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Integrating Educational Technology to Increase Academic Performance of Sixth-Grade Mathematics Students

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by
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Approval Page

This applied dissertation proposal was submitted by Ray Anthony Robinson under the direction of the persons listed below. It was submitted to the Abraham S. Fischler School of Education and approved in partial fulfillment of the requirements for the degree of Doctor of Education at Nova Southeastern University.

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Abstract

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The purpose of this study was to determine if the use of educational software contributed to increasing the academic performance of 6th-grade students in mathematics. The specific programs used were the Florida Comprehensive Assessment Test (FCAT) Explorer and Promethean ActivBoard. This summative quantitative study was guided by 3 research questions:

1. What was the effect of technology, specifically the Promethean ActivBoard and the FCAT Explorer, on the achievement in mathematics of 6th-grade students, as measured by district benchmark assessments?

2. What was the difference in mathematics achievement, if any, between male and female 6th-grade students following the use of technology, specifically the Promethean ActivBoard and the FCAT Explorer, as measured by district benchmark assessments?

3. What was the effect of technology, specifically the Promethean ActivBoard and the FCAT Explorer, on the achievement in mathematics of African American 6th-grade students, as measured by district benchmark assessments?

Participants were 6th-grade teachers and students in the experimental and control groups. Participants were 59 students in the experimental group and 61 in the control group. Students who used FCAT Explorer and the Promethean ActivBoard showed better scores on a posttest and larger percentage increase in scores than the control group. Male students in the experimental group showed the greatest increase in scores. African American students who also used FCAT Explorer and the Promethean ActivBoard scored higher than those African American students who did not use any form of technology as a supplement to learning.

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Chapter 1: Introduction

In this applied dissertation, a study was undertaken using the integration of educational software into the curriculum for mathematics students at the target middle school. The target middle school is located in central Florida. The staff at the middle school included one principal, two assistant principals, three counselors, and 73 teachers. There were 1,018 students registered at the school, including 345 in sixth grade, 366 in seventh grade, and 307 in eighth grade. The target middle school population includes a high percentage of minority students: A summary of the student ethnicity at the time of the study included 73.08% African American, 15.42% Hispanic, 9.04% American Indian, and 2.46% Caucasian. Minority groupings constituted 98% of the school's population (see Table 1). In addition, the target middle school has been identified as a Title 1 school, which means that a large concentration of low-income students is in attendance (Lorcher, 2009). According to the Florida Department of Education (2011), 79% of students in the school were economically disadvantaged.

Statement of the Problem

The purpose of this study was to determine if the academic performance of sixth-grade students in mathematics could be increased through the use of educational software. Specific programs utilized included the Florida Comprehensive Assessment Test (FCAT) Explorer and Promethean ActivBoard.

The student performance in mathematics at the target middle school had been an issue for many years because of the achievement gap in mathematics between economically disadvantaged students and their noneconomically disadvantaged peers (Florida Department of Education, 2011). In addition, African American students had not shown the same growth as Caucasians students on the standardized test. Overall, the low achievement levels in mathematics by the students at the target middle school had been a prevailing issue. Administrators planned and implemented many programs to increase the performance of African American students and students of low socioeconomic status (SES) to close the achievement gap in mathematics at the target middle school. A summary of the demographics for the target middle school is provided in Table 1.

Table 1

Target Middle School Demographics

Category	No.	%
Race/ethnicity of students		
Caucasian (non-Hispanic)	25	2.46
African American (non-Hispanic)	744	73.08
Hispanic	157	15.42
Asian/Indian/mixed	92	9.04
All	1,018	100.00
Economically disadvantaged	804	75.28
Grade level		
Sixth	345	34.00
Seventh	366	36.00
Eighth	307	30.00
All	1,018	100.00
Position of faculty and staff		
Principal	1	
Assistant principals	2	
Counselors	3	
Teachers	73	

Research problem. The problem addressed by this study was the inadequate performance of the sixth-grade African American and students of low SES at the target middle school on the mathematics portion of the FCAT and the district's benchmark assessments. After reviewing the data from 2010, the researcher discovered that the African American students and students with low SES in sixth grade at the target middle school scored significantly lower than the Caucasian students. At the target middle school, 38% of African American students who were in the sixth grade scored Level 1 and only 15% of Caucasian students scored a Level 1. Sixty-eight percent of Caucasian students scored Level 3 or higher on the FCAT; whereas, only 38% of African American students scored Level 3 or higher. In Table 2, a comparison of sixth-grade students' FCAT scores in mathematics at the target middle school is documented (Florida Department of Education, 2011).

Table 2

Sixth-Grade Scores of School-, State-, and District-Level FCAT in Mathematics, 2009-2010

		% level					
Category	No.	1	2	3	4	5	≥3
Caucasian (non-Hispanic)	9	15	17	31	24	13	68
African American	264	39	23	25	10	3	38
Hispanic	53	26	21	29	17	7	53
Asian / Indian / mixed	19	9	11	25	27	28	80
All	345	22	19	27	19	13	59
Economically disadvantaged	269	36	25	27	11	2	40

After reviewing the data from the results for 2006 to 2010 benchmark tests, the researcher discovered that, on average, 40% of sixth-grade students at the target middle school needed much improvement on the mathematics benchmark assessments given at the end of the year, 35% needed improvement, and only 25% were on target. For students to show mastery, they must be on target on the benchmark tests. The district benchmark assessment posttest was a reflection of instruction and a prediction of how well students would perform on the FCAT. In Table 3, the sixth-grade student performance on the benchmark assessment is documented (Florida Department of Education, 2011).

Table 3

Summary of Sixth Graders on End-of-Year Benchmark Test, 2006 to 2010

School year	No.	Needs much improvement %	Needs improvement %	On target %
2009-2010	345	37	34	29
2008-2009	327	40	35	25
2007-2008	330	39	31	30
2006-2007	327	39	33	28
2005-2006	333	37	31	32

Note. Average = 332 students; % needs much improvement = 38.4; % needs improvement = 32.8; and % on target = 28.8.

The researcher, a sixth-grade mathematics teacher, examined data from the target middle school to formulate a solution or intervention to increase the performance on standardized tests of African American students and those who had low SES. The researcher was given the opportunity to examine previous years of FCAT and benchmark assessment data to identify student weaknesses on that assessment instrument. As a result, the researcher devised an intervention to increase the performance of African American students, including those of low SES, as well as that of all students on the district benchmark assessment posttest. The target middle school had not met the district and state standards of increasing student achievement.

The topic. Student achievement has been positively linked to the use of educational technology at school and home (Bielefeldt, 2005). According to the National Council of Teachers of Mathematics (2000), there are six principles of improving mathematics instruction: equity, curriculum, teaching, learning, assessment, and technology. This study focused on the sixth principle: technology. The FCAT Explorer and the Promethean ActivBoard programs were used by sixth-grade students in this study.

According to the Association for Educational Communications and Technology (2004), educational technology is the facilitation of learning with technology. Examples of educational technology are computers in the classroom, class web sites, class blogs, wireless classroom microphones, and mobile devices. Technology is an innovative way to motivate students to learn in the classroom allowing them to partake in their learning experience. Labbo and Place (2010) revealed that technology allows students to learn in new ways.

The Promethean ActivBoard, a form of educational hardware, is a module of the Promethean ActivClassroom used to engage students in learning, and is also known as a technology-enabled learning environment (Promethean, 2011). The goal of the study was to increase student achievement by developing learning that was interactive with technology, because the use of technology motivates students to become active participants in their education (Liotti & Haggerty, 2010). The use of technology changes the way students learn and how educators teach them in classroom (Weiser, 2008). To this end, the Promethean ActivBoard has become an interactive learning solution that encourages personalized learning and motivates students to excel academically (Promethean, 2011).

The Promethean ActivBoard was designed to increase student achievement in mathematics and other content areas. According to Schachter (1999), students who used the Promethean ActivBoard accelerated their learning by more than 6 months in mathematics. In addition, students who attended a particular school in the state of California used the Promethean ActivBoard and their test scores on the state-standardized test increased by 27% (Schachter, 1999). As a result of using the Promethean ActivBoard and showing positive learning gains on a standardized test in mathematics, school systems were thinking of deploying the Promethean ActivBoard around the United States (Schachter, 1999). The Promethean ActivBoard was used to increase the level of students' achievement on standardized tests and to increase their engagement in the classroom. Kaufman (2009) revealed that teachers who used the Promethean ActivBoard as an instructional tool increased student enthusiasm to learn.

There are many advantages to using technology for both students and teachers (Lutz, 2010). The Promethean ActivBoard provides an opportunity for students to use activities that engage students and offers teachers the opportunity to integrate technology into the curriculum (Knowlton, 2008). In addition, the Promethean ActivBoard allows teachers to design instruction that addresses the learning style of all learners in order to increase their achievement (Illinois Online Network, 2009). Technology use improves student motivation and eagerness to learn.

Administrators in Florida determined the resources each school within the district could utilize to support student learning. The FCAT Explorer, a web-based instructional tool, was used by some school districts to prepare students for the benchmark tests and the FCAT. The program was not being implemented at the target middle school at the time of the study. The FCAT Explorer reinforces the reading and mathematics skills outlined in the Florida state standards, which are called the Sunshine State Standards (Florida Department of Education, 2011). According to Sullivan and Naime-Diefenbach (2002), students who used the FCAT Explorer scored higher on the FCAT and benchmark tests than those students who did not use the FCAT Explorer as a supplement to learning.

Background and justification. One of the primary measures of student achievement in the state of Florida is the FCAT. The purpose of the FCAT and benchmark assessment test is to measure student achievement in mathematics, reading, science, and writing (Florida Department of Education, 2011). The achievement levels range from Level 1 being the lowest to Level 5 being the highest that the students could perform on the FCAT. Students' academic performance at the target middle school is evaluated based on their achievement level on the FCAT, benchmark assessment tests, and other forms of assessments.

There are additional requirements mandated by the Florida Department of Education in order for schools to make adequate yearly progress (AYP). AYP is part of the provisions of the No Child Left Behind Act (NCLB; Florida Department of

Education, 2011). The grading scale for middle schools to make AYP included A = minimally 525 points, B = 495 to 524 points, C = 435 to 494 points, D = 395 to 434 points, and F = fewer than 395 points (Florida Department of Education, 2011). Each school grade was determined by an accumulation of percentage points for eight measures of achievement. Schools received 1 point for each percentage of students who scored Level 3 or higher in reading, mathematics, and science. Schools also received 1 point for each percentage of students who met high standards of 3.5 or higher in writing. Additionally, schools received 1 point for each percentage of students making learning gains in reading and mathematics, and 1 point for each percentage of the lowest performing students making learning gains in reading or mathematics. Schools earned points based on the 90% of eligible students who must be tested in order to make AYP. Schools with test results below 90% of the enrolled students received a Grade I and were further penalized if they were determined to be over the threshold for violence.

The target school had maintained a school grade of a B or C on AYP for 3 consecutive years, based upon students not showing significant learning gains on the FCAT from the previous year in reading, mathematics, science, and writing (Florida Department of Education, 2011). In addition, students from minority backgrounds and students of low SES who did not meet district and state expectations on the FCAT contributed to the target middle school not making AYP for 3 consecutive years. A summary of the target middle school’s annual report card is documented in Table 4.

Mathematics instruction was an issue for educators at the target middle school. The middle school’s instructional coach stated that teachers’ instruction had been unchallenging in terms of being able to increase the students’ academic performance.

During a discussion at mathematics content meetings, the instructional coach expressed that the majority of students spent most of their time on procedures and were spending little time on problems that make a connection to real-life situations. The coach also informed the staff that the teachers were not challenging students to excel and that many teachers created tests that were not challenging to the students. The student achievement levels in mathematics at the target middle school are documented in Table 5.

Table 4

Target Middle School's Annual Report Card

School year	Grade	% meeting high standards in math	% tested
2009-2010	C	51	100
2008-2009	B	52	100
2007-2008	B	48	99
2006-2007	B	54	99
2005-2006	C	48	99

Based on the FCAT data of the target middle school, the instructional coach discussed students' strengths and weaknesses on the FCAT. The instructional coach explained the formal and informal evaluation results with mathematics teachers in department meetings; however, the names of teachers were not discussed. The instructional coach was concerned that the students' lack of motivation was based on the lack of creativity within the classroom. This was supported by Ball (2008) who suggested that only a small portion of students increased their level of achievement based on instructional practices that focused on definitions and procedures.

Table 5

Student Achievement Level in Mathematics at the Target Middle School, 2009-2010

		Percentage at level					
Grade	No.	1	2	3	4	5	≥3
Sixth							
Caucasian (non-Hispanic)	9	15	17	31	24	13	68
African American	264	39	23	25	10	3	38
Hispanic	53	26	21	29	17	7	53
Asian / Indian / mixed	19	9	11	25	27	28	80
All	345	22	19	27	19	13	59
Economically disadvantaged	269	36	25	27	11	2	40
Seventh							
Caucasian (non-Hispanic)	8	12	17	34	26	12	71
African American	295	33	25	29	11	2	42
Hispanic	55	21	21	33	19	7	59
Asian / Indian / mixed	8	7	10	26	34	27	83
All	366	18	18	26	26	12	64
Economically disadvantaged	250	36	22	31	9	3	42
Eighth							
Caucasian (non-Hispanic)	8	7	14	39	24	16	79
African American	235	23	29	35	9	3	48
Hispanic	49	14	21	39	17	9	65
Asian / Indian / mixed	15	4	8	29	26	32	88
All	307	12	18	36	19	15	70
Economically disadvantaged	260	21	36	27	10	6	53

A lack of educational software could have had an impact on the students' academic performance in the target middle school. In addition, a lack of using educational software prevented teachers from catering to a greater number of students with individual learning needs (Sullivan & Naime-Diefenbach, 2002). According to Green (2001), students who used educational software improved outcomes on standardized testing and classroom performance. Students who did not utilize educational software programs did not benefit from interactive lessons; as a result, their test scores and passing rates may have been affected (Biesinger & Crippen, 2008).

Schools that did not utilize educational software programs, such as the FCAT Explorer, could demonstrate lower student performance on the FCAT (Sullivan & Naime-Diefenbach, 2002). Based upon school sample data, the FCAT scores of schools that did not use the FCAT Explorer were consistently lower than the FCAT scores of schools that did use the program (Sullivan & Naime-Diefenbach, 2002). Students whose teachers used Promethean ActivBoard scored higher than those students who did not use the software (Marzano & Haystead, 2010).

Students took district benchmark assessment tests to measure their progress based on the course standards at the beginning and end of each semester. The purpose of these tests was to predict how well students would perform on the FCAT. This prediction was made in order to alert teachers if students were not mastering the standards. District benchmark assessment tests placed students in one of three categories: (a) needs much improvement, (b) needs improvement, or (c) is on target. Students' performance on the 25 multiple-choice questions of the benchmark assessment tests was similar to their performance on the FCAT (see Table 6). Many students at the target middle school performed in the needs much improvement or needs improvement categories on the benchmark assessment tests.

Deficiencies in the evidence. Fram, Miller-Cribbs, and Van Horn (2007) conducted a study, which indicated that the learning environment, particularly the use of technology, had a positive effect on learning. The results showed that teachers who utilized technology as a supplement had a greater impact on student learning than those who did not use any form of technology. The researchers recommended additional research on learning conditions and student achievement.

Ma (2000) conducted a study on achievement gaps and student performance, and found that achievement gaps were reflected in mathematics and other content areas; and suggested that programs, such as technology, focused on student achievement. Ma suggested that school administrators should focus on other programs to close the achievement gap in mathematics. There was a need for additional studies on technology that focused on student achievement to determine student strengths and weaknesses so educators could close the achievement gap in mathematics (Ma, 2000). The results of the Ma study showed that technology had a positive impact on student performance.

Table 6

Summary of Student Performing Level on End-of-Year Benchmark Test, 2006 to 2010

School year	No.	Needs much improvement %	Needs improvement %	On target %
2009-2010	1,012	35	39	26
2008-2009	1,098	42	37	21
2007-2008	1,059	36	34	30
2006-2007	1,097	39	35	26
2005-2006	1,089	40	31	29

Note. Average = 1,071 students; % needs much improvement = 38.4; % needs improvement = 35.2; and % on target = 26.4.

The studies were important for the target middle school because a lack of educational software could have an impact on students' academic performance. Educators who did not use software applications did not bring the promise of creating a superior learning environment. In addition, a lack of educational software prevented teachers from catering to a greater number of students with individual learning needs (Sullivan & Naime-Diefenbach, 2002). According to Green (2001), students who used educational software improved outcomes on standardized testing and classroom performance. Students who did not utilize educational software programs did not benefit from additional practice; as a result, their test scores and passing rates might be affected (Biesinger & Crippen, 2008). There was a need for additional information at the target middle school with respect to the correlation between technology and student achievement in mathematics.

Audience. Students, teachers, and school administrators benefited from learning whether the use of educational technology and software, such as the FCAT Explorer and the Promethean ActivBoard, increased student achievement (Sternberg, Kaplan, & Borck, 2007). The results of the study may also be of interest to software developers and district officials seeking to improve sixth-grade student achievement in a middle school environment.

Definition of Terms

The following terms were defined to provide clarity as they were used in this study.

District benchmark assessment tests were developed to predict how well students would perform on the FCAT (Florida Department of Education, 2011). In addition, they were proven to have high predictability of student achievement on the FCAT (Florida Department of Education, 2011). Students are administered benchmark assessment tests, which consist of criterion-referenced tests in mathematics, reading, and science. Benchmark assessment tests measure student progress towards meeting the Sunshine State Standards benchmarks (Florida Department of Education, 2011).

The *Florida Comprehensive Assessment Test* (FCAT) was established in 1998 as a plan to increase student academic performance in Florida and was designed to measure the implementation of higher standards. Students in Grades 3 to 11 are administered the FCAT, which consist of criterion-referenced tests in mathematics, reading, and science. The FCAT also measures student progress towards meeting the Sunshine State Standards benchmarks (Florida Department of Education, 2011).

The *Florida Comprehensive Assessment Test* (FCAT) *Explorer*, a free, online, educational program for Florida students, is designed to reinforce reading and mathematics concepts that were outlined in the Sunshine State Standards (Florida Department of Education, FCAT Explorer, 2010).

Millennial generation students were defined by Nicoletti and Merriman (2007) as a generation born between 1982 and about 2003. This group of students is also known as Generation Y. Nicoletti and Merriman described a different style of learning, which requires additional teaching methods.

The *Promethean ActivBoard* is a large, interactive white board with the power of a computer to engage students with images, video, and audio (Promethean, 2011).

Purpose of the Study

Many African American students and students of low SES at the target middle school were failing benchmark assessment tests because of low achievement in mathematics. Specifically, the results of this research can be used by educators to determine the effectiveness of the use of the FCAT Explorer and the Promethean ActivBoard to increase the mathematics achievement of sixth-grade students on district benchmark assessments and the FCAT. Student performance evaluated for the duration of one semester was compared between an experimental group receiving instruction using educational technology and software, and a control group receiving traditional instruction.

Researchers may be able to use the results of this study to further their knowledge on technology. This study contributed information to the literature that may assist teachers in making decisions about using technology within the classroom. The findings of this study can be used by researchers to initiate related studies in the classroom and to inform teachers about the use of technology that was integrated into the curriculum.

Chapter 2: Literature Review

The purpose of this study was to determine whether the use of technology had an effect on student performance. This literature review provides information about how technology has become an instructional tool used to increase student performance. This researcher reviewed studies that showed whether technology improved or did not improve student performance in mathematics. The lack of student achievement, the lack of adequate student improvement, and the continuing achievement gap between African American and Caucasian students had become concerns for educators (Berends, Lucas, & Penaloza, 2008). Students of this generation are more proficient and comfortable with using technology than other generations (Smith, 2007); therefore, teachers could utilize technology as a supplement for student instruction. Each child has a personal style of learning and teachers should meet the learning needs of all students.

In chapter 2, an overview of the research and literature relating to this study is provided. Research topics examined in the literature review include a discussion on the effectiveness of the FCAT Explorer and the Promethean ActivBoard, the literature on the mathematical achievement of males and females, and the literature involving the correlation of student achievement and SES background.

Achievement Gap

Student performance on standardized assessment instruments is a reflection of student achievement in the classroom (Johnson, 2011). Therefore, educators have to find ways to help students improve their learning weaknesses and enhance their strengths. Because of state and federal mandates, teachers and students are held accountable based upon state and federal programs that were designed to monitor student progress and achievement (Johnson, 2011). One primary measure of student performance in the state of Florida is determined by using the FCAT (Florida Department of Education, 2011). There are other instruments that teachers use to measure student performance, such as benchmark assessment tests and summative assessments.

The failure rate of students who completed the FCAT and benchmark assessment tests was too high. According to Grech (2002), in Miami-Dade County, 50% or more of students failed the FCAT in 2002. In addition, more than 13,000 sophomores failed the reading, mathematics, or both portions of the FCAT in 2002 (Florida Department of Education, 2011). Based upon the high number of students failing the FCAT, there was a clear need for school officials to devise an alternative to help students achieve at higher levels.

Poverty, lack of motivation, low SES, and poor school environments are all contributing factors to the achievement gap (Lee, 2002). Other researchers, including Ream (2003) noted that language barriers, lack of education, and lack of cultural understanding between students and teachers contributed to the achievement gap between Caucasian and minority students. In addition, students who were poor, nonnative speakers of English, or minorities experienced low teacher expectations that resulted in low achievement (National Council of Teachers of Mathematics, 2000).

Sagun (2010) identified programs that had been conducive to raising student achievement and narrowing the achievement gap. The results of this study involved a qualitative data analysis through the use of a document review, surveys, observations, and interviews. The participants consisted of two administrators and 62 teachers. The focus of this study was to determine the effect of the Algebra 1 program for high school students on raising their math achievement and narrowing the achievement gap. The programs consisted of giving students additional time in mathematics, using spreadsheets to collect and disaggregate student data, and allowing students to track and monitor their progress. The results showed that student proficiency increased in Algebra 1 and, during the following school years, more students enrolled in Algebra 1. This study could have been enhanced if the target middle school compared Algebra 1 standardized test scores with a school with similar demographics.

Educators can close the achievement gap between Caucasian and minority students by identifying causes of performance gaps (Clark & Estes, 2002). Effective leadership is important to close the achievement gap by creating and increasing student performance (Marzano, Waters, & McNulty, 2005). Teacher effectiveness is also imperative in terms of increasing student performance. Teachers are not effective if they do not have adequate skills that are essential to educate students (Clark & Estes, 2002). Strategies exist that teachers can use to decrease the achievement gap between Caucasian and minority students. Technology can coincide with many strategies used to reduce the achievement gap.

The achievement gap between African American and Caucasian students is an increasingly large issue for schools across the United States (Stillwell & National Center for Education Statistics, 2009). Johnson and Kritsonis (2006) stated that the educational problem in mathematics achievement among the African American and Caucasian students remains an issue for educators. From a historical perspective of African American education in the United States, the achievement gap was treated as an issue without a beginning (Paige & Witty, 2010). Historically, the U.S. Constitution prohibited all African American people from receiving any form of education (Ogbonna, 2011). As a result, these laws made it a criminal offence for any African American to read and write or to become educated. In November of 1787, African American citizens had the opportunity to become educated with the opening of their first Black school in New York (Ogbonna, 2011). However, discrimination continues to occur for African American students in several parts of the country (Ogbonna, 2011).

According to Ogbonna (2011), a turning point for African Americans occurred at the end of the civil war, which resulted in the emancipation proclamation, the 1865 compulsory public education, and the 13th amendment, which ended slavery in the United States (Ogbonna, 2011). Nevertheless, the 1896 U.S. Supreme Court decided in the *Plessy v. Ferguson* case that African Americans were to be provided with a separate, but equal, facility to uphold segregation (Ogbonna, 2011). Until the 20th century, the courts continued to reinforce and enable the inequality of education in America (Cozzens, 1998). By 1954, the *Plessy v. Ferguson* case was reversed by the U.S. Supreme Court because of the *Brown v. Board of Education* case in 1954, which ruled that separation in an educational facility was essentially unequal and unconstitutional. As a result, African American and Caucasian students were integrated and desegregated in public schools. In addition, the Civil Rights Act of 1964 provided equal opportunity for all students based on race, sex, and religion.

The public school system established an accountability system to measure student performance through the use of standardized assessment tests because of a concern of teacher competency (Ogbonna, 2011). As a result of educational reform, school officials established a movement called the Competency-Based Teacher Education, formally known as Performance-Based Teacher Education (Ogbonna, 2011). The role of educational reform changed in 2001 with the establishment of the NCLB, which reauthorized the Elementary and Secondary Education Act (Ogbonna, 2011). This era led to a new era of high-stakes testing. Educators were held accountable for their students' performance on standardized testing.

The NCLB of 2001 mandated adequate instruction measured by high-stakes testing to close the achievement gap between African American and Caucasian students. Unfortunately, for some teachers, student achievement was largely determined by their scores on standardized tests (Muller & Schiller, 2000). According to Franklin (2007), African American students performed lower on standardized tests than Caucasian students. Studies showed that an achievement gap existed in standardized test results among African American and Caucasian students (Schellenberg, 2004). Paige and Witty (2010) noted that African American students tended to score lower than Caucasian students on standardized tests, such as the SAT and the ACT. African American students who were in Grades 4 and 8 were less likely than White students to be proficient in mathematics (Paige & Witty, 2010).

The sociopolitical context of American history was well beyond the scope of African American education (Davis, 2011). However, Davis (2011) believed that "given the sociopolitical context of American history, SES has a unique and distinct relationship with the progress and position of African Americans in education" (p. 585). According to the NCLB (2002), all students should improve academic achievement until working on grade level. Socioeconomic status might have an impact on student achievement (Myers, 2009). Myers (2009) stated that students of low SES often sought the answer to a question without making an attempt to solve it themselves. In addition, they were easily confused and showed uncertainty on how to solve problems in mathematics, whereas students of high SES used critical-thinking skills to solve problems (Myers, 2009). There are many reasons that students of low SES are not able to achieve academic excellence in mathematics (Lubienski, 2007). Students of low SES resist problem solving, which is important for analyzing word and complex problems. In addition, students of high SES attempt to solve a problem before seeking help from their teacher. Lubienski (2007) stated that students of low SES use a common-sense approach as opposed to utilizing critical-thinking skills.

The parents of students with a high SES background have greater access to resources for additional learning (Ogwu, 2004). In addition, Ogwu (2004) believed that parents of high SES were more likely to send their children to high-performing schools than were parents of low SES. The majority of parents of students of high SES provide everything their children need to become successful. Parents of lower SES status, however, do not have that opportunity to ensure that their children were successful (Ogwu, 2004). Parents of students having a high SES might hire a private tutor if their child was struggling in mathematics, whereas parents of students having low SES might not be able to afford additional support.

Educating the Millennial Generation

With the change in the culture of education, students of the Millennial generation are more prone to embrace experience that would help expand their awareness of other cultures and people from various backgrounds (Tucker, 2006). This generation is the first to be exposed to the FCAT; Millennial students have a different style of learning when compared to other generations (Tucker, 2006). The writers of the NCLB encouraged the use of technology to improve academic performance (Brooks, 2008). The Millennial generation is more proficient and comfortable with using technology than other generations (Smith, 2007). Students of the Millennial generation are also described as being technologically proficient (Forkum, 2008). The advancement of technology continues; therefore, teachers need to continue to prepare students to be proficient in its use. It is important for educators to understand that students learn more effectively with technology (McAlister, 2009). Students prefer to learn in an environment that uses educational software to enable them to be effective learners (Nicoletti & Merriam, 2007).

Some teachers educate their students based upon how they, the teachers, learned as students. These teachers might find it difficult to educate the Millennial generation using technology in the classroom (Tucker, 2006). Teachers face many challenges in terms of meeting the learning expectations of this generation (Tucker, 2006). Some teachers might not know how to integrate technology into the curriculum. To maximize student learning, teachers should consider making the connection between technology and student goals and objectives in the classroom (Tucker, 2006).

Students of the Millennial generation might be experienced at using the Internet and other forms of technology. Therefore, teachers have to find ways to connect with them by integrating educational software into the curriculum (Corbit, 2005). The Millennial generation students have more access to the Internet and too many other forms of technology than any previous generation (Considine, Horton, & Moorman, 2009).

Millennial generation students learn best utilizing cooperative learning or collaboration in the classroom (Nicoletti & Merriam, 2007). Cooperative learning is one of the many facets of strategies used to educate students. In an environment that requires students to collaborate, students work as a team to complete assignments (Considine et al., 2009). Technology could enhance the use of cooperative learning to increase academic performance. Teachers could allow students to work as a team to complete projects and major assignments that require the use of a computer. In addition, students prefer activities that promote cooperative learning (Nicoletti & Merriam, 2007). Although Millennial generation students spend most of their time using computers individually, they are highly sociable when working with others (McAlister, 2009). Many students have been exposed to working as a team since early childhood (McAlister, 2009).

Educators could find ways to actively engage students in learning through the use of technology (Tucker, 2006). Technology could be used to improve student performance and to increase student engagement. Therefore, teachers have to understand the nature of learning of their students in order to engage them in the classroom. Educators could find inventive ways to increase student motivation with technology. Many resources are available to engage students in learning, such as blogs and interactive instructional technology programs. Using educational software gives students the motivation to learn (Considine et al., 2009).

Many strategies that incorporate the use of technology could be used to motivate students to excel academically. Textbook companies distribute compact discs and educational software programs to coincide with the course textbook (Nicoletti & Merriam, 2007). In addition to learning with educational software, students prefer to use web sites that provide learning laboratories to increase their academic performance (Nicoletti & Merriam, 2007). Using technology, students are enabled to learn outside of the four walls of their classroom through collaboration and teamwork. By taking into consideration the best methods for student learning, teachers could provide the students of the Millennial generation with an environment in which they are accustomed to learning (Nicoletti & Merriam, 2007).

Many studies are available to demonstrate the positive effects of using technology within the curriculum. The North Central Regional Education Laboratory, a nonprofit research organization, conducted a group of studies to compare the achievement of students who used technology as an instructional tool for learning and those who did not use any technology as a supplement to learning (McCabe & Skinner, 2003). Although most of the individual studies were small, consisting of 100 students or fewer, the results of the studies were standardized and determined the mean effect size of more than 4,000 students. Overall, the results showed that technology had a positive impact on student learning based on their achievement.

Another study conducted in West Virginia compared the test scores of third- and fourth-grade students who used technology as a supplement to learning mathematics. The results showed that teaching and learning with technology had more of a positive effect on student performance than traditional instruction. Unfortunately, the effect size was not listed in this study. Teachers were able to use software, such as eMINTS, a technology initiative program for students and teachers, to integrate technology into the curriculum in order to increase student performance (McCabe & Skinner, 2003). The results showed that fourth-grade students who used eMINTS performed higher on their standardized tests than those students who did not use the program. Unfortunately, similar results were not found for third-grade students.

Using Educational Technology to Support Learning

The U.S. Department of Education's goal of integrating educational technology into the curriculum expanded after the late 1990s (Sternberg et al., 2007). The vision was to incorporate educational technology into the curricula of all schools (Sternberg et al., 2007). In the 1990s, school personnel began to integrate technology into the curriculum in order to increase student academic performance (Gaither, 2005). Compared to 21st-century learners, previous generations did not have much opportunity to utilize instructional tools and educational technology (Gaither, 2005). Sanders (1999) maintained that it was nationally imperative to incorporate instructional and educational technology into the curriculum to increase the academic performance of students in mathematics. It was also important for educators to motivate students to learn. For many years, researchers searched for ways to motivate students and improve student academic performance (Hsieh, Cho, Liu, & Schallert, 2008). Research was documented that motivation was linked to the amount of effort in completing a task (Hsieh et al., 2008).

If students spent the majority of their time using computers at home, teachers should utilize computers in the classroom to help motivate students to learn. In addition to being motivated to learn with technology, students could benefit from using computers as a tool to help target their weaknesses or individual needs (Sternberg et al., 2007). Gaither (2005) contended that, by using technology, students were motivated to excel academically so their educational needs were served.

Fraenkel and Wallen (2007) conducted a study that questioned the extent that technology enhanced learning as it related to student motivation. The participants consisted of 182 sixth- and seventh-grade students and more than one half of the participants were female students. This was a convenience sample because students volunteered to participate in this study. The researcher, using a mixed-methods design that consisted of both quantitative and qualitative methods, collected the data with the completion of a pretest, a posttest, and student interviews. The results showed that integrating technology into the curriculum produced positive results in terms of motivating students to learn, which increased their scores from the pretest to posttest. The interview results suggested that students preferred the use of technology as a supplement for student instruction. However, the study did not have a control group, which would have compared the results of students who used technology as an instructional tool for learning to those who did not use any form of technology within their instruction.

The Florida Department of Education integrated technology into the curriculum by creating Internet-based learning (Sternberg et al., 2007). Internet-based learning includes educational software and web sites that students could use as a supplement to learning. Qing (2007) conducted a study that critically examined student views about using technology in the classroom. A mixed-methods approach was used for collecting data and focusing on affective outcomes. A survey was also used within the scope of this study; open-ended questions were asked about students' views on using technology. The results showed that the majority of students who participated in this study enjoyed the use of technology and believed that it could motivate them to excel academically. This study could have been more effective if teachers compared the achievement level of students who used technology as a resource for learning to those who did not use any form of technology. A comparison of current and previous school year data could have determined if technology was as effective as the traditional method of instructing students.

The U.S. Department of Education instructed teachers to integrate technology into curriculum and instruction to meet the needs of students (Gaither, 2005). Sanders (1999) revealed that the National Science Board created a plan of action in 1983 to improve the academic performance of students through the use of technology. The plan of action included a variety of educational software programs that could improve student academic performance (National Science Board Commission on Precollege Education in Mathematics, Science, and Technology, 1983).

Weller (2008) demonstrated many benefits to integrating technology into the curriculum. It was important that teachers enjoyed integrating technology into the curriculum: If teachers were enthusiastic about utilizing technology in the classroom, student performance could increase as well (Gibson, 2009). Therefore, educational technology could be used to support all students in their education and for differentiating instruction to meet their needs. Gibson (2009) reported most teachers agreed that using technology increased students' academic performance.

School officials questioned how teachers provide information using technology if it was not integrated into the curriculum (Gaither, 2005). Therefore, teachers must be trained on the methods to utilize technology within their area of instruction. In order for instructional technology to be successfully implemented in the classroom, teachers must attend professional development with continuous support from administrators (Martin, Strother, Baglau, Bates, & Reitzes, 2010).

Integrating Educational Technology Into Mathematics Education

Educational technology, educational software, and web-based learning could help students achieve excellence in mathematics (Linnell, 2004). Learning and teaching mathematics could be more effective if teachers integrated technology into the curriculum (Linnell, 2004). Kinney and Robertson (2003) agreed that educational technology and software were effective for delivering instruction to students who were struggling learners in mathematics. In addition to using the course textbook for delivering instruction, teachers could use educational technology and software as a means of reinforcing concepts. If students were struggling to solve complex mathematical problems that require reasoning, educational software could be used as a tool for decreasing deficiencies in learning mathematics (Pugalee, 2001).

When introducing a mathematics concept, teaching could be more enjoyable by integrating technology into the curriculum (Linnell, 2004). Many forms of technology, such as computers, software, and the Internet, could improve instruction in mathematics (Kinney & Robertson, 2003). Instructional technology should address deficiencies in learning and utilize strategies that reflect the nature of student learning in mathematics (Lederman & Niess, 2000).

Hubbard (2000) conducted a study that compared the scores of algebra students who used the computerized program, Cognitive Tutors, as a supplement to learning mathematics. The results showed that students who used the program scored higher than those students who learned in a traditional learning environment without the use of any technology. In addition, students who completed the program were likely to complete Geometry and enroll in Algebra II. Unfortunately, this study did not compare the results from other schools that had similar demographics. Additionally, the sample size was not large or diverse enough; therefore, the results could not be generalized.

Other researchers concluded that integrating instructional technology into the curriculum could increase the academic performance of students in mathematics. Butzin (2001) conducted a study that compared standardized test scores in the mathematics of students who used instructional technology to those of students who did not use any form of technology. Second- and fifth-grade students from similar technology-rich elementary schools participated in this study. The school implemented Project Computers Helping Instruction and Learning Development (CHILD) as its instructional model; the control group did not use CHILD. Students who used CHILD worked with the same teacher team for 3 years. Project CHILD students who completed a full 3-year cycle of the program scored higher in mathematics than those students who did not use the program. Significant differences were obtained in the mathematics application (Grade 2), mathematics computation (Grade 5), and mathematics application (Grade 5). Unfortunately, a few teachers who participated in this study had difficulties integrating technology into the curriculum. In addition, there was a limited number of computers and a lack of computer training on how to integrate CHILD into the curriculum. However, the new approach of educating students using technology served as an advantage over the traditional method (Butzin, 2001).

Many elementary schools were providing opportunities for students to use technology applications in classrooms (Linnell, 2004). Students might struggle to understand basic mathematics concepts, but there were programs available to support students who had deficiencies in learning in mathematics. Students who were weak in mathematics might take developmental courses as reinforcement to learning. Integrating technology into remedial courses best met the needs of struggling students and allowed more opportunities for learning (Kinney & Robertson, 2003). Educational technology became a means of educating students in mathematics by providing students with the skills that were necessary to understanding mathematics (Pugalee, 2001).

Educators must take into consideration that not all students are proficient in mathematics. There are ways to eliminate student weaknesses in mathematics through instructional and educational technology. Teachers could implement intervention strategies using educational technology for students who do not master district benchmark standards. Educational technology could be used to assess student performance and provide feedback (Kinney & Robertson, 2003).

Gonzalez (2010) revealed that educational technology allowed students to think about mathematics from a different perspective. Without the use of technology, educators might have a difficult task of engaging students in teaching mathematics (Gonzalez, 2010). Technology could offer students and teachers a wide range of resources as a supplement to learning. In addition, educational technology could enhance learning and prepare students for life outside the classroom. Additionally, classrooms are becoming more equipped with technology devices to help enhance student learning (Kinney & Robertson, 2003).

Technology has an overall positive effect on student learning in mathematics and science (Butzin, 2001). Students who learn in a technology-rich environment experience greater achievement in mathematics (Coley, 1997). Butzin (2001) agreed with Pogrow (1990) that students who struggled in mathematics increased their academic performance by using educational technology as an enhancement for the learning process.

Educators should take advantage of using technology in mathematics. Educational technology allows students to explore mathematical concepts in detail. Technology has more positive results when used to educate students than to educate them without its use (Lederman & Niess, 2000). The atmosphere of the classroom changes when a teacher uses technology to educate students (Pugalee, 2001). In a technology-rich environment, teachers and students develop roles as partners to create ideas that would resolve mathematics issues (Pugalee, 2001).

Integrating technology in the classroom allows students a greater opportunity to learn mathematics. It also allows students to develop critical-thinking skills (Gonzalez, 2010). Educational technology can support students who are not proficient at analyzing word problems or who are underachievers in mathematics (Pugalee, 2001). Technology also provides students with skills necessary to solve advanced-level problems in mathematics (Pugalee, 2001). If students understand basic concepts in mathematics, they have a greater opportunity to understand problems that require critical thinking. Students might have their own style of learning or using critical thinking: Educational technology allows them to use their style of learning, which could increase their academic performance (Kinney & Robertson, 2003). Ketamo and Alajaaski (2008) argued that instructional technology guarantees that every child has the possibility of achieving academic excellence in mathematics.

Educators and policymakers wish to maximize student learning with technology in mathematics (Irving, 2006). Technology has become an important factor in educating students in mathematics (Ellington, 2007), a trend that is here to stay. Therefore, educators have to find ways to increase students’ academic performance through its use. Students’ perception of and attitudes toward mathematics might influence their academic performance (Kaur, 2006).

Middleton and Murray (1999) conducted a study that investigated how the levels of technology affected students in mathematics. The target population consisted of fourth- and fifth-grade students from intermediate schools. The sample size of this study consisted of 2,574 fourth- and fifth-grade students. The study collected quantitative and qualitative data; student achievement was measured by the Metropolitan Achievement Test. Middleton and Murray found that fifth-grade students who used technology scored higher on the Metropolitan Achievement Test than those students who did not utilize technology within their instruction. Fourth-grade students, however, did not have a significant difference in scores on the Metropolitan Achievement Test.

Promethean ActivBoard. Many forms of educational technology have been designed to increase student performance in mathematics. Similar to what was known as a white board, a Promethean Board, a form of educational technology, was known as an ActivBoard and functioned as a module of the Promethean ActivClassroom (Promethean, 2011). The Promethean Board is an innovative way to motivate students to learn in the classroom and allows them to actively participate in their learning experience. Benefits of using the Promethean ActivBoard include utilizing learning resources and creating energetic lesson designs (Fredrick, 2010). The purpose of the Promethean ActivBoard was to increase student achievement in mathematics. Schachter (1999) agreed that students who used Promethean ActivBoard moved faster in the curriculum than those students who did not use the software. In addition, students who attended a particular school in the state of California using the Promethean ActivBoard had scores increased dramatically on the standardized tests. Their scores from the state-standardized test increased by more than 25% (Schachter, 1999). As a result of using the Promethean ActivBoard to increase achievement and to enhance learning, educators were considering integrating the Promethean ActivBoard in classrooms around the United States (Schachter, 1999).

Promethean ActivBoard has a resource-based web site that teachers can access to retrieve resources (Promethean, 2011). Promethean ActivBoard allows teachers to create mathematics projects that students might find intriguing. For students who are struggling mathematics learners, Promethean ActivBoard web pages contain mathematics drills, games, and real-world activities. An array of information is available to support the mathematics curriculum. Teachers can create interactive mathematics lessons that required student involvement (Promethean, 2011).

The Promethean ActivBoard is also used to increase student engagement in mathematics. There are many studies available that demonstrate a high percentage of students are motivated and engaged when they use the Promethean ActivBoard as a supplement to learning. Kaufman (2009) reported that students' performance in mathematics increased when teachers used the Promethean ActivBoard to enhance instruction, as did student enthusiasm to learn. A mixed-methods design was used to conduct the study where 13 teachers were surveyed and six teachers were interviewed. The results confirmed that the students of teachers who used the Promethean ActivBoard showed more interest in the learning process than those who did not use the program. This study could have been enhanced if standardized test scores were compared to other schools within the same school district. A larger sample size could also have enhanced this study.

In addition, data were collected based on observations made during a school walk-through by administrators and other evaluators of classrooms that were observed three times during the semester. In addition to the walk-through, 20-minute observations of a random sample of classrooms were completed to gain additional information. All participants, selected by the school's principal, were interviewed for 20 to 45 minutes on their perspective on using Promethean ActivBoard. The results of a comparison of the results of the math scores of students who used the Promethean ActivBoard versus those who did not use the program showed that there was a significant increase in achievement levels (Kaufman, 2009). Unfortunately, student performance was only measured by the perception of teacher feedback.

Marzano and Haystead (2010) found that students' academic performance increased as the percentage of instructional time utilizing a Promethean ActivBoard increased in the classroom. Marzano and Haystead used a quasi-experimental research design to conduct the study to determine the effect that the use of the Promethean ActivBoard had on the students' performance within the content taught by their teachers. The control group of students did not have the Promethean ActivBoard as an instructional tool, whereas the experimental group used the Promethean ActivBoard as a supplement for student instruction. The sample consisted of 27 public schools that were grouped by their location within their region. The initial year of evaluation consisted of 3,338 students (1,622 students in the control group and 1,716 in the experiential group). A pretest was used to measure student achievement; a posttest was used to measure student growth during the study. There was also a continuation study that involved a total of 1,575 students (769 students in the control group and 806 students in the experimental group). The results of this study demonstrated that students who utilized the Promethean ActivBoard as a supplement to learning mathematics scored higher than those students who did not use any form of technology (Marzano & Haystead, 2010).

Teachers who used Promethean ActivBoard were able to demonstrate the learning gains of their students. Marzano and Haystead (2010) agreed that students were more engaged in learning when the Promethean ActivBoard was utilized. The advantage of using Promethean and other interactive white boards was that students were comfortable with visual learning (Fredrick, 2010). Teachers could use a system that was more student-friendly when compared to using the traditional classroom television. Learning could be enhanced when teachers used interactive white boards. Interactive white boards allowed students to learn from a visual, kinesthetic, and audio perspective (Fredrick, 2010).

Online, interactive learning systems. The goal of web-based learning is to enable students to become dynamic learners and reinforce the concepts they have not mastered (McSweeney & Weiss, 2003). Most online interactive systems generate multiple-choice questions and assess students based on the standards covered within the program. In addition, students become active learners and are able to monitor their own progress. Course web sites have an impact on how the course is organized; teachers could create materials and conduct tutorials based on student performance (Maddox, 1999; O'Sullivan, 2001; Selim, 2003).

There are other benefits to utilizing educational software to increase student academic performance in mathematics. Students could gain a deeper understanding of the subject matter by using visuals and interactive tools (Ellis-Monaghan, 2010). Students have the opportunity to work on a more customized individual basis to help eliminate any deficiencies in the skills being learned. As a result, students can master skills that they did not understand through drill and practice (Ellis-Monaghan, 2010). Teachers have more time for planning and preparing students for success through the use of interactive online learning systems because it customizes their learning.

Online, web-based courses are developed into a system that is designed to increase the academic performance of students (Lim, Lee, & Richards, 2006). Online courses use learning objectives based upon reusability and adaptability (Lim et al., 2006). Web-based programs allow students to become engaged in intellectual thoughts and higher order thinking. Hanson (as cited in Jones & Kalinowski, 2007) revealed that web-based learning combined intuition and creativity to provide real-life mathematics situations, as opposed to arithmetic. When considering the web sites that would be used as an instructional tool, teachers must determine which would stimulate learning for students to accomplish specific goals and objectives (Dede, 2000).

Students who utilize web-based tutorials have an opportunity to receive individualized feedback to help them develop critical-thinking skills. Online tutorials also allow students to explore in-depth concepts they had difficulty understanding. Higher order cogitative skills are difficult to teach students; however, web-based programs provide accurate and instant feedback to develop these skills in a timely manner (Osborn, 2010). Washburn and Flemming (2004) agreed that computerized programs helped students to develop critical-thinking skills to interpret and understand important information. Computerized remediation programs available to assist middle school mathematics students include Avid Xpress Pro Academic, Maps101, Qwizdom Student Response System, Criterion Online Writing Evaluation Service, and Northstar Math

(Doe, 2007).

FCAT Explorer. The FCAT Explorer, another web-based instructional tool used to prepare students for the FCAT, is a standards-based program that is linked to the Sunshine State Standards (Florida Department of Education, 2011). The FCAT software provides learning guidance, feedback, and an explanation to questions that students answer incorrectly. According to Sullivan and Naime-Diefenbach (2002), students who used the FCAT Explorer as a supplement to learning answered more quickly and scored better on the FCAT than those students who did not use the FCAT Explorer. The FCAT Explorer gave students hope in terms of passing the FCAT. Students who used the FCAT Explorer and other web-based learning programs showed better academic performance than those who did not use any form of web-based program (Martindale, Pearson, Curda, & Pilcher, 2005). Students must have critical-thinking skills to pass the FCAT: The critical-thinking skills used in the FCAT Explorer program helped the students master the necessary objectives (Keller, 1987; Naime-Diefenbach, 1991; Sullivan & Naime-Diefenbach, 2002). Students were given a variety of FCAT-formatted questions to practice and were given immediate feedback (Sullivan & Naime-Diefenbach, 2002).

Sullivan and Naime-Diefenbach (2002) conducted a study that compared the FCAT scores of fifth-, eighth-, and 10th-grade students who used the FCAT Explorer to those who did not use the program. The researchers used a quantitative research design to conduct their study. There were 2,424 students who participated in this study. Overall, Sullivan and Naime-Diefenbach reported that students in schools using the FCAT Explorer showed significant learning gains compared to students at schools who did not use the program. In addition, schools that used the FCAT Explorer as a learning tool showed consistently higher school ratings than schools that did not use the program (Sullivan & Naime-Diefenbach, 2002). Based on the results of this study, schools in Florida could benefit from online resources, such as the FCAT Explorer.

Myers (2009) conducted a study that compared the FCAT scores of students who used a program similar to the FCAT Explorer. Eleven schools were selected to participate in this study. Students in this study came from backgrounds of varying SES. A quantitative research design was used and the results showed that technology had a positive effect for those who used technology to practice for the FCAT as compared to the students in the control group who did not use technology. The flaw in this study was that the results were generalized by the researcher. Students selected for this study came from a small population; therefore, the population of this study might be different than other populations within the United States.

Educational software allows students to make multiple attempts to solve problems and provides detailed solutions to the problem. Instant feedback informs students on their weaknesses in content areas. Using online interactive programs could inspire students to learn more efficiently and effectively; interactive programs for mathematics have been shown to improve student learning (Shy & Hung, 2007).

Impact of Computer Technology on African American Students' Achievement

There was a rapid growth of the number of students using technology in the United States (Judge, 2005). In addition, statistics suggested that, as of 2001, more than 50% of students had access to a computer at home (DeBell & Chapman, 2003). However, African American students had the lowest access to computers at home or at school (Becker, 2000). There was also a significant gap in the use of computers at home and at school between African American and Caucasian students (DeBell & Chapman, 2003).

Judge (2005) conducted a study that determined the relationship between academic achievement among African American students and the use of technology. The participants of this study by the National Center of Education Statistics consisted of 1,601 African American students from 274 public schools in kindergarten and first grade. Student achievement was measured by class assessments provided by the teacher. This study included parent surveys, classroom assessments, teachers, and school administrators. The results showed that student achievement was correlated with the frequent use of computers. Therefore, technology had a positive impact on the achievement of African American students (Judge, 2005).

Walker and Senger (2007) conducted a similar study that investigated the effects of using computers to teach developmental skills to African American students at the intermediate level. The results showed no significant difference in achievement between students who used computers and those who did not use computers.

As part of the NCLB of 2001, educators would seek to improve student achievement through the use of technology (Judge, 2005). In addition, the NCLB was established to help students become technically proficient by the eighth grade and to ensure that teachers integrated the use of technology into the curriculum to improve student achievement.

Effects of Technology on the Achievement of Students of Low SES

It is beneficial for students of low SES to develop cognitive skills so that they could be designers of their learning (Kemker, 2007). Technology can assist students of low SES by allowing them to develop cognitive skills to enhance their thinking (Kemker,

2007) and enable them to apply concepts in a variety of methods. Roschelle, Pea, Hoadley, Gordin, and Means (2000) stated that technology engaged students in the cognitive strategies of learning, such as the collaboration and contextualize process.

The Ramey (2009) study was conducted to determine the impact of technology on student achievement in terms of their SES. Student performance was measured by the Criterion-Referenced Test, a state-mandated test. The mathematics and science scores of sixth- and eighth-grade students were the dependent variables of this study. The findings of this study showed a significant reduction in the achievement gap of students of low SES who used technology as a supplement to learning when compared to students of high SES. Although data came from a large population of students at five schools, each participating school had a small sample size.

Page (2002) investigated the effects of technology on the achievement of elementary students of low SES. The purpose of this study was to compare students' achievement results with that of students in a traditional elementary classroom. A quasi-experimental study was designed to examine the outcome of each group. The participants involved in this study consisted of 211 students from 10 classrooms. In five classrooms, technology was integrated into the curriculum and the other five did not use any form of technology as a supplement to learning. Most students involved in this study were from low SES backgrounds. Data from the Iowa Tests of Basic Skills were used to measure student achievement. The results showed that the experimental group scored significantly higher on each assessment.

Gender Differences in the Use of Educational Technology

Before teachers could analyze the gender differences for individuals using educational technology, they needed to understand the effect of gender differences in achievement in mathematics. According to Tiedemann (2000), girls achieved higher academic success than boys in Grades 1 to 3. As there was less computation in high school, boys outperformed girls at the high school level (Hyde, Fennema, & Lamon, 1990). Tiedemann claimed that boys tended to be more logical thinkers than girls. As a result, boys tended to achieve greater success in mathematics, which required logical thinking.

However, research has demonstrated that the gender achievement gap for students using educational technology has decreased (Heemskerk, Dam, Volman, & Admiraal, 2009). Yet, boys and girls are affected differently when it comes to utilizing educational technology in the classroom (Heemskerk et al., 2009). Overall, students are excited to use educational technology at school (Hunt, Davies, & Pittard, 2006; Ruthven, Hennessy, & Brindley, 2004); however, student experience varies based on gender (Heemskerk et al., 2009).

Dunleavy and Heinecke (2007) stated that technology did not have a different impact on academics based on gender. Dunleavy and Heinecke compared standardized-test scores in mathematics based upon gender. The results showed no significant differences in terms of gender on performance on standardized testing. Kay (2010) revealed that gender did not have an impact on standardized testing. Based on these findings, the use of technology might not cause boys to score higher on standardized tests than girls. However, the research portrayed mixed results, suggesting the need for further study of the topic.

Bain and Rice (2007) conducted a study to investigate whether gender had an impact on students' attitudes and their use of technology. Fifty-nine sixth-grade students participated in this study to examine their attitude towards technology through the use of a survey, student work samples, interviews, and classroom observations. One major finding in this study was that gender differences and perceptions of technology were not significant. However, the results showed that gender did affect students' attitude for the participants of this study. Many females who participated in the Bain and Rice study did not perceive technology as being difficult to use. Boys, however, stated that they were more proficient in the use of computers compared to girls. A mixed-methods approach was used to combine both qualitative and quantitative research techniques. There were also many conditions assumed in this study (Bain & Rice, 2007), including students had computers in their classrooms, understood the survey, and answered each question correctly. Students had to record their own data in the Bain and Rice study. Some students accurately recorded that data and others did not effectively record their data.

Carter (2008) conducted a study where technology had an effect on achievement in terms of gender in mathematics. To determine the significance of the independent variables, Carter used a two-way analysis of variance. Carter determined the attitude of both male and female students in their use of technology. There were 160 students who participated in this study. The results showed that a computer-enhanced curriculum had a positive effect on student achievement, which was measured by the course final exam. Gender, on the other hand, did not have a significant difference on student achievement. Carter used a quantitative analysis by conducting interviews of student perception in their mathematics class. Unfortunately, the final exam for this study might not have been tested for reliability and validity.

There were gender differences in mathematics for both male and female students (Overall, 2007). Overall (2007) suggested that girls were stronger at knowing the domain of mathematics. Therefore, girls had higher significant achievement than boys in the domain of reasoning. Boys, however, had an advantage in applying this domain as compared to girls (Mullis, Martin, Gonzalez, & Chrostowski, 2004). In addition, boys outperformed girls in an analysis of open-ended items and multipage choice items on the International Assessment of Educational Mathematics Test. The number of participants was not discussed in this study; however, participants were from six unknown countries. Moreover, the research showed that, the more the difficult items were, the better boys perform on the assessment than girls (Mullis et al., 2004).

Motivating Students With Technology

Teachers must be able to find creative ways to enhance student learning. Some teachers might find it difficult to motivate students to learn. If students are not motivated to learn, their academic performance could be affected. Haugland (as cited in Cause & Chen, 2010) stated that, in the learning process, student engagement was linked with motivation. Technology can be used as an instructional tool to promote actively engaging the students. In addition, Haugland (1999) reported that student motivation improved when instruction was paired with technology. Arrowood and Overall (2004) agreed that computers could be used as an instructional method to increase student motivation in the classroom. Motivation was a critical factor in terms of student engagement (Cause & Chen, 2010).

Student engagement might determine academic success in a course. Cause and Chen (2010) revealed that the effects of technology had a positive impact on academic performance. In addition to student motivation and academic performance, students who used computers showed significant learning gains in intelligence and problem solving compared to students who did not use any form of technology as a supplement to learning (Clements & Sarama, 2002). Students were motivated to learn when learning became active with technology: The use of computers in school increased student engagement (Cause & Chen, 2010).

If students are motivated and engaged in learning, student performance can increase to a higher level (Jones & Kalinowski, 2007). It is important for students to see how mathematics is used in different areas, such as manufacturing, sciences, construction, transportation, communication, and design. Mathematics could be made more enjoyable by correlating it with technology (Linnell, 2004). In order to motivate students to excel academically, teachers must be able to plan their instruction around a learning environment that is creative (Linnell, 2004). Technology could be used as a learning and teaching instrument to reinforce creativity.

Student engagement has become an important topic in education. Lack of motivation could lead to student failure and students coming to class ill-prepared. Some students fail to learn the skills needed in the 21st century because they feel that the curriculum is irrelevant or uninteresting (Chesley & Hartman, 2010). Educators must examine the relevance of instruction to student engagement (Chesley & Hartman, 2010).

Summary

Instructional technology and educational software have become contributing factors in increasing the students' academic performance (Kinney & Robertson, 2003). Utilizing technology allows students the opportunity to learn mathematics from a different perspective, as opposed to the traditional method of learning. There are many forms of instructional technology available to assist students in learning, such as the Promethean ActivBoard and the FCAT Explorer.

Research Questions

This quantitative study was guided by three research questions:

1. What was the effect of technology, specifically the Promethean ActivBoard and the FCAT Explorer, on the achievement in mathematics of sixth-grade students, as measured by district benchmark assessments?

2. What was the difference in mathematics achievement, if any, between male and female sixth-grade students following the use of technology, specifically the Promethean ActivBoard and the FCAT Explorer, as measured by district benchmark assessments?

3. What was the effect of technology, specifically the Promethean ActivBoard and the FCAT Explorer, on the achievement in mathematics of African American sixth-grade students, as measured by district benchmark assessments?

Chapter 3: Methodology

The main focus of any school improvement plan is student achievement (Reddekopp, 2007). At the target middle school, if students were not achieving academic excellence, administrators required teachers to identify student academic weaknesses and implement an intervention that promoted student growth. The goal for this study was to determine whether the use of specific software, the Promethean ActivBoard and the FCAT Explorer, would increase the mathematical achievement of sixth-grade students.

This chapter includes the methodology for the study and provides information regarding participants, instruments, procedures, data analysis, and limitations. The researcher also describes the intervention and data analysis process based on the data that were collected in this process.

Participants

At the target middle school, there were five teachers of sixth-grade mathematics. Two teachers were involved in this applied dissertation study; the researcher analyzed the data. The two participating teachers were asked to consent to being part of the study. Each teacher involved in this study was identified by the letters A or B. Four classes, two classes each from Teacher A and Teacher B, were involved in this study. Therefore, a convenience sample of students in the four classes of sixth-grade mathematics was involved in this study. A convenience sample is defined as a sample of study subjects that was taken from a group (Simon, 2002). At the target middle school, students in the convenience sample ranged in age from 11 to 14 years. The counselors at the target middle school grouped students in homogenous classes based on their FCAT scores and learning abilities. In addition, students were placed on teams, depending on their FCAT scores. As an example, students who score a high Level 2 on the FCAT were placed on one team, whereas students who scored a Level 3 or higher were placed on another team.

Teachers A and B each had a control group and an experimental group. The convenience sample, thus chosen, was a good representation of the population being studied.

Students in all classes were demographically categorized to be from low, middle, and high SES backgrounds based on an SES report that was provided to all teachers at the beginning of each school year. Approximately 48% of students came from a low SES background, 33% came from a middle SES background, and 19% came from a high SES background. The experimental and control groups had male and female students. Prior to implementation of this study, the researcher obtained written permission from the teachers, students, and parents participating in this study.

The experimental group began with 61 students; two students withdrew from school, resulting in 59 students. The control group began with 64 students; three students withdrew, resulting in 61 students. In addition, the experimental group had 28 male and 31 female students involved in this study, and the control group had 29 male and 32 female students. In addition, there were 45 African American students in the experimental group and 48 African American students in the control group. Based on an SES report that was provided to all teachers at the beginning of the school year, students in all classes were demographically from low, middle, and high SES backgrounds.

Instruments

District benchmark assessment tests showed reliability in generalizing student performance within the school year and from one year to the next (Florida Department of

Education, 2011). Four kinds of reliability could be used: (a) internal consistency, (b) test-retest reliability, (c) interrater reliability, and (d) reliability of classifications (Florida Department of Education, 2011). The reliability of assessments was expressed as a number from zero to 1. Since 2001, benchmark assessment tests had been reliable for assessing student achievement with reliability results of .80 or higher (Florida Department of Education, 2011). The district benchmark tests were utilized as the pretest and posttest to measure student growth, based on standards covered by the district and state. Students took one pretest and one posttest during this study. The purpose of benchmark assessment pretests was used to establish equivalency among the control and experimental groups. The benchmark assessment posttest was used to compare results from the experimental and control groups postintervention.

The validity of benchmark assessment tests was based on the interpretation of student results (Florida Department of Education, 2011). The results provided valid detailed information about the achievement of the students as measured by the Sunshine State Standards (Florida Department of Education, 2011). The assessments were placed into three interrelated categories: (a) content-related evidence, (b) criterion-related evidence, and (c) construct-related evidence (Florida Department of Education, 2011). Benchmark assessment tests were reliable for assessing student achievement with validity results of .80 or higher since 2001 (Florida Department of Education, 2011).

Procedures

Research design. A quasi-experimental design was used to examine student achievement data throughout the school year, comparing the scores of students from the experimental group to those students of the control group. Williams (2006) described this design as an equivalent group design. For this study, the quasi-experimental design required district benchmark tests and a comparison group. All participants learned the same standards, objectives, and concepts, but through differing instructional methods. Instruction was based upon a combination of lecturing, note taking, and solving in-class practice problems.

The researcher observed the teacher of the experimental group at the target middle school using the training that was provided by the staff of the targeted middle school on how to integrate technology into the curriculum. A mathematics teacher taught the control group without the use of technology as an instructional tool. Although the researcher's colleagues and other mathematic teachers did not use technology as an instructional tool, they were required to attend the training in order to utilize technology into curriculum in the future.

The experimental group used both the Promethean ActivBoard and the FCAT Explorer to support student learning in mathematics. The experimental group went to the computer laboratory twice a week while students of the control group did not have a technology component in their learning. The same standards were taught to the experimental and control groups using the same textbook. The class size of each group ranged from 26 to 33 students. Therefore, the number of participants involved in this study included 120 students and two teachers.

The first research question determined whether the FCAT Explorer and the Promethean ActivBoard were more effective than the traditional method of learning based on district benchmark test results. The traditional style of teaching consisted of using textbook material to reinforce instruction.

The second research question identified the subgroups of boys and girls, with the performance levels on the district benchmark tests as the dependent variable. The third research question identified the subgroup of African American, with performance levels on the district benchmark test as the dependent variable. Benchmark assessment tests were just as reliable as the FCAT in terms of measuring student achievement (Florida Department of Education, 2011). The African American population included 97% of students of low SES. Therefore, the effect of technology for students of low SES and African American students at the target middle school was similar (Florida Department of Education, 2011).

Intervention. The experimental group used the FCAT Explorer as an instructional tool. Students used the FCAT Explorer on Tuesdays and Thursdays to reinforce standards that were taught during the week. The experimental group also used the Promethean ActivBoard on Monday, Wednesday, and Friday as an instructional tool. Students spent approximately fifty-five minutes in the computer lab. Initially, they were informed about rules, expectation, and procedures when using the computer lab. All students had assigned seating and was instructed to login into their assigned computer and get started using FCAT Explorer after the tardy bell.

The Promethean ActivBoard promoted students becoming interactive with learning (Marzano & Haystead, 2010). Video clips were played from the Promethean ActivBoard to provide a broader understanding of a given concept. Although each teacher had a Promethean ActivBoard in their class, only the experimental group of students used it as a part of their instructional learning. All students had assigned seats and worked in pairs of two. Both experimental and control group of students used the class textbook as a resource for learning. During instruction, students that were in the experimental group lessons where presented to them by their teacher using the Promethean Activ Board. They had the opportunity to interact with their peers using the Promethean Activ Board. For example, a selected student would demonstrate learning by solving mathematic problems. Video clips were often used to assist student in learning the concept. The control group on the other hand, received instruction from their teacher using the school's washboard. As opposed to the experimental group using the Promethean Activ Board to demonstrate learning to their peers, students in the control group were selected to solve problems on the wash board. After the lesson was modeled to students by their teacher, all students complete the same assignment. Students either would completed a mathematic worksheet, use the class textbook, or worked on a class project that related to the lesson that was presented to them. A warm up was assigned daily to all students before instruction would begin. Warm ups were similar mathematic problems used from the previous school day to determine if students understood the concept that they learned. All students completed the same homework assignment as well.

Data analysis. Both the experimental and control groups took the district benchmark tests as assessments. To answer all three research questions, district benchmark tests scores were compared for all groups. Changes in mean scores were determined for the experimental and control groups to determine if there was a significant difference in the results within and between the groups.

Research Question 1 read, What was the effect of technology, specifically, the Promethean ActivBoard and the FCAT Explorer, on the achievement in mathematics of sixth-grade students, as measured by district benchmark assessments? To answer Research Question 1, scores from the experimental and control groups were compared. A two-way analysis of variance, ANOVA test was used as a method to evaluate the difference in mean scores between the experimental and control groups on the posttest. Student growth was determined from the results of their performance on the pretest to their performance on their posttest. The school's data support specialist provided the results of the benchmark assessments in a report that analyzed the students' strengths, weaknesses, and growth. The ANOVA test was also used to determine if there was a significant difference in scores on the posttest.

Research Question 2 asked, What was the difference in mathematics achievement, if any, between male and female students in sixth grade following the use of technology, specifically the Promethean ActivBoard and the FCAT Explorer, as measured by district benchmark assessments? To answer Research Question 2, the scores of boys and girls were compared to determine which gender group scored higher and showed greater improvement on the benchmark assessment posttest. The dependent variable was the achievement level for each gender. The results from the benchmark assessment test determined which gender, if any, performed better on the district benchmark posttest. A two-way analysis of variance ANOVA test was used to determine whether the difference was inferentially significant or not.

Student results were also coded by gender and group so all participants remained anonymous. A narrative of the results was analyzed from male and female students of the experimental and control groups. The narrative provided a summary of the students' pretest and posttest results, achievement, growth, and subgroup in the form of a written report. A narrative was followed by an interpretation of benchmark scores from the posttest of male and female students. The pretest was used to determine if the two groups were equivalent.

Research Question 3 read, What was the effect of technology, specifically the Promethean ActivBoard and the FCAT Explorer, on the achievement in mathematics of African American sixth-grade students, as measured by district benchmark assessments? To answer Research Question 3, the scores of African American students were compared to determine which group scored higher and showed more improvement on the benchmark assessment posttest. The dependent variable was the achievement level for each group. The results from the benchmark assessment tests determined which group, if any, performed better on the district benchmark posttest. An ANOVA was also used to test the data for the third research question.

The significance of this study was based on student growth and achievement from their pretest and posttest scores. The researcher viewed and analyzed the results from the pretests and posttests to determine student growth and achievement. ANOVA was used as a method to evaluate the differences in mean scores between the African American students of the experimental and control groups.

Organizing and preparing. Data were collected and organized according to the district benchmark assessment tests from students of the experimental and control groups. This study began, after the approval of the Institutional Review Board, by identifying the groups and having parent meetings to gain written consent for participation in the study. The researcher collected documentation from the pretest to determine student strengths and weaknesses. The results of the control and experimental groups were compared to determine equivalency between the two groups. At the completion of the semester, students took a posttest to determine which group showed significant gains from the pretest.

Interpretation. A final step of interpreting the benchmark assessment tests scores was completed. The literature review contributed to the findings of this study on the effect that technology had on student performance in mathematics.

Summary

In this applied research study, the effect of the use of instructional technology on sixth-grade student achievement in mathematics in a homogenous environment was investigated. An intervention was implemented by incorporating educational software into the curriculum of sixth-grade students to determine whether their performance increased on district benchmark tests. Results were analyzed to determine whether gender or ethnicity impacted the effect of the intervention.

Chapter 4: Results

In this chapter, the results, analyses, and interpretation of the data collected by the researcher are presented. The purpose of this applied dissertation was to determine if there was a difference in sixth-grade student's achievement in mathematics through the use of technology, and, specifically the Promethean ActivBoard and FCAT Explorer. The experimental group began with 61 students and was reduced to 59 when two were withdrawn from school. The control group, on the other hand, began with 64 students, but three withdrew from school as well. Each student in the control group received traditional mathematics instruction. The students in the experimental group received instruction through the use of technology, in addition to traditional instruction. All students in this study were chosen based on their previous year's FCAT score. The implementation of this study was conducted from March 2012, through June 2012. During this period, data were collected and analyzed. The three research questions provided a focus for this study and were designed to determine if there were significant differences in achievement for students who used technology as a supplement to learning compared to the traditional method of learning through the math textbook.

Research Questions

Three research questions were investigated in this study:

1. What was the effect of technology, specifically the Promethean ActivBoard and the FCAT Explorer, on the achievement in mathematics of sixth-grade students, as measured by district benchmark assessments?

2. What was the difference in mathematics achievement, if any, between male and female sixth-grade students following the use of technology, specifically the Promethean

ActivBoard and the FCAT Explorer, as measured by district benchmark assessments?

3. What was the effect of technology, specifically the Promethean ActivBoard and the FCAT Explorer, on the achievement in mathematics of African American sixth-grade students, as measured by district benchmark assessments?

Demographic Information

Initially, the selection of 125 students for this study was based on their previous year's FCAT scores; the students were placed in mathematics classrooms based on those scores. At the completion of this study, there were a total of 120 students: 59 in the experimental group and 61 in the control group. Preintervention, a total of 61 male and 64 female students were involved in this study; for the posttest, 59 male students and 61 female students remained for the data analysis. In addition, of the students in the initial pretest sample, 95 students were African Americans. Because of students' leaving the school, by posttest analysis, 93 of the African American students remained. Detailed information of student demographics is displayed in Table 7. Data were analyzed for the students who completed the pretest and posttest.

Table 7

Demographic Information for the Final Sample of Sixth-Grade Students

Category	Experimental group (n = 59)	Control group (n = 61)
Gender		
Male	30	33
Female	29	28
Race		
African American	45	48
Caucasian	10	9
Hispanics	4	4

Overview of Results

The experimental group of students that utilized the Promethean ActivBoard and FCAT Explorer scored higher and showed more growth on the district benchmark posttest than the students of the control group who did not use any form of educational technology. In terms of gender, the experimental group of male students had scores higher than those of the male students in the control group. Female students who used the Promethean ActivBoard and FCAT Explorer also scored higher than female students in the control group who did not use any form of instructional technology. African American students who used the Promethean ActivBoard and FCAT Explorer scored higher than those African American students who did not use either program as a supplement to learning.

The district benchmark pretest was used as an instrument to show equivalency between the experimental and control groups. One hundred and twenty students participated in the benchmark assessment pretest: 59 (49%) were in the experimental group and 61 (51%) were in the control group. The district benchmark pretest placed students in one of three categories: (a) needs much improvement, (b) needs improvement, or (c) is on target. Each benchmark assessment test consisted of 25 multiple-choice questions. A summary of the results by research question follows.

Results for Research Question 1

What was the effect of technology, specifically the Promethean ActivBoard and the FCAT Explorer, on the achievement in mathematics of sixth-grade students, as measured by district benchmark assessments? First, an analysis was conducted using Analysis of Variance (ANOVA) to determine any differences between the mathematics performance of the control (*N* = 61, *M* = 49) and experimental (*N* = 59, *M* = 47) groups on the pretest. There was no significant difference between the two groups ($p > .05$) (see Table 8 and Appendix A).

Table 8

Mean Scores of Sixth Graders at the Target Middle School on the District Benchmark Pretests and Posttests

	Experimental group			Control group		
Category	*n*	Pretest *M*	Posttest *M*	*n*	Pretest *M*	Posttest *M*
All groups	59	47	59	61	49	53
Gender						
Boys	28	48	61	29	50	56
Girls	31	46	57	32	49	51
African American	45	45	57	48	48	51

Note. A score of 53 or above represented being on target.

The posttest scores of both groups are presented in Table 8. In Table 9, the change in mean score by group was identified. For the total sample, students in the experimental group increased their scores by an average of 26% (*N* = 59) as compared to the 8% increase for students in the control group (*N* = 61) from the pretest to the posttest. A score of 53 or above in the data of Table 8 represented being on target. Table 9 shows the increase in mean scores on the posttest for both the experimental and control groups. There was a significant difference between the means of the control group and the experimental group using ANOVA ($p < .05$); there was also a significant difference in the academic performance of the experimental group when the mean scores on the pretest were compared to the mean scores on the posttest ($p < .05$; see Appendix A). There was no significant difference between the mean scores when the pretest and posttest for the control group were compared.

Results for Research Question 2

What was the difference in mathematics achievement, if any, between male and female sixth-grade students following the use of technology, specifically the Promethean ActivBoard and the FCAT Explorer, as measured by district benchmark assessments? The same district benchmark tests were used to assess the difference between the achievement of male and female students.

Table 9

Change in Mean Scores of Sixth Graders at the Target Middle School

	Experimental group			Control group		
Category	*n*	Change in *M* score	% change	*n*	Change in *M* score	% change
All groups	59	12	26	61	4	8
Gender						
Boys	28	13	27	29	6	12
Girls	31	11	24	32	2	4
African American	45	12	27	48	3	6

A review of the pretest results showed little difference in the mean scores of male ($N = 28$, $M = 48$) and female ($N = 31$, $M = 46$) students in the experimental and male ($N = 29$, $M = 50$) and female ($N = 32$, $M = 49$) students of the control group (see Appendix B).

Within- and between-group comparisons showed no significant differences in mean scores by gender on the pretest ($p > .05$; see Table 8).

The pretest results also showed little difference in mean scores of male students of the experimental group ($N = 28$, $M = 48$) and male students of the control group ($N = 29$, $M = 50$; see Appendix B). Within- and between-group comparisons showed no significant differences in mean scores by gender of male students on the pretest ($p > .05$; see Table 8).

In addition, the pretest results showed little difference in mean scores of female students of the experimental group ($N = 31$, $M = 46$) and female students of the control group ($N = 32$, $M = 49$; see Appendix B). Within- and between-group comparisons showed no significant differences by gender of female students on the pretest mean scores ($p > .05$; see Table 8).

A review of the posttest results also showed little difference in mean scores of male ($N = 28$, $M = 61$) and female ($N = 31$, $M = 57$) students in the experimental and male ($N = 29$, $M = 56$) and female ($N = 32$, $M = 51$) students of the control group (Appendix B). Within- and between-group comparisons showed no significant differences in mean scores by gender on the posttest ($p > .05$; see Table 8).

Another review of posttest results showed little difference in the mean scores of male students in the experimental group ($N = 28$, $M = 61$) and male students of the control group ($N = 29$, $M = 56$; see Appendix B). Within- and between-group comparisons showed no statistically significant differences in mean scores by gender on the posttest ($p > .05$; see Table 8).

In addition, review of posttest results showed little difference in the mean scores of female students in the experimental group (*N* = 31, *M* = 57) and female students of the control group (*N* = 32, *M* = 51; see Appendix B). Within- and between-group comparisons showed no significant differences in mean scores by gender of female students on the posttest ($p > .05$; see Table 8).

In Table 9, the increase in posttest results by gender are displayed. Boys in the experimental group increased their scores by 27% (*N* = 28); girls increased their scores by an average of 24% (*N = 31*). The increase in the mean of posttest scores of the boys of the experimental group was 3 points higher than the girls of the experimental group. Therefore, results showed no significant differences by gender ($p > .05$) on the increase in posttest scores of students in the experimental group. The increase in the mean of the posttest scores of the boys of the control group (*N* = 29, % of increase = 12) was 8 percentage points higher than those of the girls of the control group (*N* = 32, % of increase = 4).

Table 9 also showed boys in the experimental group increased their mean scores by 27% (*N* = 28, % of increase = 27); boys in the control group increased their scores by an average of 12% (*N* = 29, % of increase = *12*). The increase in posttest mean scores of the boys of the experimental group was 15 percentage points higher than those of the boys of the control group. The increase in the means of posttest scores of the girls of the experimental group (*N* = 31, % of increase = 24) was 22 points higher than those of the girls of the control group (*N* = 32, % of increase = 4; see Table 9). ANOVA was used to determine if the increase in student performance for both boys and girls was significant at the .05 level; this increase was significant for both genders.

Results for Research Question 3

What was the effect of technology, specifically the Promethean ActivBoard and the FCAT Explorer, on the achievement in mathematics of African American sixth-grade students, as measured by district benchmark assessments? As shown in Table 9, the African American students of the experimental group (N = 45, M = 57) increased mean scores by 27%, as compared to an increase of 6% of the control group (N = 48, M = 51; see Appendix C). Again, ANOVA was used to determine if the difference in the means between the pretest and the posttest was significant at the .05 level. The results showed a significant difference between mean scores for the experimental group when the pretest results were compared to the posttest. There was also a significant difference ($p < .05$) between the scores of African American students when the posttest scores of the experimental group and the control group were compared (see Appendix C).

Summary

In this chapter, data were presented to answer the research questions and to determine if technology, specifically the Promethean ActivBoard and FCAT Explorer, had an impact on student achievement in mathematics. Using the change in mean scores, the findings of this study showed an increased student achievement following the use of technology in mathematics instruction. Boys in the experimental group showed a 3% percentage increase in test scores than the girls. The experimental group of African American students' percentage increased 21% more than African American students of the control group. In chapter 5, the results of this study were discussed in detail and recommendations were offered for schools within the district and state.

Chapter 5: Discussion and Recommendations

In this chapter, the research questions, findings, conclusion, and limitations of this study are discussed. In addition, recommendations for future study are offered. This intervention plan of action was used to determine if the use of instructional technology was effective in increasing student achievement in mathematics. Based on the results of this study, teachers and administrators of schools whose students were not mastering standards in mathematics could make changes in how students were taught, including the use of instructional technology strategies. The researcher undertook this study to add to the research by determining whether students who used instructional technology, specifically the Promethean ActivBoard and FCAT Explorer, demonstrated increased achievement in mathematics.

In this study, technology was a tool used to enhance the learning environment of students. The Promethean White Board and FCAT Explorer were used to promote critical thinking and assisted students with focusing on mathematical reasoning. If technology is used as an instructional tool, increasing student achievement should be paramount.

In order to address student achievement, educators must utilize different strategies (National Council of Teachers of Mathematics, 2000). The researcher presented a supplement to learning mathematics through the use of technology. The problem addressed in this study was the students' low achievement in mathematics. Low achievement was an issue as there was no plan of action at the targeted middle school to remediate this problem. Researchers showed that technology has an impact on student performance (Ketamo & Alajaaski, 2008): This subject was specifically discussed in the literature review.

Technology helps to facilitate student learning as it assists students to able to work on problems individually or with their peers (Hobbs, 2012). Technology allowed students in the target school to explore concepts using critical thinking and mathematical reasoning as opposed to memorization, a traditional approach to learning math concepts. It was evident in the results of this study that the use of technology contributed to the increase in student academic performance in mathematics. The findings of this study supported a determination that technology integration increased student achievement levels. Research also indicated that students who used technology performed better than those students who did not have technology integrated into their curriculum (Wanjala, 2005).

Computers have become a popular trend used to assist students in learning (McKenzie, 2000). For several decades, many schools in the United States used technology as a supplement to educate students (Wilson, 2007). It is important for teachers to make effective use of computers to be able to teach more effectively (Goddard, 2002). Willis (2003) stated that technology could enhance educational practices. There are many elements of instructional application through the use of instructional technology, such as the use of the Internet, digital video productions, and educational software (Willis, 2003). The results of this study support recommendations that teachers should utilize technology, specifically for mathematics, for instruction and to ensure that students become more technologically competent (Wilson, 2007). The purpose of this study was to determine the effectiveness of students using technology in mathematics at the target school. The data showed that the use of the technology increased student performance.

Students' performance in mathematics has been, and continues to be, an issue for educators. In addition, the achievement gap between White and minority students continues to be an issue. As a result, school officials modified teaching strategies used to increase student achievement (Willis, 2003). Educators recommended that teachers use technology within their instruction to possibly have a positive impact on student learning in mathematics. The Promethean ActivBoard and FCAT Explorer introduced in classrooms at the target school had this effect.

Integrating technology, specifically the Promethean ActivBoard and FCAT Explorer in to the curriculum, when compared to nontechnology instruction, resulted in higher achievement for students on the mathematics benchmarks tests. The results of this study showed that students taught using the Promethean ActivBoard and FCAT Explorer were likely to perform better on standardized tests than those students receiving only no technology instruction.

In this study, two groups of students were selected in a particular school district in the state of Florida. The first group used technology as an instructional tool for learning mathematics. The second group, however, did not use any form of technology within their instruction. The students' benchmark assessment tests were recorded and the means from each group was calculated. The mean scores of the students who used technology as part of their curriculum were compared with those of students who did not use technology within their curriculum. In addition, student growth of each group was measured from the pretest and posttest.

Research Question 1. What was the effect of technology, specifically the Promethean ActivBoard and the FCAT Explorer, on the achievement in mathematics of sixth-grade students, as measured by district benchmark assessments? The main purpose of this study was to determine if the use of the Promethean ActivBoard and FCAT Explorer affected student performance on district benchmark assessments. Even though student performance increased for the experimental and control groups, a higher percentage of students who used the Promethean ActivBoard and FCAT Explorer scored on target on the benchmark assessment posttest (see Appendix A).

The researcher found a similar study by Myers (2009) that related to using technology to increase the FCAT scores of students in mathematics. Myers determined the achievement differences between an experimental group and a control group. The Myers's study involved 11 schools in Miami-Dade County Public Schools in a pilot program, using the FCAT as an instrument to measure student performance. In addition, the students who participated in the program came from various socioeconomic backgrounds. The results were similar to those of this research study. The results showed a significant difference in performance for students who used technology as an instructional tool for learning mathematics. Similar to Myers' study, this research study revealed a notable difference in increased achievement on the benchmark assessment test between the experimental and control groups.

In similar studies, the attitude towards the use of computers was an important factor to motivate students and to increase their academic performance (Yushau, 2006). In addition, if teachers did not integrate technology into the curriculum, then students might not embrace the use of technology for educational purposes (Yushau, 2006). Unfortunately, some teachers were not trained on how to integrate technology into the curriculum; therefore, some mathematic teachers rarely used technology to enhance student learning (Kadijevich, 2002).

Research Question 2. What was the difference in mathematics achievement, if any, between male and female sixth-grade students following the use of technology, specifically the Promethean ActivBoard and the FCAT Explorer, as measured by district benchmark assessments? The researcher analyzed the increased achievement on the posttest of male and female students in the experimental and control groups. The results revealed a difference in student achievement based on gender and the use of technology. The experimental group's mean score on the posttest was higher than that of the control group. The experimental group of boys had a greater increase in performance than experimental group of girls (see Appendix B). Myers (2009) reiterated that boys were more academically successful than girls in mathematics. This study provided evidence that the use of the Promethean ActivBoard and FCAT Explorer could close the achievement gap between male and female students in mathematics. In this isolated case, participants included a small, diverse population of students.

Research Question 3. What was the effect of technology, specifically the Promethean ActivBoard and the FCAT Explorer, on the achievement in mathematics of African American sixth-grade students, as measured by district benchmark assessments? Although student performance increased for the experimental and control groups, a higher percentage of African American students who used the Promethean ActivBoard and FCAT Explorer scored on target on the benchmark assessment posttest (see Appendix C). According to Hobbs (2012), African American students could lose interest in mathematics if the concept being taught did not have relevance to everyday life. Therefore, relevance to the students' culture was found to increase their academic performance (Ladson-Billings, 2009; Leonard, 2001). In addition, research showed that African American students were more likely to be engaged in their mathematics class if their teacher could relate mathematics to experience (Hobbs, 2012). Nasir, Hand, and Taylor (2008) conducted a study of basketball players of African American heritage at the middle and high school levels. The results showed that their academic performance increased when problems in the context of basketball were used on assessments. A research design or sample size was not discussed in this study; therefore, the generalization of results could not be determined. Hobbs suggested that schools should offer advanced mathematics course to African American students to provide them the opportunity to engage in rigorous lessons in the same way that Caucasians middle class students were taught. Although there were recent gains in achievement of African American students, many students were not performing at sufficient levels in mathematics (Tate & Rousseau, 2003).

In spite of reform efforts to address student weakness, African American students have not had the same opportunities to participate in rigorous lessons in science, mathematics, and technology education (Rosebery & Warren, 2001). However, technology provides African American students the opportunity to improve their academic performance (Hobbs, 2012), as well as to enhance their learning and develop new levels of understanding (Hobbs, 2012). The use of technology could be used to expand student knowledge and allow them to become more self-directed learners (Kara, 2008). As a result, students would have educational and instruction opportunities to improve their academic performance (Kara, 2008). In addition, students become responsible for their pace, the style, and the content of their learning (Hobbs, 2012).

Students could learn more complicated concepts in a lasting and effective manner (Kara, 2008).

In another study conducted by Hobbs (2012) in a high school that enrolled more than 2,000 students in Grades 9 through 12, 69% were African American students and 70% of students were classified as economically disadvantaged based on the district's free or price-reduced lunch classification. Fifty African American students participated in the study. In addition, students used a computer-based program that was culturally specific to their learning in mathematics. The experimental group of students used the program and the control group of students did not use any form of instructional technology as an instructional tool. A quasi-experimental study was used to determine if computer technology improved student performance. The results revealed a slight improvement of both experimental and control groups on the National Assessment of Educational Program posttest. There was no significant difference between the test scores of the students in the experimental and control groups. However, the students in the experimental group had a mean score slightly higher than that of the control group.

Unfortunately, poverty is a factor that impacts student achievement, which results in high school dropouts (Leroy & Symes, 2001). There are other factors that were affiliated with the low achievement of students, such as racial background, being raised in a single-parent home; and lack of parental education (Strahan, 2003). Poverty is detrimental to student access to a quality education. Students living in poverty might have different norms than the schools they attend. As a result, the teacher is expected to intervene between the values of school and students. Teachers play an important role as a facilitator of learning and provide support in various ways, such as spiritual and relationship building (Payne, 2001). The Ogwu (2004) results discussed in chapter 2 showed that students of higher SES showed more academic success than lower SES students. Ogwu stated that parents of higher SES students have more access to additional resources to assist their children. Lubienski (2007) found that students of low SES in high school scored lower on standardized tests than students of higher SES. Lubienski believed that students of low SES lacked basic skills that prevented them from being successful in school. Lubienski revealed that students of high SES scored significantly higher on standardized tests. Results showed that students of higher SES scored higher than students of lower SES. However, students of low SES in the experimental and control groups made greater percentage gains than their peers of somewhat higher SES (Lubienski, 2007).

Schools may be the only environment in which students of poverty have access to resources in terms of learning (Payne, 2001). According to Kemker (2007), students who attend Title I schools have limited use of technology. Although school officials spend millions of dollars on technology in order to enhance learning, it is not utilized effectively as a tool used for increasing student achievement (Waxman, Padron, & Arnold, 2001).

The researcher found similar studies that were related to SES and the use of technology in the classroom. Dreier (2000) conducted a study that involved 58 students of low SES, 29 of whom did not use any form of technology and 29 used technology as a supplement to learning. The mean scores of second-grade mathematics students who were assessed using a SAT test were compared. The results showed that students of lower SES who frequently used technology scored significantly higher than those who had limited used of technology.

Page (2002) conducted a quasi experimental study that investigated the relationship between African American students of low SES, technology, and student achievement. A comparison was made of elementary students who were involved in a technology-rich classroom and those who did not use any form of technology as an addition to learning; participants consisted of 211 students from 10 classrooms. The researcher also used a quasi-experimental design to conduct this study. The Page study conducted in the state of Louisiana involved five classrooms with the use of technology and five without the use of technology. All participants involved in this study were placed in self-contained classrooms and were labeled as being of low SES. The principal selected students based on teacher performance. All teachers involved in this study used technology as an addition to learning mathematics, and received training on how to integrate technology into the curriculum. Although the experimental- and control-group students used the same curriculum throughout the year, their instructional approach was different. Students within the control group learned in a traditional environment, such as text only and limited resources. Kemker (2007) stated that students who lived in poverty were less likely to use technology within their curriculum while learning in a traditional environment, such as lecturing and activities that involved drill and practice.

The research used standardized achievement scores as an instrument to measure student achievement and to collect data. A pretest and posttest were used to measure student growth during the school year. Data were analyzed to determine if there were significant differences in assessment scores between the experimental and control groups. The results showed a significant different in posttest mathematics scores. Students who were involved in a technology-centered environment scored higher than those students who did not have technology incorporated into their curriculum.

Benefits of Using the FCAT Explorer

The FCAT Explorer is a computer-assisted program designed to support students' learning to enable them to master standards on the FCAT (Sullivan & Naime-Diefenbach, 2002). The FCAT Explorer software individually assesses students and provides online learning exercises to enable them to improve their weaknesses and deficiencies in learning mathematics.

The FCAT Explorer program, designed to support instruction, has become a trend used to assist students in learning while preparing them for the FCAT and benchmark assessment tests. The experimental group utilized FCAT Explorer as an intervention, and the results revealed that they scored higher on the benchmark assessment posttest than the control group. According to the Florida Department of Education (2011), teachers were able to track student progress to identify strengths and weakness. Teachers of the experimental class monitored student progress while providing additional support in areas where students struggled. As a result, the experimental group of students scored higher on the benchmark assessment posttest.

Based on the findings of this study, the results supported that the FCAT Explorer can be used to improve student achievement in mathematics. It would be helpful for teachers to know if their students were performing below grade level so that they could identify effective strategies to improve students' weaknesses. Students who need the most help in mathematics would benefit from using this technology program. Further research would be helpful to determine if the achievement of students in other schools exhibit increased performance in mathematics through the use of the FCAT Explorer. Students with low achievement would have more exposure to mathematics. Technology and teacher instruction could provide students the one-on-one attention they needed in mathematics. Teachers could review reports on students as often as needed. Teachers could review reports on students as often as needed.

Sullivan and Naime-Diefenbach (2002) conducted a similar study in which the assessment scores of those schools who used FCAT Explorer were compared to those schools that did not use the program. The results showed that students who had used the FCAT Explorer answered more questions on the FCAT correctly. The results of this study were similar in terms of standardized testing.

Benefits of Using the Promethean ActivBoard

Marzano and Haystead (2010) conducted a study that was similar to this study in terms of using the Promethean ActivBoard to guide instruction. The results showed that student achievement was higher when the Promethean ActivBoard was used in the classroom. There was a similar finding in terms of students utilizing interactive white boards as a supplement to learning mathematics. Lutz (2010) conducted a study that utilized the data of students in Grades 3, 4, and 5 from 2007 through 2009. The researcher used a mixed-methods design to determine the effects of interactive white boards, a form of interactive technology. The experimental group utilized instruction that involved the use of interactive white boards within their instruction, while the control group did not use any form of technology. The participants’ achievement was measured by a math end-of-grade standardized test. Results from the end-of-grade standardized test for fifth graders in math indicated that students who used interactive white boards had mean scores significantly higher than students who did not use interactive white boards. Overall, students who used interactive white boards scored significantly higher than those students who did not use any form of technology.

Conclusions

The Promethean ActivBoard and FCAT Explorer were used to assist the students in learning and understanding the math concepts being taught which resulted in the experimental group increasing their scores on benchmark assessment tests. Initially, the two groups in this study had similar strengths and weaknesses in mathematics and similar scores on math benchmarks pretests. At the end of the study, the scores of the experimental group were higher than those of the control group, based on the use of the technology programs.

Based on the results of this study, the researcher suggests that the use of the Promethean ActivBoard and FCAT Explorer results in higher academic achievement on standardized tests. It also allowed students from the experimental group to outperform students from the control group on the benchmark assessment posttest.

Based on the results of this study, the researcher suggests that the Promethean ActivBoard and FCAT Explorer could be utilized to help improve student achievement using other measurements. Based on the percentage change in scores, the use of the Promethean ActivBoard and FCAT Explorer helped all students, regardless of gender, race or SES, to score higher on the benchmark assessment test.

In summary, it was shown in this study that technology, specifically FCAT Explorer and the Promethean ActivBoard, increased student achievement in mathematics. The benchmark assessment tests confirmed student achievement results in mathematics.

It was suggested in this study that FCAT Explorer and the Promethean ActivBoard are beneficial to students who were deficient in learning mathematics. Additional research on implementing technology into the curriculum could enhance this study.

Limitations

There were several limitations in this study. The sample size was a limitation. The sample size was 120. Fifty-nine of those students consisted of the experimental group and 61 of those students consisted of students from the control group. The results might have been distorted because of the small sample size. In addition, this study was limited to four classes in one middle school, which could cause major restriction to the results of the study. Students participating in this study were ethnically and socioeconomically diverse and results might not be generalizable to groups of students across the United States and other countries. In addition, the length of the study was less than 20 weeks, in part, because the computer lab was down for repairs during the latter part of the semester. As a result, the experimental group was unable to use the FCAT Explorer program for that period of time. There were many instances where Promethean ActivBoard was used by the principal for faculty and staff meetings, which prevented its use in the classroom. Attendance was another limitation in this study for some students. There were fewer students in the control group, and 15 of these students were either suspended or placed in in-school suspension; therefore, their posttest average scores may have been affected. Fewer students in the experimental group had attendance issues. A convenience sample was accessible to the researcher; however, it might not have been an accurate representation of the population, as a result, the data might be skewed.

This study was also limited in its findings based on several other factors, such as the participants transferring during the school year. Initially, students needed to understand the basics of using any program as a supplement to instruction. Therefore, if they started using the program midway through the intervention, results might be inconclusive. Other factors included the unpredictability of the abilities of such a small number of students (less than 130). Other limitations included the short duration of the intervention, as well as the teacher pedagogical skills. Internal bias and sample size could have been limitations that impacted on this study. The study took place in a specific geographical location; therefore, results are not generalizable. Other limitations might be the techniques that the instructors brought into their diverse classrooms. No two teachers taught exactly alike. Although all three teachers were trained on how to use technology in their classrooms, the ability levels of the teachers might have differed.

Recommendations for Future Research

Additional studies should be conducted on whether the use of the Promethean ActivBoard and FCAT Explorer results in higher student achievement at different grade levels and with groups of students in different geographical locations. Additional studies should also be conducted with larger groups to participate in the use of the Promethean ActivBoard and FCAT Explorer programs. The larger the sample size, the more valid the results. Further studies should be conducted to observe how the use of the Promethean ActivBoard and FCAT Explorer programs can close the achievement gap for gender, ethnic background, and SES. The Promethean ActivBoard and FCAT Explorer programs may be successful strategies to increase student performance as well as closing achievement gaps in mathematics.

Based on the continuation of an achievement gap between demographic groupings, there is still a need to improve student achievement. In addition to making decisions about whether teachers should use technology in classrooms, technology should be embedded in the pedagogy to enhance the learning environment of students. The results of this study could provide an addition to the research base for educators who are considering adopting the Promethean ActivBoard and FCAT Explorer programs as a supplement to learning mathematics.

The findings of this study confirmed that additional research is necessary to examine the effects of technology in mathematic instruction upon both African American students and gender for instruction. As a result of this study, the researcher made several recommendations for future research studies.

Project length. The experimental group demonstrated more growth than the control group in mathematics. However, the results of this research project revealed future studies should be of longer duration for similar studies using other computer software programs.

Sample size. Additional classes can provide more student data. Assigning more than one group to receive technology-based instruction, as well as increasing the size of the control group, could significantly strengthen the validity of additional studies.

A**ttitude measurement**. A computer and mathematic component was presented in this study. However, future studies should include a mathematics and computer attitude survey measurement so that students are able to provide feedback based on their experience of using technology to enhance their learning. Although students who used technology as an instructional tool scored higher by a greater amount than students who did not use technology as a part of their curriculum, it does not necessarily mean that students' attitude towards technology did not improve, based on their learning experience.

Mathematics Achievement of the Students

Nearly all students experienced increases in performance on the benchmark assessment tests. However, the scores of students who use technology as a supplement to learning mathematics scores were higher than those students who did not use any form of technology within their curriculum. It was noted that the boys' achievement increased by higher amounts than the girls. School districts strive to increase the achievement of students in mathematics. The Promethean ActivBoard and FCAT Explorer programs have contributed to the learning success of students in this study.

Recommendation to Improve Instruction

There is a continuing need to study educational practices designed to improve student achievement. District personnel should consider how effective a program is before implementing it within their schools to increase student achievement. Decisions related to technology are imperative in terms of increasing student achievement. It is also necessary to note that some software programs may not be as effective as others. The literature and the information attained from this study supports that when students are actively engaged, rather than performing rote computations, there was an increase in student performance on the district's mathematics benchmarks. However, further research is recommended to determine the effectiveness of integrating technology into the curriculum.

Summary

In this chapter, the impact of the use of the Promethean ActivBoard and FCAT

Explorer on sixth-grade student achievement in mathematics was discussed. In addition, conclusions, limitations, and recommendations for future studies were presented. The main purpose of this study was to determine if the use of technology as an instructional strategy could improve students' mathematics achievement as measured by a standardized benchmark test. In this study, the results from other primary studies that compared the effectiveness of technology-based instruction against effectiveness of non-technology-based instruction were combined. Technology has become a popular trend in education that should be here to stay. In a generation where educators should be catering to the learning needs of each student, technology could be used to assist in meeting the learning needs of all students in mathematics.

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Appendix A

Data Results for Research Question 1

Experimental and Control Group Pretest Results

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Experimental	59	2728	47.03448	111.3321
Control	61	2952	49.2	105.9254

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	138.2995	1	138.2995	1.273685	0.261405	3.922879
Within Groups	12595.53	116	108.5822			
Total	12733.83	117				

Experimental and Control Group Posttest Results

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Experimental	59	3400	58.62069	218.2747
Control	61	3184	53.06667	233.0124

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	909.7301	1	909.7301	4.029445	0.047037	3.922879
Within Groups	26189.39	116	225.7706			
Total	27099.12	117				

Experimental Group Pretest and Posttest Results

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Pretest	59	2728	47.03448	111.3321
Posttest	59	3400	58.62069	218.2747

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	3892.966	1	3892.966	23.62188	3.78E-06	3.92433
Within Groups	18787.59	114	164.8034			
Total	22680.55	115				

Control Group Pretest and Posttest Results

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Pretest	61	2952	49.2	105.9254
Posttest	61	3184	53.06667	233.0124

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	448.5333	1	448.5333	2.6467	0.106433	3.921478
Within Groups	19997.33	118	169.4689			
Total	20445.87	119				

Appendix B

Data Results for Research Question 2

Experimental Group Pretest Results

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Boys	28	1308	48.44444444	89.02564103
Girls	31	1388	46.26666667	128.754023

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	67.39649123	1	67.39649123	0.612843943	0.437076859	4.016195438
Within Groups	6048.533333	55	109.9733333			
Total	6115.929825	56				

Control Group Pretest Results

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Boys	29	1412	50.42857143	83.36507937
Girls	32	1524	49.16129032	114.3397849

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	23.62727486	1	23.62727486	0.237060843	0.628204127	4.009867854
Within Groups	5681.050691	57	99.66755599			
Total	5704.677966	58				

Experimental Group Posttest Results

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Boys	28	1650	61.11111111	261.6410256
Girls	31	1710	57	174

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	240.1754386	1	240.1754386	1.114863764	0.295643165	4.016195438
Within Groups	11848.66667	55	215.430303			
Total	12088.84211	56				

Control and Experimental Boy Pretest Results

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Experimental	27	1308	48.44444444	89.02564103
Control	28	1412	50.42857143	83.36507937

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	54.11255411	1	54.11255411	0.628178822	0.431557692	4.023016811
Within Groups	4565.52381	53	86.14195867			
Total	4619.636364	54				

Control Group Girl Pretest and Posttest Results

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Pretest	32	1524	49.16129032	114.3397849
Posttest	32	1584	51.09677419	235.1569892

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	58.06451613	1	58.06451613	0.332274976	0.566478805	4.001191306
Within Groups	10484.90323	60	174.7483871			
Total	10542.96774	61				

Experimental Group Boy Pretest and Posttest Results.

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Pretest	28	1308	48.44444444	89.02564103
Posttest	28	1650	61.11111111	261.6410256

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	2166	1	2166	12.35361217	0.000921203	4.026631222
Within Groups	9117.333333	52	175.3333333			
Total	11283.33333	53				

Experimental Girl Pretest and Posttest Results

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
Pretest	31	1388	46.26666667	128.754023
Posttest	31	1710	57	174

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1728.066667	1	1728.066667	11.41564792	0.001306925	4.006872822
Within Groups	8779.866667	58	151.3770115			
Total	10507.93333	59				

Experimental and Control Group Boy Posttest Results

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
Experimental	28	1650	61.11111111	261.6410256
Control	29	1568	56	218.0740741

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	359.0787879	1	359.0787879	1.499619859	0.226145108	4.023016811
Within Groups	12690.66667	53	239.4465409			
Total	13049.74545	54				

Experimental and Control Group Boy Posttest Results

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
Experimental	31	1710	57	174
Control	32	1584	51.09677419	235.1569892

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	531.2903226	1	531.2903226	2.590437244	0.112848825	4.003982435
Within Groups	12100.70968	59	205.0967742			
Total	12632	60				

Control Group Boy Pretest and Posttest Results

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
Pretest	29	1412	50.42857143	83.36507937
Posttest	29	1568	56	218.0740741

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	434.5714286	1	434.5714286	2.8833111	0.095257994	4.019540907
Within Groups	8138.857143	54	150.7195767			
Total	8573.428571	55				

Experimental and Control Group Girl Pretest Results

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Experimental	31	1388	46.26666667	128.754023
Control	32	1524	49.16129032	114.3397849

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	127.7430636	1	127.7430636	1.052034814	0.309225909	4.003982435
Within Groups	7164.060215	59	121.4247494			
Total	7291.803279	60				

Control Group Posttest Results

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Boys	29	1568	56	218.0740741
Girls	32	1584	51.09677419	235.1569892

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	353.6971022	1	353.6971022	1.557690416	0.217106369	4.009867854
Within Groups	12942.70968	57	227.0650821			
Total	13296.40678	58				

Appendix C

Data Results for Research Question 3

Experimental and Control African American Pretest Results

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Experimental	45	1976	44.90909091	123.433404
Control	48	2252	47.91489362	116.514339

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	205.32	1	205.3194465	1.71303307	0.19396	3.94808418
Within Groups	10667	89	119.8572577			
Total	10873	90				

Experimental and Control African American Posttest Results

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Experimental	45	2512	57.09090909	207.712474
Control Group	48	2384	50.72340426	198.334875

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	921.4	1	921.3989415	4.54191755	0.03583	3.94808418
Within Groups	18055	89	202.8656249			
Total	18976	90				

Experimental African American Group Pretest and Posttest Results

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Pretest	45	1976	44.90909091	123.433404
Posttest	45	2512	57.09090909	207.712474

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	3264.7	1	3264.727273	19.7177588	2.7E-05	3.95188225
Within Groups	14239	86	165.5729387			
Total	17504	87				

Experimental African American Group Pretest and Posttest Results

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Pretest	48	2252	47.91489362	116.514339
Posttest	48	2384	50.72340426	198.334875

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	185.36	1	185.3617021	1.17746333	0.28071	3.94453868
Within Groups	14483	92	157.4246068			
Total	14668	93				