhance the learning of high-ability students. Computers are one way teachers can differentiate instruction in the regular classroom (Mulrine, 2007). Technology applications are able to address many of the characteristics of gifted learners including depth and complexity, knowledge transfer, quick processing, and inductive learning (Shaunessy, 2003). Technology enhances the learning process and can be an effective tool used to promote learning. Technology should extend curriculum and objectives as well as engage students in high learning that is meaningful (King-Sears & Evmenova, 2007). Researchers caution that new concepts should not be actually taught with forms of technology just supplemented (King-Sears & Evmenova, 2007; Mulrine, 2007; & Shaunessy, 2003).

Teachers who have gifted students in their classrooms should possess an understanding of the technology process in order to engage learners (Besnoy, 2007). There are two obstacles that prevent technology from being used in the classroom. Teachers often have limited access to resources needed to use technology appropriately. During the late 20th century, 19 billion dollars has been spent on the development of technology in schools (Minkel, 2004). However, only modest technology integration is used in early 21st century classrooms. Minkel found 49 % of students were dissatisfied with the technology available in their classrooms. Student dissatisfaction was due to poor teacher training on the latest technologies. Besnoy (2007) found there was not an adequate amount of professional development required for teachers to take in order to learn more about technology. Shaunessy (2003) found that 81 % of GT teachers had less than 10 hours of staff development in technology implementation, and these teachers did not meet the needs of gifted learners. Educating GT students requires access to challenging opportunities to learn as well as classroom provisions that allow teachers to accommodate to students' individual needs (Betts et al., 2004). King-Sears and Evmenova (2007) discussed four principles for integrating technology for high-ability learners in the regular education classroom: 1) educators must choose technology that is aligned with curriculum standards, 2) teachers need to match each student's instructional needs with the technology, 3) stakeholders in education must choose technology that is most efficient and cost effective and, 4) educators need to choose to use technology that allows students to blend in with their peers while working on their own level of instruction. Teachers should handle the importance of technology and monitor the impact on student learning on a daily basis (King-Sears & Enmanova, 2007). Using these four strategies can assist teachers in differentiating instruction for students of all ability levels. According to Shaunessy (2003), "Technology is a multifaceted tool that teachers can incorporate in the curriculum for the gifted to appropriately challenge students" (p. 119).

Some researchers have proposed certain plans and types of technology that will help high-ability learners be reached in both the GT and regular classroom (Barlow & Wetherill, 2005; Besnoy, 2007). Besnoy (2007) has recommended educators use a Personal Technology Improvement Plan (PTIP) that allows teachers of high-ability students to create an individualized professional development plan that will help improve their use of technology. Teachers creating a PTIP should conduct a needs assessment, write short- and long-term technology goals for themselves, identify and access resources they already have or need, implement the learned technological skills in the classroom, and evaluate their progress (Besnoy, 2007). Barlow and Wetherill (2005) suggested using technology such as a personal handheld device, known as PDAs, to promote student learning. These PDAs offers teachers immediate feedback when conducting a lesson. One study with PDAs found an increase in student motivation and selfesteem as well as an improved reading ability after using these devices for a period of time with high-ability students. This was because the PDAs allowed students instruction to be individualized, and the high-ability students were able to work at their own level (Barlow & Wetherill, 2005).

Accelerated Math Studies

One way to help increase student achievement in mathematics is the implementation of the Accelerated Math (AM) program, which assists teachers in being able to individually instruct students at their individual level of instruction in mathematics. AM produces a progress and reward system under student control through a cycle of challenge, practice, and assessment (Riggins-Newby, 2004). No extrinsic rewards were needed when using AM because children find immediate feedback of whether they are right or wrong rewarding (Riggins-Newby, 2004). Riggins-Newby said that math needs to be more than just computation for students. It needs to be an area of investigation, and students will gain a better understanding of mathematics when it is explored. A technology enabled and joyful learning environment in math equals success.

AM was found to help educators meet the different individual needs of each student in the classroom (Ysseldyke & Tardew, 2003). This research was conducted in 125 classrooms in 47 schools across 24 states, where 67 classrooms were experimental and 58 were used for comparison. Ysseldyke and Tardew (2003) studied 2,397 students ranging from third grade to 10^{th} grade. Of the 2,397 students, 1,319 students were in the experimental classrooms and 1,078 students were in the comparison classrooms. Students in both the experimental and comparison classrooms were compared based on their scores from the STAR Math test before and after AM was implemented in experimental classrooms. Students in both classifications were pretested by the STAR Math test in January. After the experimental classrooms were pretested and results were given, each student was assigned appropriate instructional activities and objectives to meet his or her zone of proximal development. No individual objectives or activities were assigned to students in comparison classrooms. In May 2002, students in both experimental and comparison classrooms were posttested to evaluate growth in their math abilities.

Ysseldyke and Tardew (2003) expected that the students who were in the experimental classrooms where AM was used would show more growth than the students in the comparison classrooms where no individual objectives were given. The researchers found that "…all groups achieved significant pre- to post-test gains as measured by the STAR Math test. Not all control groups achieved significant gains as measured by Normal Curve Equivalent (NCE) scores; however, all Accelerated Math groups did" (p. 17). When the AM program was implemented, it resulted in positive gains in math achievement. The researchers also discovered that

> four of the six Accelerated Math subgroups-Low Achievers, English Language Learners, Free and Reduced Lunch, and Title I-demonstrated significantly greater gains than their control counterparts in both Sum of Scores (SS) and NCE. An additional group- Gifted &Talented students in Accelerated Math- achieved significantly greater gains in NCE than its comparison group did (Ysseldyke & Tardew, 2003, p. 17)

Ysseldyke and Tardew's (2003) study demonstrated that individualizing instructional activities and goals for each student, as in the AM program, can result in higher gains in math test scores especially among high ability students. The researchers also found that

> Gifted and talented students mastered far more objectives outside their major library, indicating that these students were able to explore a broader range of mathematic topics than their non-G&T counterparts. These findings indicated that G&T students benefit from differentiated math instruction more than non-G&T students do, by allowing for more advanced exploration of mathematics at an appropriately high level (Ysseldyke & Tardew, p. 18)

AM should produce similar desired results in high-ability groups at any school implementing the program.

In 2004 five researchers studied the implementation of the AM program with only gifted students (Ysseldyke et al., 2004). They studied two groups of students from third to sixth grade: 48 GT students who had AM implemented in their classrooms and 52 GT students who did not use AM. The researchers conducted an analysis of covariance (ANCOVA) between GT students who used AM and those who did not as well as used the STAR Math test as a pretest and a posttest to compare data. Ysseldyke, Tardew, Betts, Thill, and Hannigan (2004) expected that GT students in the AM group would complete more objectives compared to those that did not participate in the AM program. The results showed that on the pretest, there was no significant difference between the groups. After the posttest was given the GT students showed a significant gain in math abilities. The researchers found that "The mean NCE gain for the experimental group was 11.9 normal curve equivalent (NCE), and the mean NCE gain for the control group was 4.8, a difference of 7.1 NCE" (Ysseldyke et al., 2004, p. 25). This study demonstrated that "…the GT students were also able to master a significantly higher number of objectives since mastery of objectives is related to the number of tests taken and completed and mastered" (Ysseldyke et al., 2004, p. 27). Ysseldyke et al. (2004) found that AM works extremely well with GT students and leads to large gains in their math abilities.

Ysseldyke and Tardew (2007) explored how a progress monitoring and instructional management system like AM can be used to help educators differentiate instruction and meet wide-ranging learning needs of diverse ability classrooms. Classrooms in 24 states that implemented the curriculum based progress monitoring and instructional management system, AM, were compared to classrooms that did not implement the program. Ysseldyke and Tardew (2007) found that at each grade level there were significant differences in grade equivalent score and percentile gain for students in the experimental and control classrooms. There were also significant gains across the achievement spectrum. Low, middle, and high-ability students showed consistent gains for each math objective mastered. Intervention integrity had a large effect on each student's achievement. Also, teachers using the AM program spent more time assisting students in individual instruction rather than focusing on whole group instruction. More students liked math in classrooms where AM was implemented in comparison to classrooms where the program was not used (Ysseldyke & Tardrew, 2007). The study demonstrated that all levels of learners benefited from the use of AM.

Kettler and Curliss (2003) concluded that AM helped increase high-ability students' achievement scores. This study focused specifically on how a tiered objectives model is recommended for teachers to use in mixed-ability classrooms. The study demonstrated that if the tiered objectives model provided by the AM Program was used then there would be positive gains in achievement scores. There are several ways to specifically use the tiered objectives model in order to increase achievement. Identifying objectives is a key factor in the success of this model. AM allows classroom teachers to identify objectives for each student. The program then keeps up with the mastery of these objectives as well as individualizes what each student specifically needs in order to promote success in mathematics. A teacher must create a set of activities for teaching each objective. As long as a classroom teacher teaches each objective, AM helps reinforce those math skills. Teachers must also be able to identify the next level of increasing complexity and group students according to their level of readiness as assessed by the STAR Math program, which is a portion of AM. If educators were willing to use a tiered objectives model, significant gains in achievement scores were likely to happen.

A different study conducted by Tieso (2006) showed impressive increases in achievement grades across the curriculum for learners of high, medium, and low ability groups. In this study the researcher studied 31 fourth and fifth grade teachers who were randomly assigned to one of three treatment groups that included a comparison group, a revision group, and a differentiation group and their students from four New England school districts. Students in each group were evaluated using a curriculum-based assessment, based on local standards, their math textbook, and curriculum materials. Each group of students was given a pretest and a posttest that demonstrated their math abilities before and after treatment groups were implemented. The comparison group was assigned to an ability group, while the revision group and the differentiation group were not assigned based on ability. The researcher expected that there would be a significant difference between students in the three groups, and results would show that there were moderate to impressive gains for diverse learners in the ability groups. Results demonstrated that a differentiated curriculum combined with ability grouping between classes had a significant impact on students' math achievement. The researcher found that "Students who were exposed to differentiated curriculum combined with within- and between class ability grouping, experienced significantly higher mathematics achievement than students exposed to their regular textbook unit on data representation and analysis from pre-test to post-test" (p. 10). In addition, Tieso discovered that "differentiated curriculum, combined with appropriate grouping strategies could improve the achievement of high-ability or gifted students while addressing their academic and intellectual differences" (p. 12). Evidence indicated that there could be significant results in high-ability students' math scores due to the use of differentiated instruction using AM as a supplement to the normal mathematics curriculum.

Another case study also showed improvement of students' math scores after the implementation of Renaissance Learning products since 2001. Morgan Elementary school in Indiana implemented AM, *Accelerated Reader* (AR), and *Math Facts in a Flash* (MFF) programs, and since then the scores of students on the *Indiana Statewide Testing for Educational Progress* (ISTEP+) have increased significantly (Richards & Ferrell, 2007). The study was conducted by Lance Richards, the elementary school principal, and Mischelle Ferrell, a teacher at the school. At the time the case study was conducted, Morgan Elementary School was considered a Title I school with 46 % of students on free and reduced lunch. According to Richards and Ferrell (2007),

> After implementing *Accelerated Math* and *Math Facts in a Flash* in 2001, third grade math scores have grown 26 percentage points from 64 percent of students meeting standards in 2002 to 90 percent in 2006. Fourth graders were added to ISTEP+ testing in 2005, and have seen a 7 percent boost from 84 percent of students passing in 2005 to 91 percent passing in 2006 (p. 3)

Results indicated that there was no significant difference in performance between low and high socioeconomic students in math on the ISTEP+ test. Richards and Ferrell (2007) also discovered that "…the free/reduced lunch population outpaced the paid lunch students by achieving 89 percent passing as compared to paid lunch group's 84 percent" (p. 4). The Renaissance Learning products have been so successful at motivating students in math and reading that in 2006 Morgan Elementary received the title of No Child Left Behind (NCLB) Blue Ribbon School by the US Department of Education.

In an evaluation report of AM, Lambert and Algozzine (2009) demonstrated that a progress based monitoring system is a useful tool for students to use in mathematics. According to research AM is a technology enhanced tool used to customize assignments and monitor progress in math for students in grades 1-12. The evaluation report found that student attitudes were more positive after the implementation of the math program. The researchers studied three elementary schools and two junior high schools in Oklahoma. Lambert and Algozzine (2009) found "statistically significant greater achievement gains for students who participated in

Accelerated Math than for their peers who did not use the progress monitoring system; and the effects were evident for high-, middle-, and low- ability students" (p. 6). There were significant advantages for the treatment classrooms, especially in the elementary school classrooms, as evidenced by faster rates of growth on STAR Math and TerraNova achievement test score findings.

Another AM study was conducted, and researchers evaluated GT students based on math achievement after the implementation of AM (Betts et al., 2004). Students who used AM significantly outperformed the GT students who only participated in the standard mathematics curriculum for the year. AM is an effective mathematics program to promote further learning for high-ability students. Ysseldyke, Spicuzza, Kosciolek, and Boys (2003) examined the effects of the implementation of AM. Students who used AM demonstrated greater math gains on achievement tests than the control group who did not use AM. Educators have had difficulty identifying interventions to use in a mixed-ability level class. AM has five major components which are: AM grade level libraries, individualized practice assignments, teacher opportunities to praise students, status of the class reports, diagnostic reports, and student achievement is supported with the use of this program (Ysseldyke et al., 2003).

Huebener (2010) reported success when using AM as a supplement to the normal mathematics curriculum. In 2009 out of 91 students in her mathematics classrooms, 91% gained at least the expected year's worth of learning. Out of those 91%, 50% made a 1 or 2 level gain on the Florida FCAT state test. Thirteen students ended the year on grade level who had not been on grade level before implementation of AM. Huebener found that using AM is most effective in her classroom when used to supplement the existing curriculum as a way to practice concepts. Huebener said, "Math cannot be understood without practicing. I have not found any other instructional tool that focuses specifically on the student's strengths and weaknesses at the same time, like Accelerated Math does" (p. 3).

Diaz (2010) found similar results. In 2008-2009 and 2009-2010 Diaz used three Renaissance Learning tools to promote mathematics learning: STAR Math, AM, and MFF. The teacher has found that this type of differentiated environment allows for individual assignments to begin where a student will experience success, thus will move them into other objectives in a step-wise manner that follows New Mexico state standards. According to Diaz,

> At the beginning of the 2009-2010 year, 75 percent of my seventh grade students were functioning below grade level, ranging from the third-grade level to the sixth-grade level. By the end of the nine-week period only 25 percent of my students were functioning below grade level, and 75 percent of my students were working at or above grade level (p. 4).

AM is a math program that focuses on what a student does not understand and is a valuable and rewarding way to interact with students and their learning.

There is a significant amount of research available on using AM in order to increase student achievement (Ysseldyke et al., 2003). This program has the capacity to increase student math scores on achievement tests (Diaz, 2010; Huebner, 2010; Lambert & Algozzine, 2009; Ysseldyke et al., 2003). The AM program has been found to be an effective supplement to the normal mathematics curriculum. AM leads educators to individualize objectives and focus on where students are specifically in the math curriculum for their grade level. There is a tremendous amount of valid research available about the positive effects of the AM program for high-ability students (Betts et al, 2004; Kettler & Curliss, 2003; Tieso, 2006; Ysseldyke et al., 2004; Ysseldyke & Tardew, 2003).

Summary

Technology can be an effective way to promote student success. Schools in the early 21st century have become reliant on technology. It is crucial that technology be implemented in a valuable way in schools in order to increase student achievement. (Bielefedlt, 2005). NCLB requirements mandate that schools are held accountable for student success in all subject areas (No Child Left Behind, 2004). Individualized instruction along with effective forms of technology can help increase student achievement in mathematics (Cobb, 2010). Integrated Learning Systems (ILS) can be used by educators as a form of instruction and management (Jenkins & Keefe, 2003). AM, an integrated learning and management system, has been found to help increase student achievement in mathematics (Riggins-Newby, 2004). Many studies have shown that AM effectively promotes student success (Betts et al., 2004; Diaz, 2010; Lambert & Algozzine, 2009; Ysseldyke et al., 2003).

CHAPTER 3

RESEARCH METHODOLOGY

The purpose of this study was to examine the effects of Accelerated Math (AM), a computerized learning information management system, on students' achievement as measured by TerraNova. This chapter describes the methodology used in this study. It is organized into the following sections: research design, population, instrumentation, a description of the elementary schools' implementation of the program, a description of AM courseware, data collection, and data analysis.

Research Design

Participants in this study were part of a two-grade project that was conducted at 15 elementary schools in a rural county in east Tennessee. This study examined the effectiveness of AM, a computerized integration learning and management system in mathematics, on high-ability students' math achievement in comparison to high-ability students' math achievement who did not use the program, The study examined the helpfulness of using AM as a supplement to the normal math curriculum in grades 3 and 4 in 11 elementary schools, while comparing the achievement of high-ability students who used AM as a part of the curriculum to the achievement of students who did not use the program in the other remaining 4 elementary schools. Criterion-referenced (CRT) scores of high-ability students in grades 3 and 4 were analyzed to determine the value of using AM as a supplement to the curriculum. The study also examined the relationships between additional demographics and the intervention program. Statistical analyses were conducted on socioeconomic status, gender, and grade level differences to determine if the intervention had any effect on math achievement test scores of high-ability students compared to those who did not use the intervening program.

This study was an ex post facto comparative design that used the intervention AM in order to determine the effects of the program on high-ability students throughout the county. According to McMillan and Schumacher, "An ex post facto design is used to explore possible causal relationships among variables that cannot be controlled by the researcher" (p. 23). The research in an ex post facto design focuses on what has happened differently for comparable groups of subjects, then explores whether the subjects in each group are different in some way. In this research design the investigation of whether one or more preexisting conditions have possibly caused subsequent differences in the group of subjects. The conditions of the intervention have already occurred, and the researcher then collects the data to investigate the relationship of these varying conditions to subsequent behavior. This study used an intervention group and a control group to determine the effects of the AM program on math test scores of high-ability students. According to McMillan and Schumacher, "In ex post facto research, there is an intervention group and a control group that is used to determine any cause-effect relationship" (p. 224). Within this study students were not randomly assigned to the intervention or control group. Students were chosen as subjects based on their math ability and whether or not they participated in the AM program. High-ability students were chosen from the same school system as intact groups with similar qualities. The following questions and corresponding hypotheses were developed to serve as a guide for completing the study:

1. Is there a significant difference between TerraNova math scores of high-ability students who participated in the AM program and TerraNova math scores of high-ability students who did not participate in the AM program?

$Ho1_1$: There is no significant difference between TerraNova math scores of high-ability students who participated in the AM program and TerraNova math scores of high-ability students who did not participate in the AM program.

2. Is there a significant difference between TerraNova math scores of high-ability students who participated in the AM program and TerraNova math scores of high-ability students who did not participate in the AM program in regards to gender?

$Ho2_1$: There is no significant difference between TerraNova math scores of male high-ability students who participated in the AM program and TerraNova math scores of male high-ability students who did not participate in the AM program.

$Ho2_2$: There is no significant difference between TerraNova math scores of female high-ability students who participated in the AM program and TerraNova math scores of female high-ability students who did not participate in the AM program.

3. Is there a significant difference between TerraNova math score of high-ability students who participated in the AM program and TerraNova math scores of high-ability students who did not participate in the AM program in regards to socioeconomic status?

$Ho3_1$: There is no significant difference between TerraNova math scores of high-ability students who participated in the AM program and TerraNova math scores of high-ability students who did not participate in the AM program who qualified for free and reduced priced lunch.

$Ho3_2$: There is no significant difference between TerraNova math scores of high-ability students who participated in the AM program and TerraNova math scores of high-ability students who did not participate in the AM program who did not qualify for free and reduced priced lunch.

4. Is there a significant difference between TerraNova math scores of high-ability students who participated in the AM program and TerraNova math scores of high-ability students who did not participate in the AM program in regards to grade level?

$Ho4_1$: There is no significant difference between TerraNova math scores of high-ability students who participated in the AM program and TerraNova math scores of high-ability students who did not participate in the AM program in grade three.

$Ho4_2$: There is no significant difference between TerraNova math scores of high-ability students who participated in the AM program and TerraNova math scores of high-ability students who did not participate in the AM program in grade four.

Population

The population consisted of all high-ability students in grades 3 and 4 who attended 1 of the 15 elementary schools in a rural county in east Tennessee during the 2009-2010 school year. The high-ability students took the TerraNova achievement test during this school year. The population consisted of 492 high-ability students who participated in the AM program as a supplement to their normal math curriculum and 132 high-ability students who did not participate in the program. Because TerraNova test scores could be obtained for all high-ability students, the entire population of 624 students was included in the research study. Because the study consisted of such a large population, type I and II errors were minimized.

Instrumentation

The instrument used in this study was the TerraNova achievement test published by CTB/McGraw-Hill (2010). As part of the state mandated Tennessee Comprehensive Assessment Program (TCAP), the TerraNova is used for assessment purposes in grades 3 through 8 each school year. This achievement test uses multiple-choice questions and has time limits on each section. TerraNova's scoring provides both norm-referenced and criterion-referenced information for educators. According to CTB/McGraw-Hill (2010), "*TerraNova, Third Edition* Multiple Assessments measures important higher-order thinking skills as well as basic and applied skills. These assessments generate norm-referenced achievement scores, criterion-referenced objective mastery scores, and performance-level information" (p. 1).

Norm-referenced information is given in several various categories of scores. Scores are given for 11 subtests in the form of National Percentiles (NP), Normal Curve Equivalent (NCE) scores, Grade Equivalent (GE), and Scale Scores (SS). In Tennessee the department of education also provides value-added scores for grades 4 through 8 in reading, language arts, mathematics, science, and social studies (Tennessee Department of Education, 2010).

Criterion-referenced information is also provided by the TerraNova achievement test. The criterion-referenced test portion provides educators with three pieces of information for each part of the test: the number of correct questions answered, the percentage of questions answered correctly, and the proficiency status (below proficient, proficient, and advanced). This part of the test is used to determine if students meet a minimum specified level of performance (CTB/McGraw-Hill, 2010).

The most current national norm for the TerraNova achievement test is from 2007. CTB/McGraw-Hill (2010) reported that the TerraNova is both reliable and valid by stating:

> Our research methodology ensures that every assessment we design and test meets the highest standards of reliability and validity. Our methodology drives every aspect of the development process for our assessments— for test design, item development, tryout studies, standard setting, national standardization, and more. Our methodology ensures that our assessments deliver information you can trust—data that provides a solid foundation for informed instruction (p. 3)

CTB/McGraw-Hill has matched the test content to the curriculum for TerraNova as part of a statewide testing program. The company has sound policies, procedures, and standards in place to ensure a high degree of validity and reliability for the achievement assessments created (CTB/McGraw-Hill, 2010). The company also adheres to high national testing standards set by nationally recognized organizations defined by the American Educational Research Association (AERA), the American Psychological Association (APA), the National Council of Measurement in Education (NCME), and the Joint Committee on Testing Practices' (JCTP) Code of Fair Testing Practices. CTB/McGraw Hill has designed TerraNova to ensure the highest degree of reliability and validity.

Description of School's Implementation of the AM Program

During the 2001-2002 school year several of the elementary schools throughout the system studied began to implement the AM program as a supplement to the normal mathematics curriculum. The elementary schools that implemented the program provided teachers with the software and technology needed in order to use the program. All of the elementary schools that have used AM have provided various staff development opportunities that allowed educators to gain the appropriate training needed in order to implement the program successfully.

By the 2009-2010 school year 11 out of 15 elementary schools had implemented AM as a supplemental tool to instruct mathematics aligned with their normal curriculum. However, schools that use the AM program have incorporated it into their curriculum in a variety of ways.

Some schools have used the program for many years, while other schools have only used it for a short length of time. Most schools that have adopted the AM program as a tool to enhance math instruction require that all math teachers use the program on a regular basis. Other schools participating in the AM program do not require teachers to use AM at all or to implement it for any specified amount of instructional time.

A considerable investment has been made by the 11 schools that have chosen to use the AM program as a supplement to the state mandated mathematics curriculum. The school system is continually seeking ways to improve students' math achievement. It is hopeful that this study might provide information on the effectiveness of the AM program.

Description of AM Program

AM is a task-level computerized learning information management system designed to provide information to allow teachers to individualize mathematics instruction, allowing students to work in their zone of proximal development (ZPD), support NCTM and state standards, increase academic learning time on task, generate reports for teachers, and provide immediate feedback to students (Ysseldyke & Tardew, 2007). This scientifically-based research program monitors all students' progress as they work through math objectives aligned with the state's math curriculum. Students are allowed to work on mathematics at their own pace, and the assignments meet students where they are academically. AM allows teachers to instruct students on their own level with minimal paperwork. AM has a random generator that is capable of generating a never-ending supply of unique problems for students to complete on each new objective. Not only do students receive the practice needed on new skills, but periodic review questions are provided as well on previously mastered objectives. The computerized program keeps track of all students' work and progress and tells teaches when a student is ready to test on objectives that are mastered (Betts et al., 2010). In order for students to master any objective assigned, they must score a mastery level of 80% as determined by the AM program. Schools using the AM program have the ability to change the initial level of mastery if desired. Many reports can be generated by AM or by the teacher in order to track student and classroom progress while using the program.

Data Collection

Approval was granted from the Institutional Review Board (IRB) at East Tennessee State University prior to collecting data. In addition, written permission was received by the director of schools for the use of the archival data from the school system being examined. Data consisted of demographics and TerraNova math scores for students in grades 3 and 4 during the 2009-2010 school year. Data were provided by the director of accountability and testing for the school system. The data provided did not identify students in any manner. Identifiable information such as student names, social security numbers, and birth dates were eliminated prior to obtaining the data. The school system provided a unique I.D. number for each student that was used to look at student achievement scores for the purpose of this study. After receiving the data of all third and fourth grade students' TerraNova math scores, it was determined which students were considered to have a high-ability in mathematics. Using the data, the researcher used the students who scored proficient or advanced on the TerraNova as the high-ability population of students. During the 2009-2010 school year 1,569 third and fourth graders who took the TerraNova achievement test. Of the 1,569 student population, 624 students were chosen as part of the high-ability group for this study.

Data Analysis

Both descriptive and inferential statistics were used in the data analysis of this study. Descriptive statistics were used to provide a profile for the population of students studied. The set of data came from the TerraNova Comprehensive Tests of Basic Skills (CTB/McGraw-Hill, 2010). Once gathered, data were entered into the Statistical Program for Social Sciences (SPSS) statistical package. Based on the 2010 TerraNova test results, data consisted of the percentage correct and the proficiency (below basic, basic, proficient, or advanced) status from the CRT portion of the mathematics subtest. The data provided allowed the researcher to analyze CRT in order to determine the effects of AM on high-ability students' achievement.

SPSS was used to analyze the data. Inferential statistics were also used to determine the effects and relationships among the variables. Using inferential statistics, the researcher ran a series of independent samples t-tests for grades three and four. The purpose of this procedure was to determine if there was a statistically significant difference in the dependent variable between two different populations of subjects (McMillan & Schumacher, 2010). While conducting the series of independent samples *t*-tests with SPSS, the mean and standard deviation were calculated from each sample and used to determine the t-statistic. Last, the *t*-statistic was evaluated based on the specified degrees of freedom and the predetermined level of significance set in order to determine if the null hypotheses could be rejected by the researcher. High-ability third and fourth grade students' math scores from TerraNova were analyzed. All statistical analysis was conducted using a preset alpha level of .05, which was used to conclude the statistical level of significance of the data tested. The effect size was also calculated in order to determine the impact of the AM program intervention. A series of independent *t*-tests were used to address the research questions and null hypotheses.

Summary

This study examined the effects of AM on third and fourth grade high-ability students' math achievement in comparison to third and fourth grade high-ability students' math achievement and did not use the program. The study also examined the relationship between additional demographics such as gender, socioeconomic status, and grade level to the intervening program. This study was an ex post facto comparative design that used the AM program in order to determine the effects of the program on high-ability students in the county. A series of independent *t*-tests were used to address the research questions and null hypotheses.

CHAPTER 4

RESULTS AND ANALYSIS OF DATA

Increased demands are being placed on school systems nationally to improve achievement tests scores. This study was designed to compare TerraNova mathematics achievement test scores among third and fourth grade high-ability students who participated in the AM program to third and fourth grade high-ability students who did not participate in the program for the year 2009-2010. Archival data were collected on the above indicators using 2009-2010 TerraNova mathematics achievement test scores provided by the director of accountability and testing for the large rural county in east Tennessee.

This study also examined the TerraNova math scores of high-ability students in regards to gender, socioeconomic status, and grade level among students who participated in the AM program in comparison to students with these characteristics who did not participate in AM. In 2009-2010, there were 1,549 students enrolled in third and fourth grades in 15 elementary schools across the school system. Eleven of the 15 elementary schools participated in the AM program, while 4 of the schools did not participate in the math program. Of the 1,546 students enrolled in grades 3 and 4, 624 students were determined to be high-ability students. Students who were considered to be high-ability scored proficient or advanced on the TerraNova mathematics achievement test in 2009-2010.

Table 1 shows the number of third and fourth grade male and female high-ability students who did and did not participate in the AM Program as well as the number of third and fourth grade high-ability students with low and high socioeconomic status who did and did not participate in the AM Program during the 2009-2010 school year.

Table 1

Number of 2009-2010 AM and Non-AM High-Ability Third and Fourth Grade Students Compared by Grade Level, Gender, and Socioeconomic Status

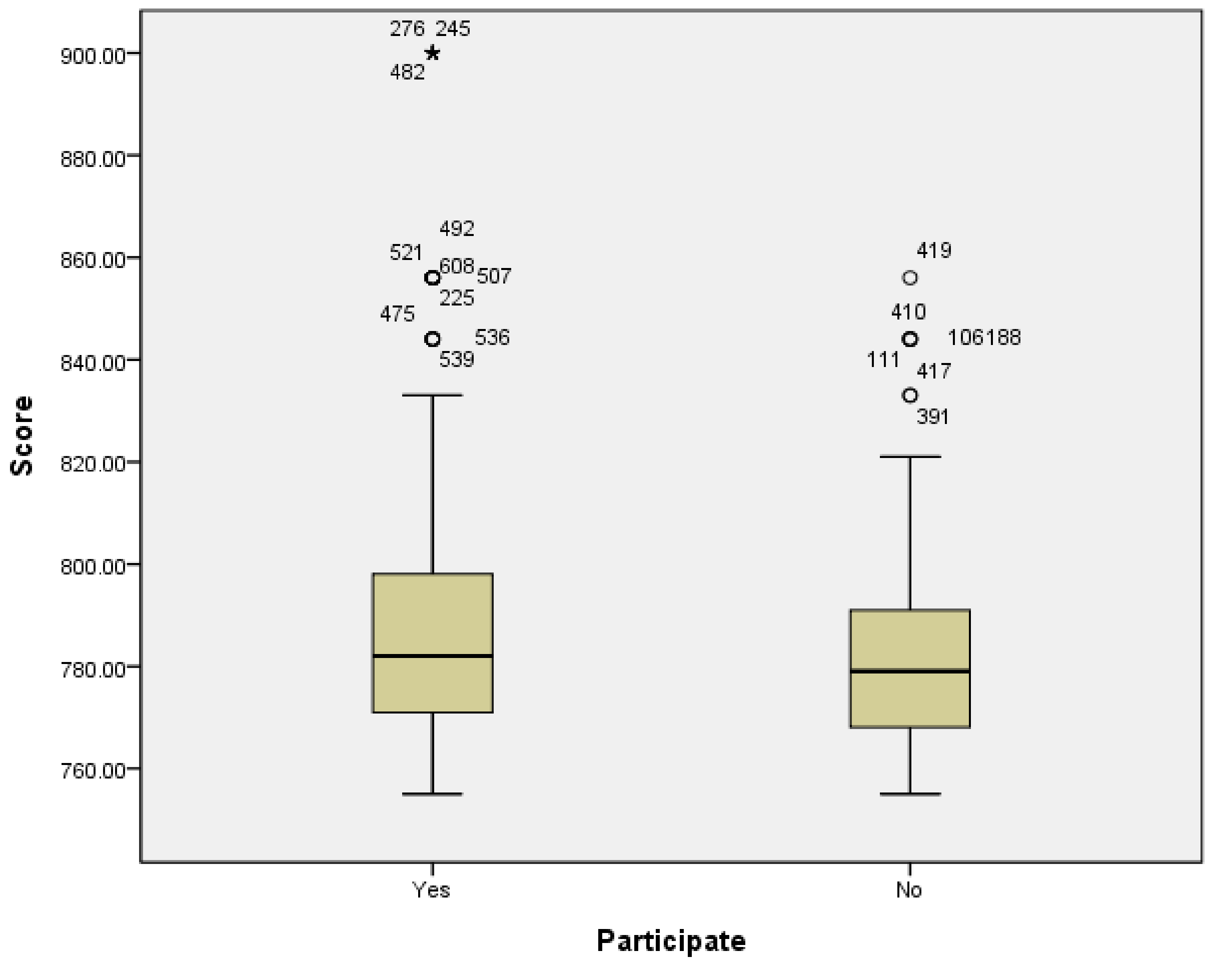
Grade Level		Number of 2009-2010 AM students	Number of 2009-2010 Non-AM students	Total
Males	3	139	33	172
Females	3	144	34	178
Low SES	3	179	54	233
High SES	3	121	13	134
Males	4	107	34	141
Females	4	102	36	138
Low SES	4	119	49	168
High SES	4	89	21	110
Total		1,000	274	1,274

Research Question 1

Is there a significant difference between TerraNova math scores of high-ability students who participated in the AM program and TerraNova math scores of high-ability students who did not participate in the AM program?

$Ho1_{1:}$ There is no significant difference between TerraNova math scores of high-ability students who participated in the AM program and TerraNova math scores of high-ability students who did not participate in the AM program.

An independent-samples *t* test was conducted to evaluate the null hypothesis that there was no difference between TerraNova math scores of high-ability students who participated in the AM program to those who did not participate in the AM program for the 2009-2010 school year. The test was not significant, $t(624) = 1.93$, $p = .055$. Therefore the null hypothesis $Ho1_1$ was retained. High-ability students who participated in the AM program ($M = 786.96$, $SD = 24.21$) scored only slightly higher on the TerraNova math achievement test than high-ability students who did not participate in the AM program ($M = 782.60$, $SD = 20.36$). The 95% confidence interval for the difference in means ranged from -.09 to 8.80. The η^2 index of .01 indicated a small effect size. Figure 1 shows the distributions of the two groups.



O = an observation between 1.5 and 3.0 times the interquartile range, with case numbers indicated

*= an extreme outlier and an observation above 3.0 times the interquartile range, with case numbers indicated

Note: AM participants = 489, Non-AM participants = 137

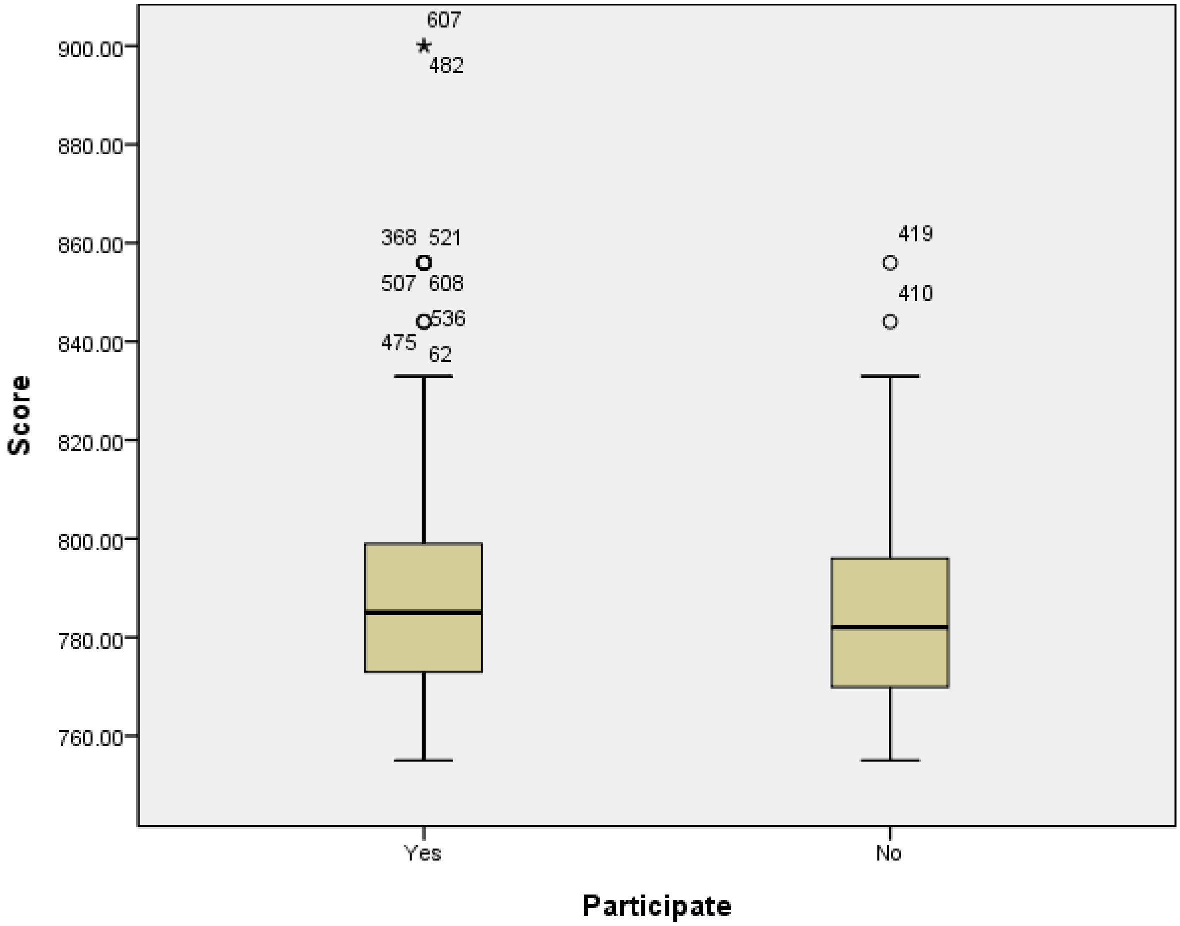
Figure 1. Distributions of the 2009-2010 TerraNova Math Test Scores for the 15 Participating School Systems

Research Question 2

Is there a significant difference between TerraNova math scores of high-ability students who participated in the AM program and TerraNova math scores of high-ability students who did not participate in the AM program in regards to gender?

$Ho2_1$: There is no significant difference between TerraNova math scores of male high-ability students who participated in the AM program and TerraNova math scores of male high-ability students who did not participate in the AM program.

An independent-samples *t* test was conducted to evaluate the null hypothesis that there was no difference in TerraNova math achievement scores between high-ability male students who participated in the AM program and high-ability male students who did not participate in the program for the 2009-2010 school year. The test was not significant, $t(308) = 1.58$, $p = .12$. Therefore the null hypothesis $Ho2_1$ was retained. High-ability male students who participated in the AM program ($M = 789.84$, $SD = 24.59$) scored only slightly higher on the TerraNova math achievement test than high-ability male students who did not participate in the program ($M = 784.64$, $SD = 21.01$). The 95% confidence interval for the difference in means ranged from -1.28 to 11.68. The η^2 index of .003 indicated a small effect size. Figure 2 shows the distributions for the two groups of males.



o = an observation between 1.5 and 3.0 times the interquartile range, with case numbers indicated

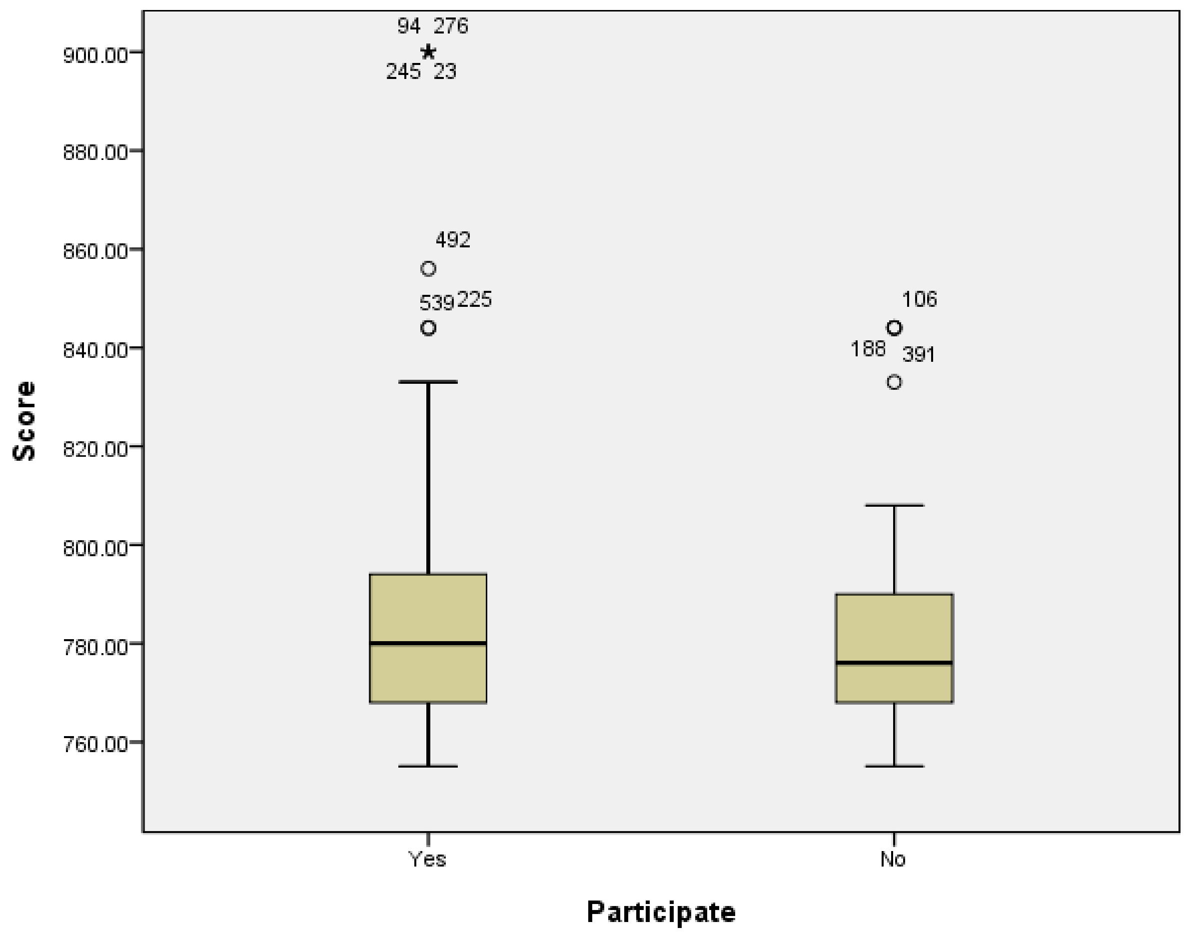
*= an extreme outlier and an observation above 3.0 times the interquartile range, with case numbers indicated

Note: High-ability Male Student Participants in AM = 243, High-ability Male Student Non-participants in AM = 67

Figure 2. Distributions of the 2009-2010 TerraNova Math Achievement Test Scores of 3rd and 4th Grade Male High-Ability Students Who Did and Did Not Participate in AM

$Ho2_2$: There is no significant difference between TerraNova math scores of female high-ability students who participated in the AM program and TerraNova math scores of female high-ability students who did not participate in the AM program.

An independent-samples *t* test was conducted to evaluate the null hypothesis that there was no difference in TerraNova math achievement scores between high-ability female students who participated in the AM program and high-ability female students who did not participate in the program. The test was not significant, $t(314) = 1.13$, $p = .26$. Therefore the null hypothesis was retained. Female high-ability students who participated in the AM program ($M = 784.11$, $SD = 23.53$) scored only slightly higher on the TerraNova than female high-ability students who did not participate in the AM program ($M = 780.64$, $SD = 19.66$). The 95% confidence interval for the difference in means ranged from -2.59 and 9.53. The η^2 index of .004 indicated of a small effect size. Figure 3 shows the distribution for the two groups.



o = an observation between 1.5 and 3.0 times the interquartile range, with case numbers indicated

*= an extreme outlier and an observation above 3.0 times the interquartile range, with case numbers indicated

Note: High-ability Female Student Participants in AM = 246, High-ability Female Student Non-participants in AM = 70

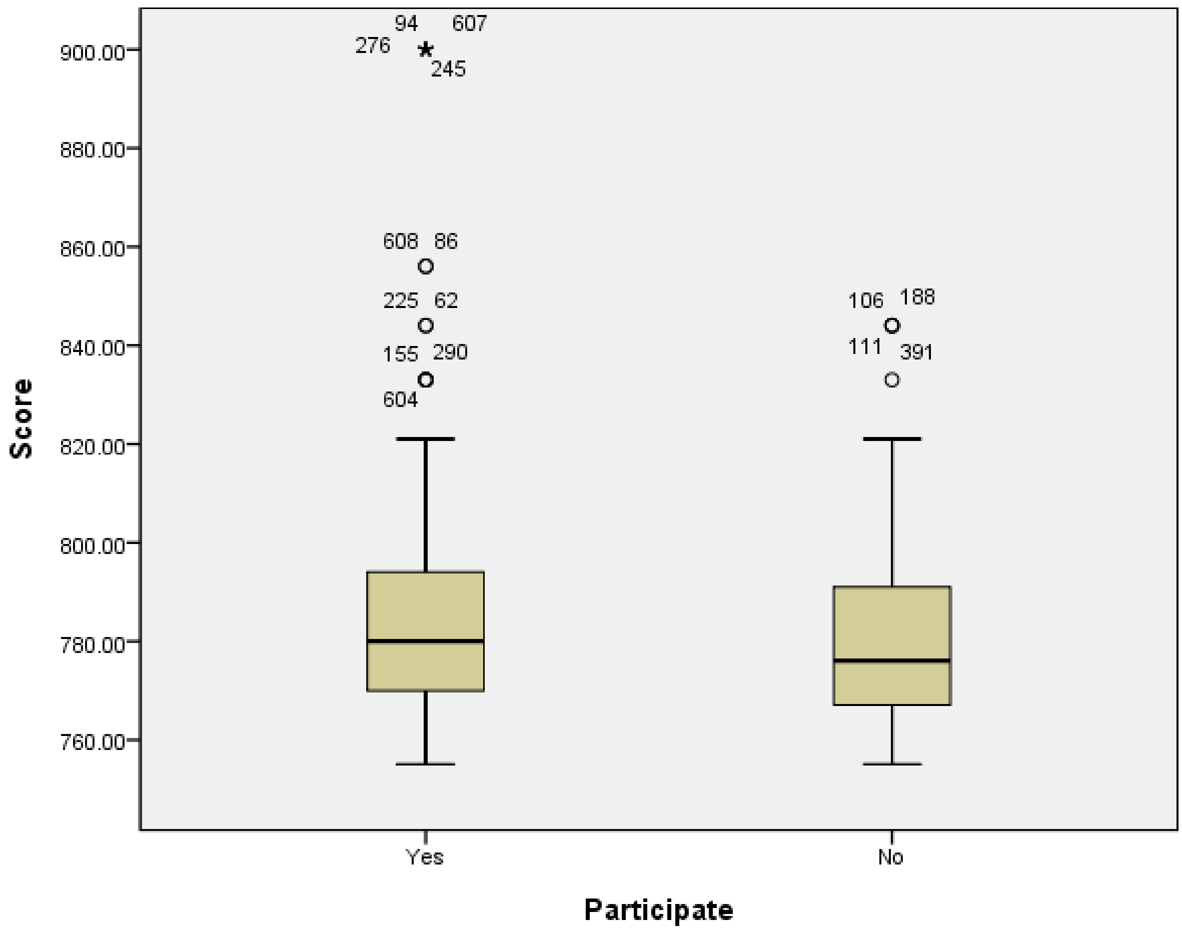
Figure 3. Distributions of the 2009-2010 TerraNova Math Achievement Test Scores of 3rd and 4th Grade High-Ability Female Students Who Did and Did Not Participate in AM

Research Question 3

Is there a significant difference between TerraNova math scores of high-ability students who participated in the AM program and the TerraNova math scores of high-ability students who did not participate in the AM program in regards to socioeconomic status?

$Ho3_1$: There is no significant difference between TerraNova math scores of high-ability students who participated in the AM program and TerraNova math scores of high-ability students who did not participate in the AM program who qualified for free and reduced priced lunch.

An independent-samples *t* test was conducted to evaluate the null hypothesis that there is no difference in TerraNova math achievement test scores between high-ability students on free and reduced lunch that participated in the AM program and the high-ability students on free and reduced lunch that did not participate in the AM program for the 2009-2010 school year. The test was significant, $t(394) = 1.99$, $p = .048$. Therefore the null hypothesis $Ho3_1$ was rejected. High-ability students on free and reduced lunch who participated in the AM program (M = 785.46, SD = 24.10) scored significantly higher on the *TerraNova* math achievement test than high-ability students on free and reduced lunch who did not participate in the program (M = 780.22, SD = 19.27). The 95% confidence interval for the difference in means ranged from .05 to 10.43. The η^2 index of .003 indicated a small effect size. Figure 4 shows the distributions for the two groups.



o = an observation between 1.5 and 3.0 times the interquartile range, with case numbers indicated

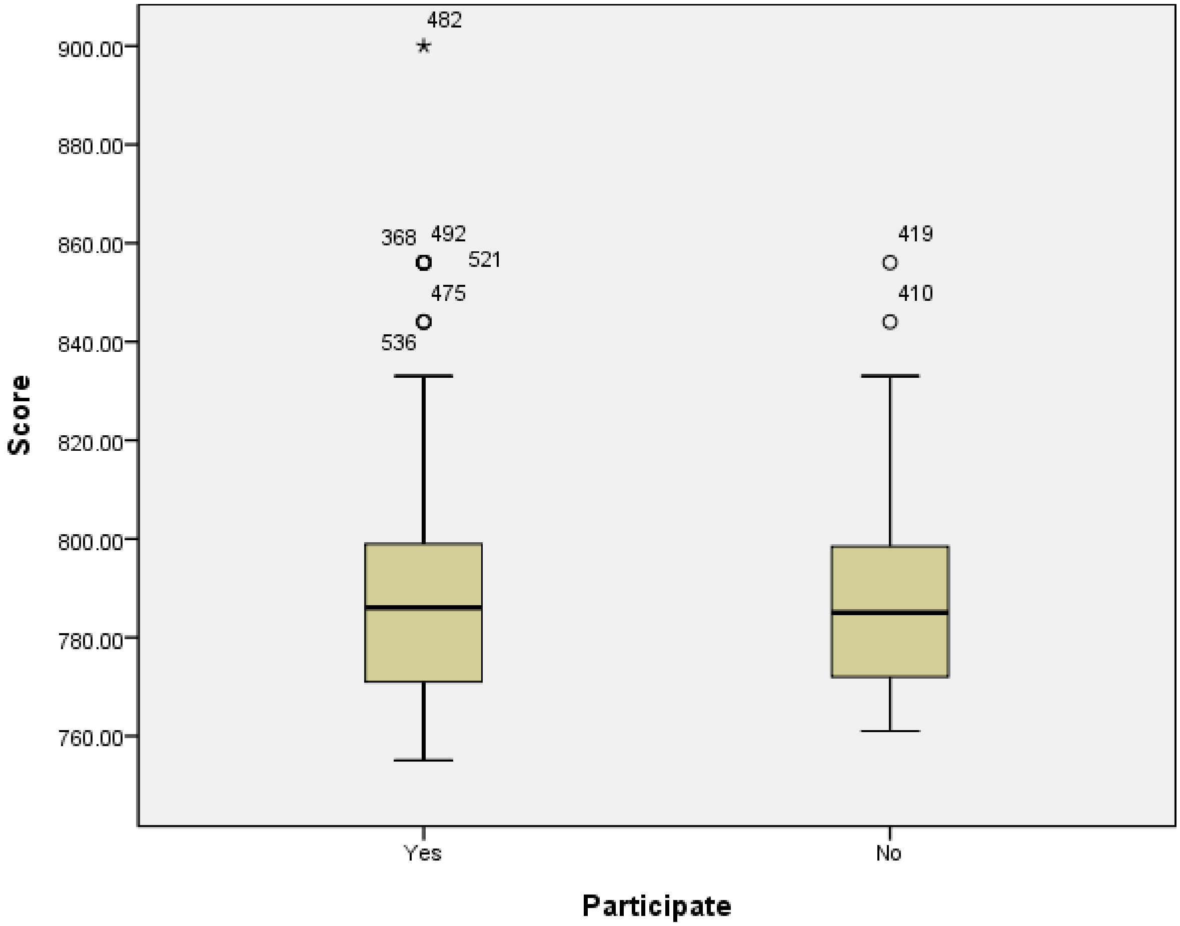
*= an extreme outlier and an observation above 3.0 times the interquartile range, with case numbers indicated

Note: AM Participants on Free and Reduced Lunch = 294, Non-AM participants on Free and Reduced Lunch = 102

Figure 4. Distributions of the 2009-2010 TerraNova Math Scores of High-Ability Students on Free and Reduced Lunch Who Participated in the AM Program and the Scores of High-Ability Students on Free and Reduced Lunch Who Did Not Participate in the AM Program

$Ho3_2$: There is no significant difference between *TerraNova* math scores of high-ability students who participated in the AM program and *TerraNova* math scores of high-ability students who did not participate in the AM program who did not qualify for free and reduced priced lunch.

An independent-samples *t* test was conducted to evaluate the null hypothesis that there was no difference between high-ability students who did not qualify for free and reduced priced lunch that participated in the AM program and the high-ability students who did not qualify for free and reduced lunch that did not participate in the AM program for the 2009-2010 school year. The test was not significant, $t(228) = .07$, $p = .94$. Therefore the null hypothesis was retained. High-ability students who did not qualify for free and reduced lunch who participated in the AM program (M = 789.23, SD = 24.27) scored only slightly lower on the TerraNova math achievement test than students who did not qualify for free and reduced lunch who did not participate in the AM program (M = 789.54, SD = 22.09). The 95% confidence interval for the difference in means ranged from -8.98 to 8.35. The η^2 index of < .01 indicated a small effect size. Figure 5 shows the distributions for the two groups.



o = an observation between 1.5 and 3.0 times the interquartile range, with case numbers indicated

*= an extreme outlier and an observation above 3.0 times the interquartile range, with case numbers indicated

Note: AM Participants Who Did Not Qualify for Free and Reduced Lunch = 195, Non-AM Participants Who Did Not Qualify for Free and Reduced Lunch = 35

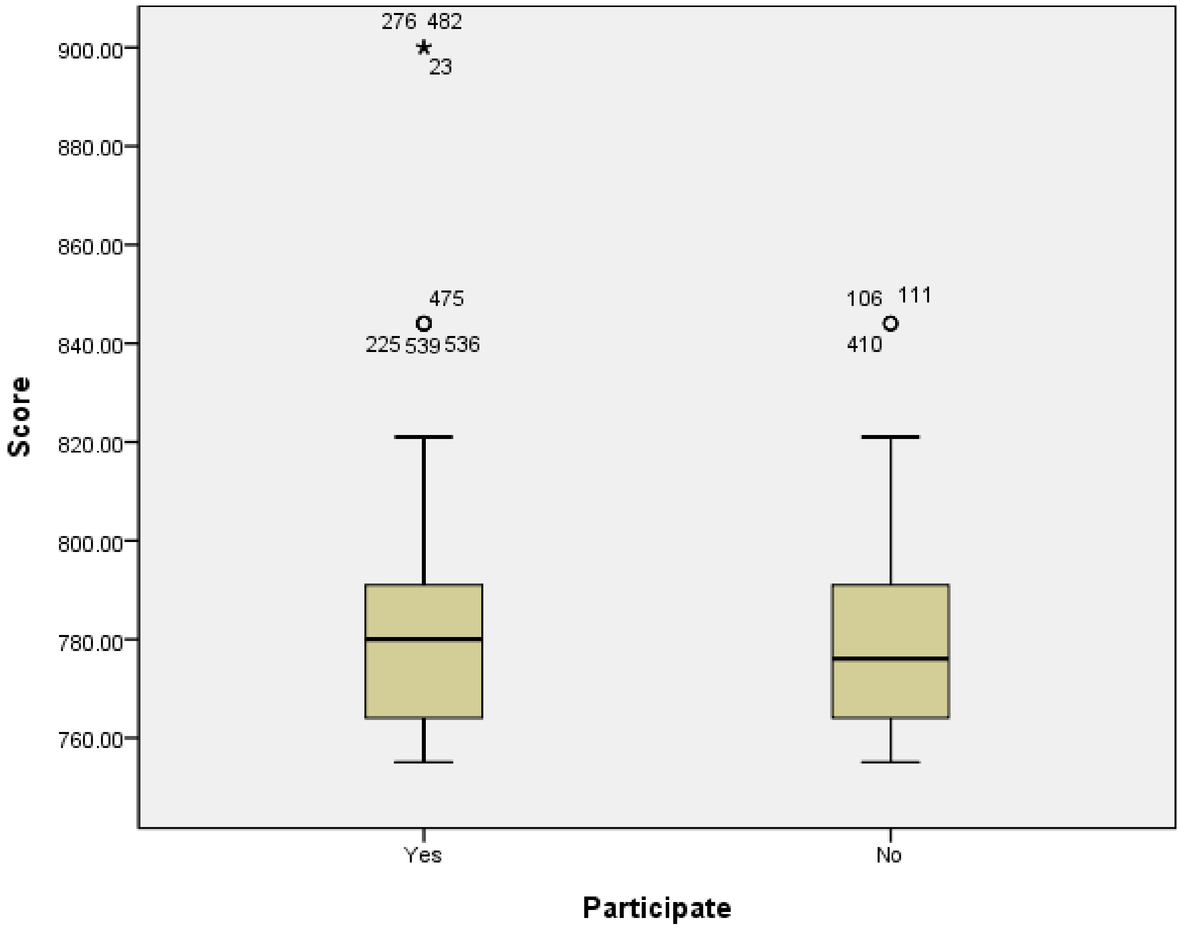
Figure 5. Distributions of the 2009-2010 TerraNova Math Achievement Test Scores of High-Ability Students Who Participated in AM Who Did Not Qualify for Free and Reduced Lunch and Scores of High-Ability Students Who Did Not Participate in AM Who Did Not Qualify for Free and Reduced Lunch

Research Question 4

Is there a significant difference between TerraNova math scores of high-ability students who participated in the AM program and TerraNova math scores of high-ability students who did not participate in the AM program in regards to grade level?

$Ho4_1$: There is no significant difference between TerraNova math scores of high-ability students who participated in the AM program and TerraNova math scores of high-ability students who did not participate in the AM program in grade 3.

An independent-samples *t* test was conducted to evaluate the null hypothesis that there was no difference between TerrraNova math achievement test scores of third grade students who did participate in the AM program and the scores of third grade students who did not participate in the AM program for the 2009-2010 school year. The test was not significant, $t(347) = .87$, $p = .38$. Therefore the null hypothesis $Ho4_1$ was retained. High-ability students in third grade who participated in the AM program ($M = 782.28$, $SD = 22.83$) scored only slightly higher than high-ability students in third grade who did not participate in the AM program ($M = 779.58$, $SD = 22.39$). The 95% confidence interval for the difference in the means ranged from -3.39 to 8.78. The η^2 index of .002 indicated a small effect size. Figure 6 shows the distributions for the two groups.



o = an observation between 1.5 and 3.0 times the interquartile range, with case numbers indicated

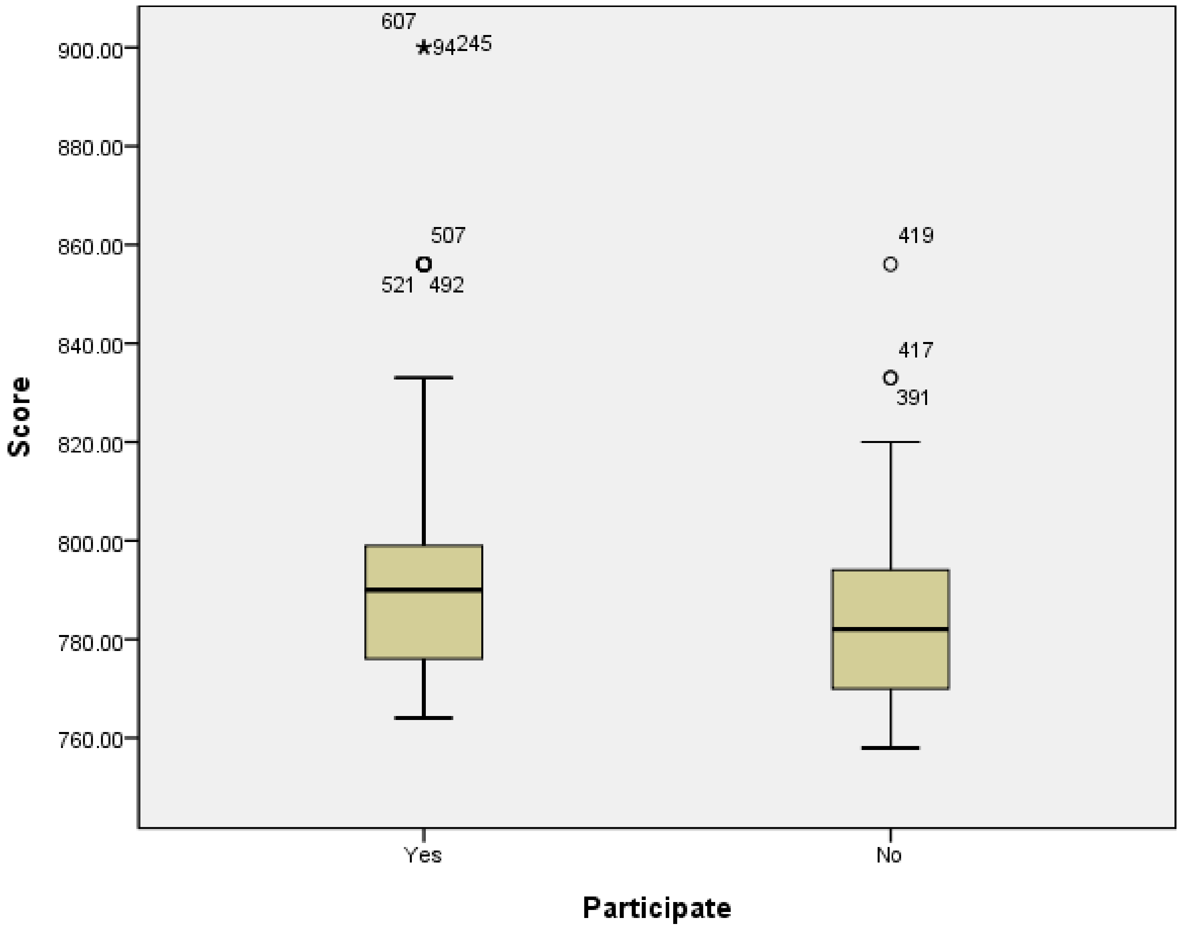
*= an extreme outlier and an observation above 3.0 times the interquartile range, with case numbers indicated

Note: AM Participants in Grade Three = 282, Non-AM Participants in Grade Three = 67

Figure 6. Distributions of the 2009-2010 TerraNova Math Achievement Test Scores of Third Grade Students Who Did and Did Not Participate in the AM Program

$Ho4_2$: There is no significant difference between TerraNova math scores of high-ability students who participated in the AM program and TerraNova math scores of high-ability students who did not participate in the AM program in grade four.

An independent-samples *t* test was conducted to evaluate the null hypothesis that there was no difference between TerraNova math achievement test scores of fourth grade students who participated in the AM program and the scores of fourth grade students who did not participate in the AM program for the 2009-2010 school year. The test was significant, $t(275) = 2.46$, $p = .02$. Therefore the null hypothesis was rejected. High-ability students in grade 4 who participated in the AM program ($M = 793.33$, $SD = 24.63$) scored significantly higher than high-ability students in grade 4 who did not participate in the AM program ($M = 785.49$, $SD = 17.89$). The 95% confidence interval for the difference in means ranged from 1.56 to 14.15. The η^2 index of .02 indicated a small effect size. Figure 7 shows the distributions for the two groups.



o = an observation between 1.5 and 3.0 times the interquartile range, with case numbers indicated

*= an extreme outlier and an observation above 3.0 times the interquartile range, with case numbers indicated

Note: AM Participants in Grade Four = 207, Non-AM Participants in Grade Four = 70

Figure 7. Distributions of the 2009-2010 *TerraNova* Math Achievement Test Scores of 4th Grade Students Who Did and Did Not Participate in the AM Program

Summary

Increasing TerraNova math achievement test scores is one area of concern for a single large rural county in east Tennessee. This study compared TerraNova mathematics achievement test scores among third and fourth grade high-ability students who participated in the AM program to third and fourth grade high-ability students who did not participate in the program for the 2009-2010 school year. This study also explored TerraNova math scores of high-ability students in regards to gender, socioeconomic status, and grade level among students who participated in the AM program in comparison to students with these characteristics who did not participate in AM.

The study resulted in several significant findings between students who did and did not participate in the AM program, while findings of other characteristics were not found to be significant. There was no significant difference found between TerraNova math scores of high-ability students who participated in the AM program to the TerraNova math scores of high-ability students who did not participate in the program in regards to gender. However, there was a significant difference found in TerraNova math scores between high-ability third and fourth grade students who did and did not qualify for free and reduced lunch. Students who qualified for free and reduced priced lunch who participated in the AM program scored significantly higher on the TerraNova math test than students who qualified for free and reduced priced lunch who did not participate in the program. In addition, there was a significant difference found in TerraNova math scores between high-ability students who did and did not participate in regards to grade level. High-ability students in grade 4 who participated in the AM program scored significantly higher on the TerraNova math achievement test than high-ability students in grade four who did not participate in the program.

CHAPTER 5

SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS FOR FUTURE RESEARCH AND TO IMPROVE PRACTICE

The purpose of this study was to examine the effects of Accelerated Math (AM), a computerized learning information management system, on students' achievement as measured by TerraNova. Out of 15 elementary schools, 11 used the AM program in grades 3 and 4 as a supplement to the normal curriculum during the 2009-2010 school year, while 4 schools did not use the program. This study was conducted in a large rural county of east Tennessee using data exclusively from the mathematics scores on TerraNova achievement tests of all third and fourth grade students for the 2009-2010 school year. Statistical measures were used to conclude if there was a significant difference between third and fourth grade TerraNova math achievement test scores for those who participated in the AM program to scores of those who did not participate in the AM program. Chapter 5 contains a summary of the study, a summary of the findings, conclusions, recommendations for practice, and recommendations for further research.

Summary of the Study

This quantitative study examined whether AM, a computerized learning information management system, would impact the criterion-referenced scores of the TerraNova math achievement test in a statistically significant manner. The population for this study consisted of 624 high-ability third and fourth grade students who participated in the TerraNova math achievement test during the 2009-2010 school year. TerraNova math scores of third and fourth grade high-ability students who participated in the AM program were compared with TerraNova math scores of third and fourth grade high-ability students who did not participate in the AM program for that year.

Summary of Findings

The purpose of this study was to determine if the AM program played a role in increasing TerraNova mathematics achievement test scores of third and fourth graders in the school system. The statistical analysis detailed in the study was centered on four research questions presented in Chapter 1 and 3. The seven null hypotheses that concentrated on the AM program's association on math achievement test scores were listed in Chapter 3. A series of independent-sample *t* tests were used to answer each research question and the corresponding hypotheses. The level of significance used in the test was .05. Presented in this section are each research question and a summary of the related results.

Research Question 1

Is there a significant difference between TerraNova math scores of high-ability students who participated in the AM program and the TerraNova math scores of high-ability students who did not participate in the AM program?

An independent-samples *t* test was conducted to evaluate whether there was a significant difference between the mean of third and fourth grade high-ability students' TerraNova math scores who participated in the AM program to the math scores of those who did not participate in the AM program. The null hypothesis was retained. Results indicated that the TerraNova math achievement test scores of high-ability third and fourth grade students who participated in the AM program were not significantly higher than those who did not participate in the AM program.

There was not a statistically significant relationship between high-ability third and fourth grade students' TerraNova math achievement test scores who participated in the AM program to those who did not participate in the AM program. The findings in this group did not support earlier conducted research (Betts et al., 2004; Ysseldyke & Bolt, 2007) that found participating in the AM program resulted in higher academic achievement on standardized test outcomes for high-ability students. Some analysts have suggested the current standardized tests now in place are the most accurate means of assessing students' achievement (Bos, 2009; Fuchs, 2004). However, other studies have found that standardized test results should not be the sole factor in determining what students learned throughout one school year. Jensen (2005) found that there is a small amount of evidence that supports a seamless transition of skills that are needed to be successful at taking standardized tests to other, more functional areas of a student's life. Berry, Daughtrey, and Wieder (2010) argue the right tests need to be used with tools that accurately measure student growth in order to determine their achievement. Other environmental factors such as family background and school characteristics can be negatively related to student performance in reading and mathematics (Fuchs, 2004).

Research Question 2

Is there a significant difference between TerraNova math scores of high-ability students who participated in the AM program and TerraNova math scores of high-ability students who did not participate in the AM program in regards to gender?

One independent-samples *t* test was conducted to evaluate whether there was a significant difference between the male high-ability third and fourth grade students' TerraNova math achievement test scores who participated in the AM program to those who did not participate in the AM program. The null hypothesis was retained. Results indicated that male high-ability students’ math scores on the TerraNova achievement test in third and fourth grade who participated in the AM program were not significantly higher than the scores of males who did not participate in the program.

An independent-samples *t* test was conducted to evaluate whether there was a significant difference between female high-ability third and fourth grade students’ TerraNova math achievement test scores who participated in the AM program to those who did not participate in the AM program. The null hypothesis was retained. Results indicated that female high-ability students’ math scores of the TerraNova achievement test in third and fourth grade who participated in the AM program were not significantly higher than the scores of females who did not participate in the program.

There was not a statistically significant relationship between high-ability third and fourth grade students’ TerraNova math achievement test scores who participated in the AM program to those who did not participate in the AM program in regards to gender. The mean of TerraNova math test scores for males was higher than the mean of the math test scores for females; however, whether male or female high-ability students used the AM program, there was no significant difference. The findings for this study coincide with research from previous studies. Research has indicated mixed findings for the overall effects of technology use with mathematics (Bielefeldt, 2005; Kulik, 2003; Wenglinsky, 1998). Bielefeldt (2005) found evidence that the use of technology can have a significant impact on learning, while Goolsbee and Guryan (2002) found negative findings in relation to technology use and math achievement. However, effective technology programs have been found to significantly help increase student test scores. Betts, Tardew, and Ysseldyke (2004) discovered positive results in mathematics achievement test scores after the implementation of AM when high-ability males and females who were using the program significantly outperformed the high-ability students who only participated in the normal mathematics curriculum.

Research Question 3

Is there a significant difference between TerraNova math scores of high-ability students who participated in the AM program and TerraNova math scores of high-ability students who did not participate in the AM program in regards to socioeconomic status?

An independent-samples *t* test was conducted to evaluate whether there was a significant difference between the TerraNova math achievement test scores of third and fourth grade students who qualified for free and reduced priced lunch and who participated in the AM program to the math scores of those who qualified for free and reduced priced lunch and who did not participate in the program. The null hypothesis was rejected. Results indicated that high-ability third and fourth graders who qualified for free and reduced priced lunch and who participated in the AM program scored significantly higher on the TerraNova math achievement test than students who qualified for free and reduced priced lunch and who did not participate in the AM program.

An independent-samples *t* test was conducted to evaluate whether there was a significant difference between TerraNova math achievement test scores of third and fourth grade students who did not qualify for free and reduced priced lunch and who participated in the AM program to the math scores of those who did not qualify for free and reduced priced lunch and who did not participate in the program. The null hypothesis was retained. Results indicated that third and fourth grade high-ability students who did not qualify for free and reduced priced lunch and who participated in the AM program did not score significantly higher on the TerraNova math achievement test than students who did not qualify for free and reduced priced lunch and who did not participate in the AM program.

There was a statistically significant difference between third and fourth grade high-ability students' TerraNova math achievement test scores who qualified for free and reduced priced lunch and who participated in the AM program and scores of students who qualified for free and reduced priced lunch and who did not participate in the AM program. However, there was not a statistically significant difference between third and fourth grade high-ability students' TerraNova math achievement test scores who did not qualify for free and reduced priced lunch and who participated in the AM program and the scores of students who did not qualify for free and reduced priced lunch and who did not participate in the AM program. These findings correspond with several previous research studies. Ysseldyke and Tardew (2003) found that students who qualified for free and reduced lunch achieved significantly greater gains on mathematics achievement tests after the use of AM for 1 school year when compared to free and reduced lunch students who did not use the AM program. Richards and Ferrell (2007) also discovered that after the implementation of AM in a Title I school with 46% of students on free and reduced lunch that the free and reduced lunch population outpaced the paid lunch students by achieving significantly higher scores on the ISTEP+ test.

Research Question 4

Is there a significant difference between TerraNova math scores of high-abilty students who participated in the AM program and TerraNova math scores of high-ability students who did not participate in the AM program in regards to grade level?

An independent-samples *t* test was conducted to evaluate whether there was a significant difference between the TerraNova math achievement test scores of third grade students who participated in the AM program to the math scores of third grade students who did not participate in the AM program. The null hypothesis was retained. Results indicated that high-ability third grade students' TerraNova math achievement test scores who participated in the AM program were not significantly higher than scores of high-ability third grade students who did not participate in the AM program.

An independent-samples *t* test was conducted to evaluate whether there was a significant difference between TerraNova math achievement test scores of fourth grade students who participated in the AM program to the math scores of fourth grade students who did not participate in the AM program. The null hypothesis was rejected. Results indicated that high-ability fourth grade students' TerraNova math achievement test scores who participated in the AM program were significantly higher than the scores of high-ability fourth grade students who did not participate in the AM program.

There was a not statistically significant difference between third grade high-ability students' TerraNova math achievement test scores who participated in the AM program and the scores of third grade students who did not participate in the AM program. However, there was a statistically significant difference between fourth grade high-ability students' TerraNova math achievement test scores who participated in the AM program and the scores of fourth grade students who did not participate in the AM program. This study's finding is supported through prior research. Huebener (2010) found that AM was a successful math program to help fill curriculum gaps, provide remedial work, and revisit concepts throughout the year for students. Lambert and Algozzine (2009) discovered statistically significant greater achievement gains for students who participated in AM, especially in the upper elementary school classrooms. What Works Clearinghouse (2010) reviewed upper elementary and middle school math program such as AM and discovered substantial technology use in the classroom positively affected achievement. Riggins-Newby (2004) stated that math needs to be more than just computation for students, and a technology enabled and joyful learning mathematics environment equals success in the upper elementary school classrooms.

Recommendations for Practice

This study provided insight into the impact that an individualized math program, AM, may have on standardized test scores. The following recommendations for practice are a result of the findings and conclusions of this research.

1. School systems should consider implementing an integrated computerized learning system that differentiates instruction, like AM, in all elementary schools. The amount of research that supports the positive aspects of individualized learning should not be ignored by stakeholders in education. Individualizing instruction for students has many positive benefits when done effectively (Jenkins & Keefe, 2003). DeStasio (2009) has found evidence that indicated individualized instruction has a positive effect on student achievement. Jenkins and Keefe (2003) discovered that technology-assisted learning can be used to expand learning opportunities for more students by allowing students to use the computer to move through a predetermined curriculum at their own pace. Research has shown that combining technology with differentiated instruction is an effective way to meet students' individual needs (Cobb, 2010; Hsiao et al., 2010; Stroud, 2009). Stroud (2009) argues that technology is the best way to allow teachers to differentiate instruction in the classroom. Elementary schools should find a program that combines technology with differentiated instruction to use to enhance student learning in order to promote mathematics achievement for their students.

2. School systems should consider implementing an integrated computerized learning system like AM in all elementary schools with a 70% free and reduced rate or above. Programs that monitor student progress and individualize student learning have been found to increase student achievement in Title I schools (Ysseldyke & Tardew, 2003). Educators who are willing to use a tiered objectives model will show significant gains on achievement tests, especially with students who qualify for free and reduced lunch (Kettler & Curliss, 2003). Tieso (2006) noted that a differentiated curriculum had a significant impact on free and reduced lunch students' math achievement test scores. Schools that are considered to be Title I should offer their students an individualized mathematics program like AM in order to help increase students' achievement with lower socioeconomic statuts.
3. School systems that have schools participating in programs like AM need to provide staff development opportunities for teachers, administrators, and decision-makers. All stakeholders in education need to be familiar with the programs in place for student use within their school system. According to Education Digest (2010), attitudes of teachers, parents, and students make a difference in students' achievement in mathematics. Using technology in an effective manner is the key to student achievement (Bielefedlt, 2005). Tester (2003) found that in order to effectively integrate technology students and teachers must have equitable access to technology, teachers must receive adequate training in the use of technology aligned with curriculum standards, and technical support must be readily available for teachers. School systems should understand the relationship between student achievement and the knowledge teachers have of the

programs in place within their school. Teachers who are not adequately trained will not be able to effectively use the programs provided in their classrooms.

4. School systems that have spent money integrating technology on costly programs like AM should provide teacher and administrator training on how to effectively use this in the classroom with students. A significant amount of money has been spent on technology in the past several decades in the United States (Barlow, 2005). Bielefedlt (2005) reported the National Educational Technology Standards essential conditions for effective use of technology as stating that schools must use technology aligned with the curriculum as a way to enhance instruction, as a resource used for students, and schools must make sure teachers are knowledgeable in the specified area as the best practices to successfully implement technology. The presence of technology itself is not related to student achievement (Tester, 2003). Administrators and teachers must have adequate amounts of training in order to effectively use technology programs in schools (Ozel et al., 2008). Research has shown that teachers make the greatest difference in student achievement (Fuchs, 2004). Corbett, Wilson, and Williams (2005) noted that using effective forms of technology to change the classroom environment is important to student achievement. School systems should adequately research costly technology programs before investing in them as well as be prepared to train administrators and teachers to effectively use the programs within their school.

Recommendations for Future Research

The study provided a narrow scope of focus as only one large rural school system in east Tennessee was examined to determine if the AM program was one variable that had an effect on high-ability students' achievement test scores. The following represent recommendations for additional study:

1. A similar study can be conducted to compare a school system in a large rural setting where several schools use the AM program while others schools do not use the program and compare math achievement test scores of students.
2. This study addressed only the performance on the TerraNova math achievement test of high-ability students' who did and did not use the AM program. A comparable study could investigate the associations of the AM program to TerraNova math achievement test scores on low and middle achieving students as well.
3. Further research can be conducted that involves other factors such as teachers' knowledge of the AM program, class size, teacher-to-pupil ratio, and teachers' actual use of the AM program in their classroom that contribute to increased test scores.
4. Qualitative studies should be performed to investigate student, parent, and teachers' perceptions of the AM program and its effectiveness on student achievement test scores.
5. A similar study can be conducted to determine if the AM program is more successful at improving achievement test scores of students who qualify for free and reduced lunch in a Title I school in comparison to the test scores of students who do not qualify for free and reduced lunch.

Summary

This study, which is organized and presented over five chapters, used a quantitative research design and centers on the associations of a single large rural county in east Tennessee's use of the AM program with their high-ability third and fourth grade students. The TerraNova math achievement test scores of third and fourth grade high-ability students in this system were compared to the scores of high-ability students who did not use the AM program. Chapter 1 contained an introduction, statement of the problem, research questions, significance of the study, limitations and delimitations, the definitions of terms, and an overview of the study. Chapter 2 presented a review of literature and included the following sections: introduction, student achievement, mastery, accountability, individualized instruction, technology and computer-assisted instruction, brain-based learning, high-ability students, *Accelerated Math* studies, and conclusion. Chapter 3 contained the research design for this study that makes use of the TerraNova math achievement test scores to determine the effectiveness of the AM program with high-ability students. Chapter 4 contained an analysis and presentation of data related to this research study along with four research questions and seven corresponding null hypotheses that guided the investigation. Chapter 5 included a summary of the findings, conclusions about this research study, implications for educators, and recommendations for future study.

The results indicated that there was not a significant difference between high-ability third and fourth grade TerraNova math achievement test scores who participated in the AM program and the scores of students who did not participate in the program. However the findings showed a significant difference between the TerraNova math achievement test scores of third and fourth grade high-ability students who qualified for free and reduced lunch who used the AM program when compared to the students who qualified for free and reduced lunch who did not use the program. The findings also showed a significant difference between the TerraNova math achievement test scores of high-ability fourth grade students who participated in the AM program to those fourth graders who did not participate in the program. School systems were urged to consider implementing an individualized math program like AM in all elementary schools, especially in the upper elementary grade levels to promote math achievement. Schools with a free and reduced percentage of 70% or above were advised to start individualized math programs like AM as a means to improve standardized tests results in Title I schools. Future research should focus on the importance of using research-based math programs in order to increase student achievement in mathematics.

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