THE EFFECTS OF IMPLEMENTING BLOOM'S TAXONOMY AND UTILIZING THE *VIRGINIA STANDARDS OF LEARNING CURRICULUM FRAMEWORK* TO DEVELOP MATHEMATICS LESSONS FOR ELEMENTARY STUDENTS.

A Dissertation

Presented to

The Faculty of the School of Education

Liberty University

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Education

By

Kristel W. Hawks

April 2010

The Effects of Implementing Bloom's Taxonomy and Utilizing the *Virginia Standards of Learning Curriculum Framework* to Develop Mathematics Lessons for Elementary Students

By Kristel W. Hawks

APPROVED:

COMMITTEE CHAIR	Scott B. Watson, Ph.D.
COMMITTEE MEMBERS	JoAnne Y. Carver, Ed.D.
	Melanie A. Stanley, Ph.D.
CHAIR, GRADUATE STUDIES	Scott B. Watson, Ph.D.

Abstract

Kristel Williams Hawks. THE EFFECTS OF IMPLEMENTING BLOOM'S TAXONOMY AND UTILIZING THE *VIRGINIA STANDARDS OF LEARNING CURRICULUM FRAMEWORK* TO DEVELOP MATHEMATICS LESSONS FOR ELEMENTARY STUDENTS. (Under the direction of Dr. Scott B. Watson) School of Education, April 2010.

The purpose of this study was to determine if teachers who developed lessons based on Bloom's Taxonomy and the *Virginia Standards of Learning Curriculum Framework* saw increased scores on the mathematics benchmark assessment for fourth grade. Two classes taught by different mathematics teachers participated. The mean of the posttest scores for the experimental group in which the teachers developed lessons using Bloom's Taxonomy would be significantly higher than the mean of the group which used textbook bound instruction. An analysis of covariance was conducted, and the hypothesis was rejected. The experimental group would yield significant gains as measured by the difference between the pretest and posttest scores. The hypothesis was retained as a result of a paired-samples t-test.

Acknowledgements

I would like to thank my precious Savior, Jesus Christ, for giving me the desire, courage, and strength to endure this entire process. Without His constant presence, this project would never have been completed.

Thank you to Dr. Scott B. Watson, my committee chair, for providing suggestions. My thanks also are extended to Dr. Melanie A. Stanley and Dr. JoAnne Y. Carver for their assistance throughout the writing of my dissertation.

Thank you to my friend Nanette for enduring this "walk" with me. It was so wonderful to have a strong Christian friend as a prayer partner and supporter.

Dedication

This study is dedicated to all my loved ones who truly provided me with the support when I needed it to endure my dream. Kenneth, my wonderful husband and best friend, you have been very patient and supportive throughout the entire process. Many hours were spent away from you so I could fulfill this dream, and I am very grateful for your understanding and love.

Ethan, my newborn son, you provided encouragement for “mommy” even though you did not understand. From your movements in my womb to your precious smiles and coos, you gave me motivation when I needed it the most.

Tommy and Linda Williams, my parents, thank you for planting those seeds long ago as a child. You have encouraged me to continue with my dreams even when I wanted to give up. My sister Darlene FitzPatrick, you listened and comforted me any time of the day or night. You always provided the right words of encouragement.

Thank you all so much! I love you dearly!

TABLE OF CONTENTS

Page

List of Tables

List of Figures

CHAPTER 1

Introduction

With the increasing demands of the *No Child Left Behind (NCLB) Act* and maintaining Adequate Yearly Progress, educators are constantly searching for ways to increase student achievement and test scores on the state assessments (McColskey and McMunn, 2000). The educators of Virginia are no exception. The intent of *NCLB* is that all students, regardless of economic status, race, ethnicity, language spoken at home, or disability, demonstrate proficiency in reading, mathematics, and science by 2014 (Karwasinski and Shek, 2006). *NCLB* is an attempt to increase student achievement in all schools across America, attract highly qualified professionals to teach in every classroom, and eliminate the achievement gap among students from different backgrounds (Ryan, 2004). In addition, *NCLB* requires school leaders to select scientifically based research practices and programs (Beghetto, 2003).

Most public schools are working hard to maintain Adequate Yearly Progress (AYP). To make AYP, schools must increase K-12 student achievement in gradual increments until the 2013-2014 school when schools should achieve a 100 percent pass rate on state assessments (Virginia Department of Education, n.d.). Because the AYP pass rates increase annually, schools have to make adjustments within their instructional program to aim at the moving target. The closeout procedure for the end of the year is one thing that has changed since AYP began. In the past, the school year ended in June, and September began a new year. There was no carryover from the previous year. There were no data or trends studied from year to year, nor was progress based on the previous school year. Now, there is a continuum in that schools study data and trends from year to year that might help the next school year be more successful. Many schools or school districts have data specialists employed to assist with the disaggregation of data. In the proposed *Standards of Quality* for the Commonwealth of Virginia, it has been recommended to include a data manager for every 1,000 students (Virginia Department of Education, 2008).

Countless hours are spent searching for the products, strategies, or other quick fixes to help prepare students for the end-of-year assessments. Textbook companies, supplemental material publishers, and technology vendors are publishing test preparation materials advertising state aligned content to help prepare students for state assessments while providing diagnostic tools for teachers (Supon, 2008). Companies are publishing curriculum items developed specifically around *Virginia's Standards of Learning* and flooding the mailboxes of curriculum leaders, principals, and teachers with advertisements of their products. Pearson Education is one such vendor from which various types of materials can be purchased to help with student achievement. According to Pearson Education (2008), their product Success Maker supports 21st century learning skills, contains standards-based curriculum, and stresses problem-solving techniques. Another such publisher, Compass Learning, advertises that their product Odyssey is aligned to curriculum standards and helps prepare students for high stakes testing (Compass Learning, 2008). Curriculum Associates also produces many resources built around the *Virginia Standards of Learning*. They offer test preparation materials for reading and mathematics as well as online diagnostic assessments for grades K-12 (Curriculum Associates, n.d.) All of these companies tend to have one commonality in that they all claim to help improve test scores.

Academic achievement and acquiring the proficient levels of test scores to meet the state and *NCLB* goals are on the forefront of the minds of most educators. The results of a study conducted by Pilcher and Largue revealed that school districts felt extreme pressure to meet Adequate Yearly Progress goals for *NCLB* (2007). Many dollars and staff development hours have been provided in an attempt to increase student achievement. According to Richardson (2002), $2.8 billion of Title II money is spent on professional development. States and school divisions also are searching for ways to fund the requirements of *NCLB* that remain after the allotted federal dollars are gone (Linik, 2005, Lu, 2005). Teachers are receiving information on researched-based best practices to help them provide the quality of instruction that is needed to be successful.

Accountability has become a major buzzword and has educators frantically grasping for solutions to increase their percent passing rate. The word accountability has a different meaning for educators today. At one time, as long as report card grades fell within the Bell Curve, nothing was really questioned. It was accepted if one or two students failed a class. Parents normally did not get upset as long as students came home happy and seemed to love their teacher. One study at the University of Michigan found that parents preferred teachers who made their children happy over those who emphasize academic achievement (University of Michigan, 2007). Administrators typically left well enough alone as long as parents were happy. Student attitudes and report cards typically drove teacher accountability. Accountability has definitely changed with the state and national standards and goals. Now with *NCLB*, states must hold schools and school districts accountable for failing to meet the established goals (Ryan, 2004). Academic achievement is now based on standardized test scores, not only group scores but individualized scores as well. The public often judges teachers on academic achievement. In fact, many states are now offering teachers merit pay (Holland, 2005). Even though many individuals feel they are aiming for a moving target as the requirements increase annually, the assessments are becoming increasingly more difficult for students as the questions move to higher levels of thinking.

Background

In 1981, Secretary of Education T.H. Bell formed a committee known as the National Commission on Excellence in Education to present a report on the quality of education in America. In 1983, the Commission presented the report, *A Nation at Risk: The Imperative for Educational Reform.* Within the report, the Commission reported the problems in American education as well as solutions.

According to the National Commission on Excellence in Education (1983), many 17 year-old students did not have the higher order thinking skills that were expected. Still today, educators are finding this to be true (ACT, 2006, Lips, 2008). The Commission also found that only one- third of these 17 year-olds could solve a mathematics problem involving multiple steps (1983). The report indicated that public schools were not preparing students for college. From 1975 to 1980, remedial mathematics classes in public four-year colleges increased by 72 percent. In addition, businesses and military leaders complained that millions of dollars were spent to provide remedial education programs for basic skills such as reading, writing, spelling, and computation. According to the report, many individuals felt that schools are over emphasizing reading and computation and not spending time on necessary skills such as comprehension, analysis, solving problems, and drawing conclusions. The Commission concluded that the declines in educational performance were a direct result of the way the educational process was conducted.

In 1998, fifteen years after *A Nation at Risk* was published, *A Nation Still at Risk* was released. This document reiterated that the education of America was still not where it needed to be compared to other nations, and that many individuals shrug their shoulders or display indifference or apathy (Bennett, 1998). According to the report in 1998, twelfth graders scored at the bottom on the Third International Mathematics and Science Study. In addition, students of the United States placed 19th out of 21 developed nations in mathematics (DeSchryver, Petrilli, and Youssef, 1998). The report also indicated that from 1983 until 1998, over 20 million Americans reached their senior year of high school unable to do basic mathematics. Therefore, remediation was still crucial for freshmen entering college. According to the Eric Clearinghouse on Assessment and Evaluation (1999), over 30 percent of college freshmen needed remediation in reading, writing, and mathematics. Twenty-two percent of college students need mathematics remediation in their first year of college (Hussey and Allen, 2006). In addition, it was reported that businesses still had difficulty finding employees that possessed the basic skills required to do the job tasks.

Overall education was still lagging behind the other countries despite the previous report. The question to consider is why do individuals continue to do what does not work. *A Nation Still at Risk* proposed several strategies for changes in education within the United States. The first strategy was to have standards, assessments, and accountability. It was suggested that every student, school, and district meet high standards of learning. The second strategy was that there needed to be alternatives in the delivery of education, but yet firm in the knowledge and skills being delivered. The report also stated, “It is madness to continue acting as if one school model fits every situation, and it is a sin to make a child attend a bad school if there's a better one across the street," (Bennett, 1998, Strategies for Change section, ¶ 2).

The *No Child Left Behind Act of 2001*, the reauthorization of the *Elementary and Secondary Education Act of 1965*, addressed the status of education in the United States. Unlike the previous reports, this *Act* was more than making the public aware of the current status of education in the United States. It also provided the procedures established by the United States Department of Education and interpretations of the legislation at the local education authority level. The requirements that came from the *NCLB* Act are that educators must prepare all students to meet rigorous standards by 2014. This requirement raised expectations for state and local education as well as students. According to the *Act*, student achievement is measured annually by the state assessments. Students, schools, and school divisions are expected to make Adequate Yearly Progress (AYP) on these assessments. However, there are consequences if schools or school divisions do not make AYP.

If a school or school division fails to make AYP for three or more consecutive years, it moves into a category known as Needs Improvement (NI) schools. Schools that are labeled NI must offer additional instructional programs to students, which could include before-or-after school tutoring or remediation.

The Virginia Board of Education adopted the *Standards of Learning* in 1995. At the end of the 1997-1998 school year, the Commonwealth of Virginia implemented mandated state assessments in grades three, five, and eight for all content areas, which include English, mathematics, history and/or social science, and science as well as several end of course assessments for high school subjects. In 2005-2006, mandated testing for Virginia students began in English and mathematics for grades four, six, and seven to be in alignment with the *NCLB Act of 2001*.

At the secondary level, the pass rate for Virginia is 70 percent in all four content areas to be accredited. In elementary schools, a combined pass rate of at least 75 percent on the English test is required for accreditation. In addition, elementary schools must achieve a 70 percent pass rate in mathematics, fifth grade science, and fifth grade history. At the third grade, elementary schools must have a pass rate of at least 50 percent in science and history for state accreditation. The required pass rate percentages for each content area at each grade level are presented in Table 1.1.

Table 1.1

Accreditation Benchmarks for the Virginia Department of Education

Subject	Grade 3	Grades 4-5	Grades 6-12
English	75%	75%	70%
Mathematics	70%	70%	70%
Science	50%	70%	70%
History	50%	70%	70%

School accreditation in the Commonwealth of Virginia is based on student achievement of the *SOL* assessments of the previous school year or a three-year average of achievement (Virginia Department of Education, n.d.c). Schools receive one of four ratings, which include fully accredited, accredited with warning, accreditation denied, or conditionally accredited.

At the secondary level, for a school to be accredited, students must achieve pass rates of 70 percent or above in all content areas. In elementary schools, students must have a combined adjusted rate of at least 75 percent in English, 70 percent in mathematics, fifth grade science and history, and at least 50 percent in grade three science and history.

In Virginia, schools are accredited with warning if adjusted pass rates are below the achievement levels required for full accreditation. Schools cannot hold this rating for more than three consecutive years. They must undergo academic reviews and are required to have school improvement plans. If the school is warned in English or mathematics, the school must adopt an instructional program that is research-based and proven to be effective in raising achievement in the warned area.

A school is denied accreditation if it fails to meet the requirements to be fully accredited for four consecutive years. Schools that fall under this status are subject to corrective actions as noted by the Board of Education and agreed upon by the local school board. The school board must send a corrective action plan to the Board of Education within 45 days of notification of the denied accreditation. The plan will be considered when the Board of Education develops the memorandum of understanding, and the plan must be implemented by November 1 of the school year. If a school division has one-third or more of its schools with a rating of accreditation denied, the superintendent will be evaluated by the school board with a report sent to the Board of Education by December 1 of the school year. As stated in the *Standards of Quality*, the Board of Education may take action against the local school board for failure to maintain accredited schools.

In addition, any school denied accreditation must provide required information to parents. Within 30 calendar days of receiving the announcement of the rating from the Virginia Department of Education, a written notice must be sent to the parents making them aware of the school's accreditation rating. Also, the school must provide to parents a copy of the school division's proposed corrective action plan to improve the school's accreditation rating, including the timeline for implementation. The parents must be given an opportunity to comment on the proposed corrective action plan prior to the adoption of the plan.

Schools in Virginia also may be conditionally accredited. New schools that are formed from students who previously attended one or more existing schools will be awarded this status for one year until the evaluation of the performance of students on *SOL* tests. A school that is being reconstituted also may be awarded a rating of conditionally accredited.

According to Epstein and Salinas (2004), the *NCLB Act* requires schools, school divisions, and states to implement academic programs that will increase students' proficiency in reading, mathematics, and science. After each of the required academic programs has been taught, the requirements are that students will take state assessments to demonstrate academic achievement in those areas.

Annually increasing percentages have been established to determine passing rates until eventually the pass rate becomes 100 percent in 2013-2014. In 2001-2002, the AYP starting point pass rate for reading and language arts was 60.7 percent (Virginia Department of Education, n.d.) Beginning with 2003-2004, the AYP pass rate was set at 61. Each year that goal increases by four percentage points until eventually in 2013-2014 it is 100 percent. Table 1.2 presents the AYP pass rates for reading and language arts.

Table 1.2

AYP Pass Rates for Reading and Language Arts

2001-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	2013-14
60.7	61.0	61.0	65.0	69.0	73.0	77.0	81.0	85.0	89.0	93.0	97.0	100%

For mathematics, in 2001-2002, the AYP starting point pass rate for mathematics was 58.4 percent. According to the Virginia Department of Education, in 2003-2004 the AYP pass rate for mathematics was 59 percent with the goal increasing four percentage points each year thereafter until 2013-2014 when the schools must reach 100 percent passing (n.d.). Table 1.3 presents the AYP pass rates for mathematics.

Table 1.3

AYP Pass Rates for Mathematics

2001-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	2013-14
58.4	59.0	59.0	63.0	67.0	71.0	75.0	79.0	83.0	87.0	91.0	95.0	100%

In addition, the students' scores are analyzed in subgroups to determine if the schools make Adequate Yearly Progress (AYP). According to the Virginia Department of Education (n.d.), the subgroups used to determine AYP are students with disabilities, Limited English Proficiency (LEP) students, economically disadvantaged students, and major racial/ethnic groups. The school must maintain the pass rate in each of these subgroups to make AYP. According to the Virginia Department of Education (n.d.), the *NCLB Act* requires a minimum of 95 percent participation of all students and all subgroups of students at the school, division, and state levels. If a school or school division fails to have 95 percent participation in one or more subgroups, the school or division does not make AYP, regardless of the pass rate.

With the increased demands of state accreditation and making AYP for *NCLB*, educators are seeking ways to ensure students are prepared for the end of the year tests before the end of the year arrives. Many school divisions have incorporated benchmark testing throughout the school year to help determine what students do and do not know. In some school divisions, benchmark assessments are administered as often as every four and half weeks.

Many educators are finding data-driven decision making the only way to ensure success on the end-of-year assessments. The data that educators receive from the benchmark assessments help them to make instructional decisions. Teachers are able to determine which students need remediation on certain standards as well as which standards need to be taught again. Data from benchmark assessments help guide teachers to differentiate instruction as needed to optimize student performance and academic achievement.

When testing began in grades four, six, and seven, it was a difficult transition. Those teachers felt as the other teachers did when *SOL* testing first began. Scores were also in alignment with the scores of the tests when testing first began. In the new testing grades for the area of mathematics, passing rates were low across the entire state, causing educators great concern. Not only was testing new to these grades causing teachers to adjust teaching styles and strategies and creating more accountability at those grade levels, but the tests incorporated higher level thinking skills as well. When the scores were returned, many individuals panicked trying to determine the problem. Since the problem occurred across the state, some educators deemed it as a problem with the test construction. However, after the second test administration, scores still were not near the state pass rates for certain grades. Many educators were searching trying to determine a quick fix for the next administration of tests in these grades. The school division in which the study was conducted was no exception. Even though state scores were low, the division scores were lower than the state. Many excuses were offered as to why, with none of them focused on instruction. Test construction for the *Standards of Learning* test was still deemed as the blame for low scores.

Table 1.4 shows the sores of mathematics in grades four, six, and seven for the past two years in Virginia.

Table 1.4

Mathematics Scores in Grades Four, Six, and Seven for Virginia

Grade	05-06	06-07
4	77%	81%
6	51%	60%
7	44%	56%

Table 1.5 shows the scores for mathematics in grades four, six, and seven for the school division in which the study was conducted.

Table 1.5

Mathematics Scores in Grades Four, Six, and Seven for a School Division in Virginia

Grade	05-06	06-07
4	76%	74%
6	55%	64%
7	29%	46%

Since *Y Elementary School* is a new school formed by the closing of several elementary schools, there are no school scores to report. The school decided to use the data from the division to help select strategies and techniques to use in an attempt to improve scores. This appeared to be a logical solution since the new school was formed from one third of the total division elementary school population.

Statement of the Problem

Since fourth grade was new to *Standards of Learning* assessments, no mathematics *Standards of Learning* released tests were available. However, the fifth grade mathematics test included *Standards of Learning* from the fourth grade so the teachers within the school division utilized those tests to study test questions for fourth grade mathematics.

After examining the fifth grade released test questions that covered the fourth grade *Standards of Learning*, it was noted the questions were more difficult than initially perceived by the teachers within the school division. Later it was speculated that the newly formed fourth grade mathematics *Standards of Learning* Tests had moved to higher levels of thinking. Therefore the questions were designed differently than earlier tests. Many of the educators within the school division realized that students had to think in a different way, and therefore may need to be taught in a different way. This prompted the school division to focus more closely on classroom instruction. Therefore, it was necessary to conduct this study to examine the relationship between classroom instruction, Bloom's Taxonomy, and the Virginia Department of Education's *Standards of Learning Curriculum Framework*. This study will determine if teachers at *Y Elementary School* who develop lessons based on Bloom's Taxonomy and the *Virginia Standards of Learning Curriculum Framework* see increased scores on the mathematics benchmark assessment for fourth grade.

Research Questions

1. If the teacher of the experimental group develops lessons aligned to the *Virginia Standards of Learning Curriculum Framework* and based on higher levels of thinking on Bloom's Taxonomy, do students' scores increase on the mathematics benchmark assessments?
2. Do the scores of the students in the experimental group show an increase in the fourth grade mathematics scores between the pretest and posttest by subgroups?

Hypotheses

1. The mean of the Mathematics Benchmark Assessment posttest scores for the treatment group in which the teachers develop lessons using Bloom's Taxonomy will be significantly higher than the mean of the group which uses traditional, textbook bound instruction as indicated by scores from the Third Nine Weeks Fourth Grade Mathematics Benchmark Assessment.
2. The treatment group in which the teacher develops lessons using Bloom's Taxonomy will yield significant gains as measured by the difference between the

pretest and posttest scores on the Third Nine Weeks Fourth Grade Mathematics Benchmark Assessment.

Professional Significance of the Study

The results of this study will increase knowledge in the field of education. Teachers are often reluctant to deviate from the textbook. If this study indicates a strong correlation between the alignment of the local curriculum to the *Virginia Standards of Learning Curriculum Framework* and the students' scores, perhaps teachers will be more likely to utilize the documents provided by the Virginia Department of Education. In addition, if utilizing higher levels on Bloom's Taxonomy helps scores to increase, perhaps educators will focus more on the verbs used when writing objectives. This would help with *NCLB* requirements, making state accreditation, and making Adequate Yearly Progress within all of the subgroups.

Applications

If it is found that teachers who develop lessons based on Bloom's Taxonomy and the *Virginia Standards of Learning Curriculum Framework* see increased scores on the mathematics quarterly benchmark assessment for fourth grade, other educators may want to replicate the procedures of the study within their school. Then that would spiral to other schools within the school division. School administrators and teachers are constantly searching for ways to increase student performance on testing. The results of this study could be beneficial and applicable to all educational settings. In addition, they would be highly applicable to the Virginia Department of Education.

Definitions of Key Terms

The following definitions are provided to ensure uniformity and understanding throughout the study. Unless otherwise noted the definitions were developed by the researcher.

Adequate Yearly Progress (AYP) – "An individual state's measure of yearly progress toward achieving state academic standards. Adequate Yearly Progress is the minimum level of improvement that states, school districts and schools must achieve each year." (Virginia Department of Education, n.d.b).

Annual Measurable Objectives (AMO) – "The yearly achievement benchmarks in reading and mathematicsematics established by the Board of Education as part of Virginia's implementation of NCLB." (Virginia Department of Education, n.d.c).

Benchmarks – Assessments given on a regular basis such as each grading period to assess individual student knowledge. The data gathered from these assessments is used to determine material that needs to be taught again or to determine the standards for which individual students need remediation.

Bloom's Taxonomy – Benjamin Bloom identified six levels within the cognitive domain. They range from simple recall of facts as the lowest level to more complex thinking at the highest level which is classified as evaluation.

Content areas - English, mathematics, science, and history/social science are considered the content areas.

Higher Order Thinking Skills (HOT Skills) – Higher levels of thinking which usually include the levels of analysis, synthesis, and evaluation on Bloom's Taxonomy. They require more critical thinking and problem solving verses recalling facts.

No Child Left Behind Act (NCLB) – A law that is aimed to improve the performance of schools in the United Sates by increasing the standards of accountability for states, school districts, and schools. It requires each state to develop assessments on state determined standards which will be given at certain grade levels if the state plans to receive federal funding for schools.

Reports Online System (ROS) – Data disaggregator used by the local school system in conjunction with Tests for Higher Standards.

State accreditation – A process used by the Virginia Department of Education to determine if the educational performance of public schools is in accordance with the regulations set by the Standards of Quality for Virginia Public Schools.

Standards of Learning (SOL)- "The *Standards of Learning* for Virginia Public Schools describe the commonwealth's expectations for student learning and achievement in grades K-12 in English, mathematics, science, history/social science, technology, the fine arts, foreign language, health and physical education, and driver education." (Virginia Department of Education, n.d.a).

Tests for Higher Standards (TfHS) – Test bank of questions used to make the local school system's benchmark assessments.

Virginia Standards of Learning Framework - The specific knowledge and skills students must possess to meet the standards.

Organization of the Dissertation

The dissertation is organized into five chapters. Chapter One has presented the introduction, background, statement of the problem, professional significance of the study, and definitions of key terms. In Chapter Two, a review of related literature and research pertaining to the study is presented. Chapter Three explains the methodology used for the study. The results and analysis of the research conducted for the study are discussed in Chapter Four. Chapter Five includes a summary of the findings, conclusions drawn from the findings, and recommendations for further study.

CHAPTER 2

Review of Literature

Accountability for public education has become more of a focus now than in the past. The *No Child Left Behind (NCLB)Act* and stringent demands of making Adequate Yearly Progress have caused educators to look for strategies or methods to increase student achievement and test scores on the state assessments (McColskey and McMunn, 2000). The purpose of *NCLB* is that all students, regardless of race, ethnicity, economic status, the language spoken at home, or disability will demonstrate proficiency in reading, mathematics, and science by the 2013-2014 school year (Karwasinski and Shek, 2006). According to Ryan (2004), the *NCLB Act* is aimed to increase student achievement in all schools across America, attract highly qualified educators for every classroom, and eliminate the achievement gap for students from various backgrounds. Also, as Beghetto discussed (2003), the *NCLB Act* requires that school administrators utilize scientifically based research practices and programs within the instructional program.

Most educators within public schools are striving to maintain Adequate Yearly Progress (AYP). In order to make AYP, schools must reach benchmarks that gradually increase until the 2013-2014 school year when schools must have a 100 percent pass rate on state assessments (Virginia Department of Education, n.d.). Schools have to make adjustments within their instructional program to reach the annually increasing goals. In order to make adjustments, school leaders analyze data, looking for trends to help the next school year be more successful for more students. Data specialists are now being employed to assist with the disaggregation of data in many school divisions. The

Commonwealth of Virginia has proposed in the new *Standards of Quality* that schools hire a data manager for every 1,000 students (Virginia Department of Education, 2008). This effort by the state of Virginia is to provide personnel to assist schools with the utilization of more data to make better instructional decisions.

Much time is spent by many individuals trying to determine the best research based products or instructional methods to help prepare students for the end of the year state assessments. Many curriculum companies and other vendors have published test preparation materials aligned to the state content to help prepare students for the end of the year assessments (Supon, 2008). All of these companies claim to increase test scores on the end of the year state assessments as well as provide diagnostic information to help teachers make better instructional decisions within the classroom.

Academic achievement has become a national priority. Acquiring the proficient levels of test scores to meet the state and federal requirements has become schools priority. Many dollars have been devoted to standardized testing and increasing student achievement. Some of this allotted money is to go towards providing good quality staff development to help educators with the implementation of best practices within the instructional program. Richardson (2002) stated that $2.8 billion of Title II money was spent on professional development. However, it is still not enough money so some school divisions are continuing to search for money to fund the requirements of *NCLB* that remain after the allotted federal money has been spent (Linik, 2005, Lu, 2005). Research based best practices are bring delivered to teachers to help them provide the level of instruction that is needed to be successful with the state and national requirements.

Educators often are frantically grasping for solutions to increase their percent passing because they are being held accountable for test scores. The word accountability has a different meaning for educators than it has in the past. In the past student attitude and report cards typically drove teacher accountability. As long as students were happy, most parents were happy. If parents were happy, most administrators felt things were fine and did not bother teachers. However, the definition has changed with the state and national standards and expectations. With the *NCLB*, states must put accountability on schools and school districts for failing to meet the established goals set by the state and national government (Ryan, 2004). Academic achievement is determined by scores on standardized tests. This includes both group and individual scores. Schools and teachers are often judged by the public based on the scores received on the end of year assessments. Because of this, several states have implemented merit pay to offer an incentive to teachers to perform better on the end of the year assessments (Holland, 2005). Some individuals feel the requirements are not attainable since they increase annually, and the assessments are becoming more difficult for students as the questions move to higher levels of thinking on Bloom's Taxonomy. However, the federal requirements are still in place, and schools must still work towards reaching those established goals.

Since Virginia's mathematics test scores have been low in the more recently assessed mathematics testing grades, which include grades 4, 5, and 7, most educators have been searching for ways to increase scores. Some individuals at first blamed the test construction but now realize that may not be the problem. It is not only a problem in Virginia. The National Mathematics Advisory Panel declared mathematics education in the United States as broken (Glod, 2008). The panel urged schools to focus on making sure students mastered basic skills that lead to success in higher mathematics. Many school divisions are now observing and analyzing instruction and classroom assessments to determine the problem.

Theoretical Background

Secretary of Education T.H. Bell formed the National Commission on Excellence in Education to present a report on the quality of education in America in 1981. In 1983, the Commission presented the report, *A Nation at Risk: the Imperative for Educational Reform*. The Commission listed the problems in American education as well as provided solutions within the report to help improve American education. *A Nation at Risk* presented the problems in public education and discussed the importance of quality education which requires a commitment from school administrators, teachers, parents, and students (Peterson, 2003). In addition, at least six other task forces and commissions made reports on schools in 1983 (Paris, 1995).

According to the National Commission on Excellence in Education (1984), when compared to other industrialized nations, students of the United States were last seven times. In mathematics and science, the students in the United States performed closer to the bottom of the world's industrialized nations (Holland, 2004). The Third International Mathematics and Science Study (TIMSS) indicated mediocre performance by the students in the United States in mathematics and science. The Program for International Student Assessment (PISA) showed that 18 out of 31 countries outranked the United States in mathematics. Many 17- year olds did not have the higher order thinking skills that were expected according to the report by the National Commission on Excellence in Education (1983). Problem solving was one area of higher order thinking skills that the students lacked. The Commission determined that only one-third of the 17- year olds could solve mathematics problems involving multiple steps, and nearly 40 percent could not draw inferences (1983). According to Peterson (2003), the report emphasized the concern that comprehension and problem solving were not receiving the necessary attention in public education. However, it noted that more time was spent on basic skills such as number facts, phonics, and spelling. A *Nation at Risk* indicated that if American education continued to decline, other better educated nations would take over the American economy (Peterson, 2003).

A 1998 study found that within students entering the same school with similar scores and socioeconomic backgrounds, black students learned less than white students by the time they graduated from high school (Peterson, 2003). In 1999-2000, on the National Assessment of Educational Progress (NAEP), five percent of black, ten percent of Hispanic, and thirty-four percent of white students in 4^{th} grade scored at the proficient level or above in mathematics (Peterson, 2003). The federal government has spent over $130 billion since the 1960's to close the achievement gap between whites and blacks, although the gap still exists (Holland, 2004). Per pupil spending rose 35 percent between 1982 and 1992 in excess of inflation. From *A Nation at Risk* until 2003, per pupil spending has increased sixty percent (Peterson, 2003).

A Nation at Risk also discussed the declining Scholastic Aptitude Test (SAT) scores from 1963 to 1980. The average mathematics scores dropped almost 40 points while verbal scores fell over 50 points (The National Commission on Excellence in Education, 1984). This set the crusade to establish and enforce standards in education. Also, according to *A Nation at Risk*, public schools were not preparing students for college, and therefore, there was a 72 percent increase in mathematics remediation offered at the college level. In fact, remedial mathematics classes make up 25 percent of all mathematics classes taught at the four-year colleges (National Commission on Excellence in Education, 1984). Businesses also have spent a lot of money to provide education programs for basic skills to employees could perform the required job duties. The report indicated many individuals felt that most schools are over emphasizing reading and computation and not spending enough time on comprehension, analysis, and problem solving, and drawing conclusions.

American education has been watered down according to the National Commission on Excellence in Education (Peterson, 2003). The Commission indicated that the public school curriculum was not challenging, student expectations were too low, students did not spend enough time in school and wasted most of the time they did spend in school, and many teachers lacked ability and preparation. *A Nation at Risk* recommended teachers take more content area classes and fewer educational methods classes. However, according to Peterson (2003), there has been no progress made towards that recommendation. *A Nation at Risk* was extremely concerned about the lack of mathematics and science knowledge American teachers had. In 1982, the average teacher took six semesters of mathematics and science compared to 1999 when it dropped to only four semesters (Peterson, 2003). *A Nation at Risk* argued that there were a low number of science and mathematics teachers that were qualified to teach those subjects. Today’s teachers are less likely to have a degree in mathematics and science as compared to 1982 (Peterson, 2003). Teacher training has not focused on raising academic achievement (Holland, 2004). The National Center for Education Information (NCEI) reported that forty-five states offered alternate ways to get teacher certification in 2000. One fourth of all teachers have degrees in areas other than education (Holland, 2004).

The Commission concluded in the report that the declining educational performance for American public education was a direct result of the way the educational process was being conducted (1983). Student grades are based on teacher expectations. Teachers differ on this in that one may have lower expectations than another. Grades do not always indicate improvements in achievement (Holland, 2004). Today true achievement is not indicative of actual worth. Yesterday's C's are today's A's because of grade inflation, and because of this, honor roll lists are extremely long (Holland, 2004).

A Nation Still at Risk was released fifteen years after *A Nation at Risk* was published. According to Bennett (1998), *A Nation Still at Risk* concurred that American education was behind where it should be especially when compared to other countries. Unfortunately, many individuals do not seem to be concerned about the condition of American education (Bennett, 1998). The report indicated that United States students in twelfth grade scored at the bottom on the International Mathematics and Science study. According to DeSchryver, Petrilli, and Youssef (1998), the United States placed 19th out of 21 developed nations in mathematics. *A Nation Still at Risk* also reported that over 20 million Americans reached their senior year of high school unable to do basic mathematics in the 15 years since *A Nation at Risk* was published. Because of this alarming statistic, over 30 percent of college freshmen needed remediation in reading, writing, and mathematics (Eric Clearinghouse on Assessment and Evaluation, 1999). The report also confirmed that many businesses still had difficulty finding employees that possessed the basic skills required to do the job tasks.

Even though the Commission released the first report 15 years ago, education was still not going well for the United States as schools continued to do things that were not working. Several strategies for changes in education within the United States were proposed through *A Nation Still at Risk*, including implementing standards, assessments, and accountability. The report suggested that every student, school, and district meet high standards of learning. It also was noted that there should be alternatives in the delivery of education even though there was a common core of knowledge.

In 1989, President Bush held a summit with the governors. A year later, six national goals were established for education that were to be achieved by 2000. *America 2000* which was released by the Bush administration and Lamar Alexander, the secretary of education, offered a response to the gap between the goals and implementation. It suggested national standards and voluntary tests which would create standards and accountability (Paris, 1995). In 1990, the nation was setting national educational goals and revamping the National Assessment of Educational Progress (Peterson, 2003). President Bill Clinton's administration promoted Goals 2000 during which many states were setting their own standards, developing their own assessments, and implementing their own accountability system (Peterson, 2003).

In 2001, the reauthorization of the *Elementary and Secondary Education Act of 1965* known as the *No Child Left Behind Act (NCLB*) addressed the status of education in the United States. In addition to public awareness, *NCLB* also provided the procedures established by the United States Department of Education and interpretations of the legislation at the local education authority level. *NCLB* required that educators prepare all students to meet rigorous standards by 2014. Expectations for state and local education as well as students were raised as the *Act* required student achievement to be measured annually by the state assessments in grades three through eight and at least once in high school to measure student progress in reading and mathematics (Virginia

Department of Education, n.d.). It is expected that schools, school districts, and states meet annual objectives for Adequate Yearly Progress (AYP) on these assessments. There are 29 benchmarks a school, school district, or state must meet or exceed to make AYP. There are consequences in place if schools or school divisions do not make AYP. If a school or division misses a single benchmark, they may not make AYP. If a school or school division fails to make AYP for three or more consecutive years, it moves into a category known as Needs Improvement (NI). Schools that are labeled NI must offer additional instructional programs to students, which could include before or after school tutoring or remediation. With *NCLB*, states that fail to make adequate progress can be converted to charter schools or parents can get $500 to $1000 per child to provide remedial help form private tutoring services (Holland, 2004). States also have the flexibility to offer teachers merit pay (Holland, 2004).

In 1995, the Virginia Department of Education adopted the *Standards of Learning*. At the end of the 1997-1998 school year, the Commonwealth of Virginia implemented mandated state assessments in grades three, five, and eight for all content areas, which include English, mathematics, history/social science, and science as well as several end of course assessments for high school subjects. Eight years later, for the 2005-2006 school year, students began mandated testing in English and mathematics for grades four, six and seven. This was to be in alignment with the requirements of the *NCLB Act of 2001*.

According to Peterson (2003), although there is an increase in academic coursework, there is not an increase in achievement. Contributing causes are weaker curriculum materials, grade inflation, and inadequate preparation of teachers. Schools are trying to teach higher order thinking skills such as critical thinking, problem solving, and looking for the main idea. However, the students of the United States continue to decline when compared to students of Asian and European countries (Peterson, 2003).

Mathematics Instruction

Although many teachers have to provide mathematics instruction within the classroom, they are not necessarily certified mathematics teachers. In the elementary environment, most teachers are not certified in a certain content area as they are in secondary education. Often these teachers received a broader range of education within the various content areas during their college training, majoring in areas such as *Liberal Studies or General Studies* and receiving an endorsement to teach elementary education (Newton & Newton, 2006). This sometimes causes problems within elementary instruction, especially in the area of mathematics.

According to Ketterline-Geller, Jungjohann, Chard, and Baker (2007), teachers' understanding of mathematics influences instruction, and many teachers in elementary schools lack the knowledge and skills to teach mathematics effectively. Teachers need to have a deep understanding of the content in order to teach mathematics for conceptual understanding (Schifter, 2007). Most elementary teachers only had minimal college-level mathematics courses. Therefore, these teachers need general instructional practices that will assist them with the teaching of mathematics. According to Ketterline-Geller, et al. (2007), there is a critical need to develop algebraic thinking and provide the best instructional practices for all students. In the past, most elementary mathematics instruction has focused on arithmetic and computational fluency (Blanton & Kaput, 2005). Algebraic reasoning can enhance the elementary program (National Council of Mathematics, 2000). School divisions need to provide professional development for elementary teachers to help them succeed with providing the best mathematics instruction. According to Schifter (2007), professional development needs to offer teachers an opportunity to reflect on how they are teaching mathematics as well as their own learning process so they consider how it supports or hinders classroom instruction. Teachers' reflection on past teaching situations helps to plan future classroom instruction (Garcia, Sanchez, & Escudero, 2006). Professional development needs to be more structured and comprehensive where opportunities will lead to new insights of providing quality mathematics instruction.

Mathematics seems to be a foreign language for some students in that it contains words and concepts that are not in their everyday lives (Janzen, 2005). Hyde (2007) suggested that reading and thinking strategies should be adapted to help students develop a deeper understanding of mathematics concepts. One study showed that other countries assign students challenging mathematics problems and use active questioning and dialogue to help students understand the connections within mathematics concepts (Hyde, 2007). However, the study also revealed that teachers in the United States did not use dialogue to help students explore connections. Rather, the study showed that the teachers from the United States approached the problems as procedural exercises, often telling the students the answers (Hyde, 2007). According to Schifter (2007), in many classrooms teachers model the procedure for getting the correct answers and supervise students as they practice the same procedures. They tend to focus on facts, routines, and answers to avoid conversational risk when they do not feel confident (Newton & Newton, 2006). Unfortunately, according to Hyde, drilling procedural steps and teaching by telling are methods that are embedded in the culture of mathematics in the United States. According to Burns (2007), students need to make connections among mathematical concepts so they do not view it as a series of disconnected facts.

The National Council of Teachers of Mathematics identified five cognitive processes which students utilize to understand mathematics concepts (Hyde, 2007). They were problem solving, reasoning and proof, communication, connections, and representations. Problem solving is an important life skill that needs to be better integrated within lessons (Checkley, 2006). Hyde suggested that in order to raise mathematics in the United States to higher levels, language and thought must be included within mathematics. Often students do not make the necessary connections on their own so teachers have to help them with building the new learning into what they already know. Successful teachers find ways to make mathematics concepts understandable, relevant, and familiar (Janzen, 2005). One reading comprehension strategy Burns (2007) suggested would assist students in becoming skillful mathematics problem solvers is making connections. Students make connections by activating prior knowledge and relating what is in the text to other material read, things in the world, and things around them. According to Hyde (2007), students need to be taught an adaptation of these within mathematics. Students need to look for connections that are math-to-self, math-to-world, and math-to-math. Math-to-self involves connecting math concepts to prior knowledge and experience. Math-to-world involves connecting mathematics to real world situations. Problems should be made relevant to students' lives so they will see the purpose for learning (Checkley, 2006). Math-to-math involves connecting mathematics concepts to other mathematics concepts or connecting concepts and procedures. Teachers should assist students with making connections and building bridges across contexts to help their understanding. Students want to know why and knowing why is extremely valuable for learning in mathematics (Newton & Newton, 2006).

Students need to recognize and analyze patterns, study and represent relationships, make generalizations, and analyze how things change (Checkley, 2006). Hyde (2007) also recommended teaching students to create representations when they encounter challenging mathematics problems, which helps them to see and express meaningful connections and patterns. Suggested representation strategies include discussing the problem in groups, using manipulatives, acting out the problem, drawing a visual representation such as a picture or diagram, or making a list (Wong & Evans, 2007, Ketterline-Geller, et al., 2007). By incorporating these representation strategies, different modalities are utilized which automatically provides differentiated instruction (Hyde, 2007). In addition, these strategies help students to observe patterns and establish possible relationships (Rivera, 2006, Wong; Evans, 2007). Representations help children to organize their thinking and understanding (Rivera, 2006). According to Clemons (2005), 90 percent of learning is visual and 85 percent of the brain is wired for visual learning.

Burns (2007) suggested lessons that are accessible to all students should be taught at a deeper understanding. In addition, lessons should include differentiated instruction. These strategies help to build a deeper understanding of the mathematical concepts. Hyde (2007) also suggested students use the reading comprehension strategy of inferring and predicting. According to Hyde, inferring and predicting require students to go beyond the surface, forcing them to make connections between their prior knowledge and the information before them. Burns explained the importance of building students' new understanding on their prior learning.

According to Schifter (2007), teachers and students need to examine the reasoning behind students' incorrect answers in order to gain new mathematical understanding.

This process helps teachers to understand the students' thinking and alter instruction to remedy their thinking. Scherer (2007) suggests that the focus needs to be less on acquiring the correct answer and more on understanding mathematics. Schifter described a teacher who taught mathematics as an investigation. Students were challenged to not only determine right from wrong but to determine where it went wrong and how to make it right. According to Burns (2007), students' correct answers are not sufficient for judging mathematical understanding unless they include explanations of how they reason. Students would be able to explain the meaning of data, tables, graphs, and formulas (Steen, 2007). Having students share their verbal explanations helps develop conceptual understanding (Ketterlin-Geller, et al., 2007). In order to develop problem-solving skills, children must learn to recognize and answer why questions (Chard, n.d.). Teachers should have students write in mathematics classes because writing leads to a better understanding and better communication skills (Countryman, 1992).

The concepts and skills that are required for student learning must be identified. In Virginia, the *Standards of Learning* does that for educators in each content area for every grade. According to Burns (2007), teachers need to chunk and sequence the content to optimize learning. Chunking involves grouping items into smaller chunks of seven plus or minus two chunks (Clemons, 2005). This technique helps students to retain information over time. Lessons need to be paced carefully. Children learn best when new topics are presented at a brisk pace (MCGraw Hill Wright Group, n.d.). However, they need multiple exposures over a time period with review and practice sessions provided frequently. As mentioned by Burns, many students take longer to learn and internalize new skills, and some students have to unlearn material before they relearn these same skills. Another useful strategy was to build in a routine of support (Burns, 2007). Teachers need to model exactly what they want students to do with careful verbal explanations of how to solve the problem (Ketterlin-Geller, et al., 2007). As students start to understand, teachers should provide fewer verbal explanations. This helps to reinforce skills before students complete independent work. Another essential strategy was to foster student interaction which should be an integral part of instruction (Burns, 2007). The emphasis of today's mathematics instruction should be on developing students' understanding through exploration and discovery (Wong & Evans, 2007). Students need to scaffold their thinking, examine the quality of their thinking, and ask as well as answer questions within mathematics lessons (Newton & Newton, 2006.) Their understanding is solidified when they can explain how they solved a problem and discuss their strategies (Checkley, 2006). It helps students to express their mathematics knowledge verbally. Burns stated that teachers need to make connections explicit. Often students do not make the necessary connections on their own so teachers have to help them with building the new learning onto what they already know. Teaching and learning must be interactive (Black & William, 1998). Burns encouraged mental calculations which helps build students' ability to reason. Teachers need to create learning situations that require students to think about mathematical relationships before they begin computation (Rivera 2006). Teachers should help students use written calculations to track thinking (Burns, 2007). Burns suggested that students get ample practice that is connected to the immediate learning experiences. With this extensive practice, students need to express verbally the quantitative meanings of both problems and solutions (Steen, 2007). Games are an excellent way to provide practice opportunities for students (Burns, 2007). Using games in the classroom encourages active learning and collaboration (Kumar & Lightner, 2007). Games allow learning to be fun and provide opportunities for immediate feedback and motivation (Sugar, 2008).

Vocabulary is extremely important within mathematics instruction. Teachers need to build in vocabulary instruction and use the terminology consistently (Burns, 2007). According to Dr. Chard (n.d.), vocabulary is as necessary to learning mathematics as it is to learning how to read. Understanding the language of mathematics provides students with the skills they need to think and talk about mathematical concepts. Students need to learn how to articulate what they are learning in mathematics, not just how to do the mathematics. According to Chard (n.d.), an effective mathematics curriculum should include preteaching vocabulary, modeling of vocabulary, and integrating vocabulary in assessments. By preteaching vocabulary, cognitive barriers are removed that prevent students from learning new content. Otherwise, students focus on learning the new procedures and lose the vocabulary words. Student achievement will increase 33 points when the focus is on specific words that are important to what students are learning (Rimbey, n.d.). Preteaching the vocabulary helps the students prepare to put the new information into practice.

Teachers need to model vocabulary words as new concepts are introduced. However, it is important that the examples are such that the students can see, manipulate, write about, and discuss. Graphic organizers help children grasp an understanding of mathematics terms and the relationship to one another. Gaming is a great way for students to practice using the content vocabulary (Kumar & Lightner, 2007). Vocabulary should be included in assessment questions to reinforce vocabulary knowledge with conceptual knowledge (Chard, n.d.; Mentoring Minds, n.d.). It is important that teachers carefully review vocabulary in different contexts so students get the connections that are made. With the use of word banks, student achievement will improve in mathematics because they get a better grasp of vocabulary (Rimbey, n.d.) Often students perform poorly on assessments because they have difficulty reading and understanding the problems. Therefore, lessons need to focus on mathematics vocabulary as well as the comprehension skills students need to have in order to read and interpret mathematics problems (Chard, n.d.).

Keeping current with research based practices that have demonstrated student learning are critical to continuous improvement and good teaching (Checkley, 2006). Professional development is mentioned throughout the *NCLB* legislation which eludes to the fact the federal government realizes the importance of professional development when achieving the goals of *NCLB* (Richardson, 2002). According to Schools Moving Up (n.d.), *NCLB* requires that all public school teachers of core academic subjects receive high quality professional development. This is for all teachers, not just those who are classified as not yet highly qualified. Title I and Title II include money to support professional development. Title II funds are aimed at preparing, training, and recruiting high quality teachers and to assure that all teachers are highly qualified. According to Richardson (2002), in one way or another, all of the $2.8 billion of Title II could be spent on some form of professional development. However, the law defines professional development activities as high quality and classroom focused in order to have a positive and lasting impact on classroom instruction and the teacher's performance (Richardson, 2002).

Mathematics is too important to only depend on mathematics teachers alone (Steen, 2007). Mathematics should be taught across the curriculum which would help students to better understand both the importance and relevance of mathematics.

Otherwise, students will insist mathematics is only useful in mathematics class (Steen, 2007). Teachers should work together to teach mathematics across the curriculum so that it becomes relevant and practical to students.

Standards

Standards are what students should know and be able to do. According to the Virginia Department of Education (n.d.a), the *Standards of Learning* describe the expectations for student learning in grades K-12 for Virginia Public Schools. In Virginia, there are standards for English, mathematics, science, history, technology, the fine arts, foreign language, health and physical education, and driver education. The standards are comprised of what parents, classroom teachers, school administrators, business leaders, and community leaders believe students should learn (Virginia Department of Education, n.d.a). In addition, Virginia has developed a curriculum framework for each of the core areas of English, mathematics, science, and history. This document provides details about the specific knowledge and skills that students must have to meet the standards in the four core areas.

According to Guskey (2005), teachers should add to or delete information from the textbook and other materials to better fit the standards and students' learning needs. Although many textbook companies claim to write textbooks specifically aligned to the state's standards, teachers need to check the alignment against the standards and curriculum framework. Schools need to make sense of national, state, and district standards and documents. McColskey and McMann (2000) suggested that schools spend time discussing and reviewing standards and putting them into user-friendly format for instructional planning. According to Guskey, educators must unpack the standards which means to determine the components of each standard that students must know and arrange the components into meaningful learning steps. The standards must be linked to what occurs in the classroom. Curriculum materials, teacher professional development, and classroom instruction should all reflect state standards (American Educational Research Association, 2003). Many school divisions develop teaching guides that identify activities and materials to help translate the standards info specific experiences that facilitate learning (Guskey, 2005). The objectives require higher level thinking which often is neglected in classrooms in the United States. As teachers start to implement a standards based program, they find that their students can be high-level learners, even at a young age (Checkley, 2006). Most teachers have the Virginia Department of Education documents and the school division's curriculum and pacing guides to follow, but they have to be willing to go beyond the textbook to achieve the standards listed in these documents.

Bloom's Taxonomy

Questioning has a purpose which should be to achieve well-defined goals (Center for Teaching Excellence (n.d.) Teachers should ask students questions that require thinking skills. A system that helps to organize those thinking skills is Bloom's Taxonomy. A taxonomy is an orderly classification of items which is usually in a systematic relationship such as low to high or simple to complex (Fredericks, 2005).

Benjamin Bloom identified a taxonomy of learning for the cognitive domain which contains six progressive levels (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956). As students progress through the increased critical thinking levels, it can be assured that the previous level of thinking for that concept has been mastered. Each category requires more complex thinking than the category before it (Vidakovic, Bevis, & Alexander, 2004). However, mastery of one level does not ensure the students can perform at a higher level (Aviles, 1999). Many have illustrated the levels of Bloom's Taxonomy as stair steps; the higher the stairs, the higher the level of thinking (Forehand, 2005). As often as possible, students need to be thinking at the top of the stairs. Benjamin Bloom proposed that almost all students can learn at a relatively high level (Tanner & Tanner, 1990). Higher level questioning is one of the best ways to strengthen the brain (Fredericks, 2005).

The first level of thinking on Bloom's Taxonomy is knowledge. This is defined as the behaviors and test situations that emphasize remembering information, either by recognition or recall (Bloom, et al., 1956). The behavior expected during the knowledge level is similar to that of the original learning situation. The second level of Bloom's Taxonomy is comprehension. Comprehension is when given communication, students know what is communicated and are able to use the information (Bloom, et al., 1956). This generally includes an understanding of the literal message contained in the communication. Often, people think of comprehension as only reading comprehension, but it could pertain to any content. Application is the third level of Bloom's Taxonomy. When at student is given a new problem, he can solve it without having to be prompted or shown how to do it (Bloom et al., 1956). With application, there is a transfer of learning to new situations (Aviles, 1999). Analysis involves the breakdown of material into parts as well as the detection of the relationships of the parts. Inferences are then made on the discovered relationship (Aviles, 1999). Synthesis is putting together the parts of the material to form a whole. This involves combining the parts to form a pattern or structure that was not there before, something new. According to Bloom et al., (1956), a task involving synthesis will also require the previous levels of knowledge, comprehension, application, and analysis. When students teach other students what they have learned or create a simulation, they retain 90 percent of what was taught (Munday, 2001). The highest level of Bloom's Taxonomy which has been classified as the highest level of thinking is evaluation. Evaluation involves making judgments about the value of the material (Bloom et al., 1956). This highest level of thinking involves a combination of all the other levels of thinking on Bloom's Taxonomy. If students evaluate and judge, they are more likely to retain information and perform better on standardized tests (Waxler, 2005).

According to Forehand (2005), the levels of Bloom's Taxonomy are referred to as the lower levels and higher levels. Typically, lower level questions are those at the knowledge, comprehension, and simplistic questions at the application level. Higher-level questions require students to think harder and include more complex application questions, analysis, synthesis, and evaluation. According to the Center for Teaching Excellence, questions at the lower levels of thinking typically are suitable for evaluating students' preparation and comprehension, diagnosing students' strengths and weaknesses, and reviewing or summarizing content (n.d.). Questions at the higher levels of thinking are more appropriate for encouraging students to think more critically, problem solving, encouraging discussions, and motivating students to seek information independently.

The purpose of the Taxonomy of Educational Objectives is to help define the thinking skills teachers expect from students as well as help the goals of the teacher to be equivalent to the questions asked to students. However, this requires advanced preparation. Teachers should determine the purpose for asking the questions, select the content for the questions, phrase the questions carefully, anticipate possible student responses, and write the main questions in advance (Fries-Gaither, 2008; Center for Teaching Excellence, n.d.). Determining the purpose of asking the questions helps to determine the level of questions that should be asked. According to the Center for Teaching Excellence, students study material based on the questions asked by the teachers so emphasis should not be placed on less important material (n.d.). Questions should require extended answers, more than yes or no answers. The questions should be phrased carefully so the task is clear to the student. Students should not have to play a guessing game to determine the answer the teacher wants but the answer should not be embedded in the question either. The Center for Teaching Excellence suggested teachers could add to those questions throughout the lesson but by having prepared questions, it would help to ensure teachers ask questions appropriate for the goals and relevant to the content (n.d.). Students need to efficiently use lower-order processes to be successful with higher order processes (Wong & Evans, 2007). Earlier research conducted by Benjamin Bloom demonstrated that mastering prerequisites before moving to more advanced learning has positive effects on the quality of learning and the rate of learning (Bloom, 1985). Basic mathematics facts should be committed to long-term memory which helps to free working memory. Higher order thinking such as problem solving requires more working memory. Therefore, if students are able to recall basic facts from memory, they will be able to better focus on higher level thinking skills such as problem solving. It is challenging for teachers to provide cognitively demanding tasks (Cavey, Whitenack, & Lovin, 2006). They have to hold students to high expectations for explanations and have other students support ideas.

Qaisar (1999) conducted a study evaluating first year teachers' lesson plans and Bloom's Taxonomy. The lesson plans of 67 newly certified teachers were evaluated to determine if lesson objectives developed higher-level thinking as defined by Bloom's Taxonomy. The lesson plans were collected over a three-year period. Forty-one percent of the objectives were written at the knowledge level. See Table 2.1 for the percentage of objectives at each level of Bloom's Taxonomy.

Table 2.1

Lesson Plan Objectives and Bloom's Taxonomy

Level of Bloom's Taxonomy	Percentage of Objectives
Knowledge	41.3
Comprehension	19
Application	16.7
Analysis	10.3
Synthesis	9.5
Evaluation	3.2

According to Fredericks (2005), teachers average asking 400 questions a day with 80 percent of them at the knowledge level. Lessons should include a variety of types of questions. Including each level of questioning will promote deeper thinking in students (Wagaman, 2008). The cognitive expectations of the classroom also should match assessment measures (Tankersley, 2007). Otherwise, there is a disconnect between instruction and assessment performance. Teachers have to require students to synthesize their learning and apply their knowledge in more advanced ways so they are able to do so on the state assessments. The standards that most states now have in place require students to use higher order thinking and reasoning skills as opposed to memorizing the information (Tankersley, 2007). True mastery of content is demonstrated by the ability to reason and apply skills. According to Tankersley (2007), even though tests have changed to emphasize higher order thinking skills, some teachers have not changed their approach to daily instruction. Student learning is maximized when independent thinking is valued and students are encouraged to be problem solvers. This requires providing students time to explore and reflect.

Lesson Plans

In college, most students aspiring to become teachers had practice with writing lesson plans. Often this practice revolved around using a particular lesson plan format known as Madeline T. Hunter. The Madeline Hunter Method involved a seven-step lesson plan which included an anticipatory set, objectives/standards, teaching and modeling, guided practice, check for understanding, independent practice, and closure (Burns, 2005). This method has been widely used throughout the United States in both elementary and secondary education. Madeline Hunter claimed it was equally effective in all levels of teaching, including elementary, secondary, and university (Hunter, 1985).

When that college student becomes a teacher, the type of lesson plans written often change drastically. The required format of lesson plans varies by school (Murray, 2002). Many teachers submit lesson plans written in purchased lesson plan books which contain small squares. In these small squares, teachers write the gist of the lesson for each subject taught. Other schools allow teachers to develop their own lesson plan format. Often, the lengthy lesson plan format from college is never revisited. Many reasons can be heard for doing a short simple lesson plan. These include things such as "I don't need to plan out everything. I know what I am doing. It takes too long. It is a waste of time." The list goes on and on. However, according to Dr. Kizlik (2009), the best, most effective teachers are good planners, although it takes time and practice. Effective planning is very time consuming and requires a lot of thinking (Trim, n.d.). In addition, lesson plans should always be readable and detailed enough for substitute teachers to implement in case of an emergency (Murray, 2002).

Careful planning of lesson plans and units is extremely important (Ediger, 2004). When beginning to plan a lesson, the first step should be to think about what the lesson is supposed to accomplish what students are supposed to achieve (Kizlik, 2009; Trim, n.d.). Teachers also need to develop a connection with the content to help spark the interest of students. This might include career opportunities, life skill applications, or anything that helps students to understand why the skill or concept is important. Teachers need to teach for meaning and foster deeper understanding for students (Brooks, 2004). As educators write lesson plans, a copy of the state's standards should be used as references as well as any district documents that need to be followed such as pacing guides or curriculum guides. This will help to form the goals and objectives for the lesson or unit. When writing objectives in Virginia, careful attention needs to be given to the *Virginia Standards of Learning Curriculum Framework*. This document contains specific information for each learning objective that students must know. The document also provides background information for the teacher. The verbs within the *Curriculum Framework* should be utilized within the lesson, paying attention to the level on Bloom's Taxonomy. If the *Standard of Learning* objective is written at a higher level of thinking, the lesson needs to be designed to reach that higher level of thinking. The activities planned for a lesson should match the lesson objectives. As one of the most common mistakes in lesson plans, Kizlik (2009) listed that student activities for the lesson plan do not effectively contribute to the lesson objective. In many instances, activities that keep students busy or fill time slots are utilized instead of activities that help to accomplish the objective.

Assessment is another key component of lesson plan development. This does not necessarily mean a test on the information taught in the lesson. Assessment begins when instruction begins so teachers can be aware of what students need (Strickland, 2005). Throughout any lesson, teachers should assess student learning. However, this assessment could come in many different formats, including questioning, discussions, or observations. According to Trim (n.d.), connecting the objectives, activities, and assessment during planning ensures students will achieve the objectives and not spend time on activities they do not need.

Lesson planning often is viewed as a chore or task teachers must do weekly to submit to the principal. However, teachers need to understand the true purpose of a lesson plan. According to Kizlik (2009), a lesson plan is to guide individuals with organizing the material and themselves for the purpose of helping students achieve the intended learning outcomes. A lesson plan is designed to help teachers think through the entire lesson considering the needs of all learners in an organized format.

Benchmark Assessments

Currently, a critical national priority is raising the standards of learning that are achieved through the public schools (Black & Wiliam, 1998). This progress is being monitored through the results of the standardized tests. *NCLB* requires states align K-12 assessments with their academic standards (American Educational Research Association, 2003). This depicts what students should know and be able to do. With the increased importance of state mandated testing, educators are looking for ways to ensure students are ready for the end of the year tests. According to Rettig, McCullough, Santos, and Watson (2003), the results of state-mandated tests are too infrequent and do not provide enough details to be useful in raising achievement. Often the state assessment data returns too late to be helpful in making adjustments for the current school year (Marsh, Pane, & Hamilton, 2006). Also, many teachers complain that the data from the state tests is not on their current students (Trimble, Gay, & Matthews, 2005). Therefore, educators need an ongoing formative assessment to get the necessary data to assist with academic achievement (Guskey, 2003). The challenges of *NCLB* are pushing many school divisions to have access to real time data (Trimble, et al., 2005).

According to Herman and Baker (2005), the purpose of benchmark testing is to provide accurate information about the students' progress as well as provide useful feedback to guide instruction and improve learning. Many school systems are now implementing benchmark assessments several times throughout the school year to help guide instruction. According to Trimble, et al. (2005), the benchmark tests provide real time data about progress which enables teachers to make better instructional decisions. The data from these assessments helps to ensure that instruction is on target and students are moving effectively towards mastering the standards. The results have to be used to adjust teaching and learning. Because the benchmark assessments are given more frequently throughout the year, they provide diagnostic information that can be acted on immediately (Marsh, e al., 2006). With the use of frequent classroom assessments, teachers can get feedback about student progress in a timely manner (Chard, n.d.).

Instruction and formative assessments are indivisible (Black & Wiliam, 1998). Teachers are able to identify the objectives on which students need more instruction before the state test is given. Administrators, teachers, and students are provided the progress made and areas to improve. The purpose of the benchmark tests is to utilize the results to find strategies for using meaningful contexts with weak skills for students who need help (Trimble, et al., 2005). Many school divisions have developed benchmark assessment to help identify problems students have with the mastery of required skills. They are analyzing this data at the school, classroom, and student levels. The emphasis should be on identifying problems and addressing them quickly (Shellard, 2005). The tests designed to gauge student performance clearly demonstrate expectations and whether students have learned the required content and skills (American Educational Research Association, 2003). The data from the benchmark assessments allow educators to identify struggling students and develop interventions and supports to implement immediately. In addition, data help to identify students that may need tutoring or other remediation to be successful on the state tests. Another way benchmark assessments are beneficial to educators is it often helps to identify bubble kids which are those students who current levels of achievement place them near the state's requirements (Marsh, et al., 2006). Shanahan, Hyde, Mann, and Manrique (n.d.) stated that benchmark tests administered quarterly allow for any necessary reteaching or remediation to occur prior to the state mandated testing date.

With administration of benchmarks quarterly, there are ample opportunities for students to practice taking a test under similar conditions to the state mandated tests. Most schools that implement benchmark testing establish tests that mirror the end of the year state assessments. According to McTighe and O'Connor (2005), good teachers recognize the need for ongoing assessments and adjustments for both the teacher and student to maximize performance. According to Black and Wiliam (1998), formative assessments help low achievers more than other students which still raises overall achievement. However, it was noted that frequent assessment feedback helps all students enhance their learning.

Assessments are important with education, especially with *NCLB* legislation. According to Shellard (2005), when the curriculum is aligned to state standards, frequent assessments are essential to ensure that students are meeting those standards. If assessments are going to impact teaching and student learning, aligning standards, instruction, and assessment is crucial. Shanahan, et al. (n.d.) stated that benchmark tests administered quarterly provide timely evidence as to whether the district's curriculum is being implemented so it can be adjusted. It also provides feedback as to whether pacing is being followed as it should. According to the American Educational Research Association (2003), alignment is the core of standards based education. Assessments must include items for each concept and subskill related to the standards being measured (Guskey, 2005). They also should be comprised of questions utilizing a wide range of cognitive skills including lower and higher levels of thinking. According to Tankersley (2007), how questions are asked and the tasks students are asked to perform make a difference. Curriculum materials, teacher professional development, and classroom instruction should all reflect a state's standards.

Students are tested so educators can infer what they know (Popham, 2001). After taking the benchmark assessments, the data must be studied to determine the actions that need to follow the assessment. Data use is more prevalent in the field of education because of *NCLB* (Marsh, et al., 2006) Schools have additional data to analyze and with the pressure to improve test scores, schools and school districts are utilizing more locally gathered data. Administrators and teachers use the data to make critical decisions about what to do and when to do it (Tankersley, 2007). This includes decisions about students, progress, practices, and plans to address concerns. According to Marsh, et al. (2006), one study reported that more than 80 percent of superintendents found results from local assessments to be more useful in decision making than state test results.

When analyzing test data, attention needs to be given to those questions missed by a large number of students (Guskey, 2003). The quality of the item needs to be studied, and if no problem is found, then teachers should examine their teaching. Often when analyzing data, it is found that students successfully answered questions pertaining to a concept at the knowledge level but could not apply that knowledge in a problem-solving situation (Guskey, 2005). Making accurate inferences from the data is critical because the understanding a teacher has about students' knowledge, abilities, and attitude should guide the teacher's instructional decisions (Popham, 2003). According to Guskey, assessments must be followed with good quality corrective instruction in an attempt to remedy learning errors. This means that teachers should present the material in new ways and engage students in different learning experiences. According to Guskey, to improve academic achievement, the focus needs to be on changing the way assessment results are used, improving the quality of classroom assessments, and aligning assessments with state standards.

CHAPTER 3

Methodology

This chapter describes the methodology and procedures used to determine if teachers at *Y Elementary School* who develop lessons based on Bloom's Taxonomy and the *Virginia Standards of Learning Curriculum Framework* will see increased scores on the mathematics benchmark assessment for fourth grade. The subjects and instruments will be described as well as the design for data analysis. This study was conducted during the spring semester of 2008 and data analysis and presentation of the completed study conducted during the fall of 2008.

Design of the Study

A nonrandomized control group, pretest posttest design was used. This design was selected because the chosen groups were already organized into classes, and they could not be reorganized to accommodate the research study. This design did not allow for random assignment of the subjects to the experimental and control groups. The groups were determined at random.

Statement of the Problem

This study will determine if teachers at *Y Elementary School* who develop lessons based on Bloom's Taxonomy and the *Virginia Standards of Learning Curriculum Framework* will see increased scores on the mathematics benchmark assessment for fourth grade.

Research Questions

1. If the teacher of the experimental group develops lessons aligned to the *Virginia Standards of Learning Curriculum Framework* and based on higher levels of

thinking on Bloom's Taxonomy, do students' scores increase on the mathematics benchmark assessments?

2. Do the scores of the students in the experimental group show an increase in the fourth grade mathematics scores between the pretest and posttest by subgroups?

Hypotheses

1. The mean of the Mathematics Benchmark Assessment posttest scores for the treatment group in which the teachers develop lessons using Bloom's Taxonomy will be significantly higher than the mean of the group which uses traditional, textbook bound instruction as indicated by scores from the Third Nine Weeks Fourth Grade Mathematics Benchmark Assessment.
2. The treatment group in which the teacher develops lessons using Bloom's Taxonomy will yield significant gains as measured by the difference between the pretest and posttest scores on the Third Nine Weeks Fourth Grade Mathematics Benchmark Assessment.

Research Context

The school division in which the study took place was relatively small in population but large in land area. It contained seven attendance zones, so students attended seven elementary schools, one middle school, and one high school. There were 6,101 students in the division, 300 in Pre-Kindergarten, 2601 in elementary schools, and 3200 in secondary schools. The school division had a 95 percent attendance rate.

The leadership was comprised of a superintendent, deputy superintendent, assistant superintendent for instruction, department directors and supervisors, and an eight-member school board. Of the eight school board members, five were new to the board for the current school year. The Deputy Superintendent headed the human resource department, including all hiring of individuals. In addition, he handled all of the legal issues. The Assistant Superintendent of Instruction was in charge of K-12 instruction. A Supervisor of Instruction for Elementary Education and a Supervisor of Instruction for Secondary Education were assigned to the Assistant Superintendent for Instruction and who worked more closely with the school administrators and teachers.

With the beginning of school this year, two new elementary schools opened which in turn closed seven elementary schools. The middle school was remodeled with the addition of a new wing so that sixth graders could move to the middle school. The building of the new schools and additions to the middle school caused a great debate within the county, leaving many individuals upset with the Superintendent, School Board, and Board of Supervisors. Individuals did not like the idea of losing the small community schools and having students taken by bus to the larger elementary schools. Also, many individuals wanted to keep sixth grade students at the elementary schools. However, all elementary schools were comprised of grades K-5, middle school was grades 6-8, and high school was 9-12. With the major transitioning of the schools, school leaders were relocated as well as faculties merged. Again, this caused quite an upset within the school community as well as the community as a whole.

The school designated as *Y Elementary School* was one of the seven elementary schools within the division. It also was one of the new larger schools, which was comprised of students from three elementary schools. In addition, the faculty of the new school was created from educators across the division. Because of the size of the school, there was a principal and an assistant principal. This was a new concept to the elementary setting for this school division. In the past, each elementary building only had one administrator. The principal had several years of experience as an administrator, but it was the assistant principal's first year in an administrative position after having taught for 20 years. There was an instructional coach within the building to help with data disaggregation, provide instructional strategies to assist teachers with instruction, and model for teachers as needed. In addition, there were grade chairpersons who were paid to serve in this role. Principal designees also were employed to operate the school and handle any discipline issues in the absence of the principal and assistant principal.

Y Elementary School consisted of grades K through five. Each grade level had five classes of students. The school practiced inclusion so students of special education were in general education classes. In most cases, this also meant extra adults were in the classroom serving as paraprofessionals.

There were 722 students in attendance at *Y Elementary School.* At the time of the study, the school had a 97 percent attendance rate. In fourth grade at *Y Elementary School*, there were 116 students. These students were divided into five homerooms. Within the grade level, students and teachers were divided into two teams. One team had a three-way switch, and the other team had a two-way switch. On the three-way team, one teacher taught language arts, one teacher taught mathematics and social studies, and the other teacher taught science. On the two-way team, one teacher taught the mathematics and science, and the other teacher taught the language arts and social studies.

Within the school division, the student population was made up of various ethnic groups. Even though diversity was increasing in the division, the student population continued to be comprised mostly of black students and white students. The population was similar to that of the school division in that it was made up primarily of black students and white students. However, it was different from that of the school division in that there were over two times as many white students as black students. The school was comprised of several races, and the number of students from various races was on the increase. Table 3.1 provides the number of students for each race within the school division.

Table 3.1

Student Membership by Race

Race	Division	Percentage of Students at Y Elementary School	Percentage of Students in Fourth Grade
American Indian	0.17%	0	0
Asian	0.27%	0	0
Black	47.7%	29%	31%
Hawaiian	0.16%	0	0
Hispanic	1.8%	2%	2%
White	49.9%	69%	67%

There were slightly more male students than female students within the division in which the study took place. The percentage of males in fourth grade was slightly lower than the percentage for *Y Elementary School* and the school division. There were more girls than boys in the fourth grade. Table 3.2 displays the percentage of students by gender within the school division.

Table 3.2

Division Student Membership by Gender

Gender	Division	Percentage of Students at Y Elementary School	Percentage of Students in Fourth Grade
Female	49%	49%	56%
Male	51%	51%	44%

There were more students who received free and reduced lunch than paid full price for lunch. This percentage for the school division was very high compared to the percentage of students who were economically disadvantaged in the state of Virginia. According to School Matters, 29.8 percent of the students in Virginia were classified as economically disadvantaged (2008). The percentage of students receiving free and reduced lunch at *Y Elementary School* was much lower than that of the division. It was more aligned to that of the state of Virginia. The percentage of students receiving free or reduced lunch was much higher in fourth grade than the total population of Y Elementary School. Table 3.3 displays the percentage of students within the school division who receive free and reduced lunch as well as those who pay full price.

Table 3.3

Lunch Price of Students within the Division

Lunch Price	Division	Percentage of Students at Y Elementary School	Percentage of Students in Fourth Grade
Free/Reduced	54.3%	26%	44%
Regular	45.7%	74%	56%

At the time of the study, the division had a high percentage of students with disabilities compared to the state of Virginia (School Matters, 2008). Virginia had 13.3 percent of students with disabilities. The percentage of students having a disability at *Y Elementary School* was extremely consistent with that of the division. However, it was somewhat higher than that of the state of Virginia (School Matters, 2008). The percentage of students labeled disabled in fourth grade was much lower that that of the school. Table 3.4 displays the percentage of students having disabilities within the school division according to an Individualized Education Plan (IEP).

Table 3.4

Disability of Students within the Division

Disability	Division	Percentage of Students at Y Elementary School	Percentage of Students in Fourth Grade
Disabled	17.7%	16%	5%
Nondisabled	82.3%	84%	95%

The school division in which the study was conducted had a small percentage of students who were classified as English Language Learners. The percentage of students that were classified as English Language Learners at *Y Elementary School* was low compared to more affluent areas within the state of Virginia. However, it was much higher than that of the school division in which the study occurred. Table 3.5 displays the percentage of students who were labeled as English Language Learners and received services from the school system to assist with their language development.

Table 3.5

English Language Learners within the Division

Language	Division	Percentage of Students at Y Elementary School	Percentage of Students in Fourth Grade
ELL	0.3%	1.7%	2%
Non ELL	99.7%	98.3%	98%

Subjects

The fourth grade students that participated in this experiment all attended *Y Elementary School* which was located in a very rural area. Two intact heterogeneous classes taught by different mathematics teachers participated. There were a total of 31 students comprised of 15 males and 16 females. Thirty-four percent of the children were black, and 66 percent were white. Of all the subjects, 25 percent received free lunch, 12.5 percent received lunch at a reduced rate, and 62.5 percent paid full price for lunch.

The control group and experimental group were similar in their statistical make-up although the classes were intact prior to the beginning of this study. They were compared by race, gender, the price paid for lunch, disabilities, and English Language Learners (ELL) to determine their equivalence.

The gender make-up for both the experimental and control groups were very similar to that of the entire fourth grade. Table 3.6 shows the gender make-up of each group that participated in the study.

Table 3.6

Gender of Subjects

Group	Gender	Percentage
Control	Male	47.1%
Control	Female	52.9%
Experimental	Male	46.7%
Experimental	Female	53.3%

The percentage of students in each racial group was similar to that of the entire fourth grade. In both the experimental and control groups, there were twice as many white students as black students. Table 3.7 compares the racial make-up of the groups that participated in the study.

Table 3.7

Race of Subjects

Group	Race	Percentage
Control	Black	35.3%
Control	White	64.7%
Experimental	Black	33.3%
Experimental	White	66.7%

The experimental and control groups varied greatly on the prices paid for lunch. Table 3.8 compares the prices students who participated in the study paid for lunch. As shown in the table, the percentage of students receiving free lunch was much higher for the experimental group than the control group. In turn, the percentage of students paying full price for lunch was much higher for the control group than the experimental group. The percentage of students paying a reduced rate was similar among the groups.

Table 3.8

Lunch Price of Subjects

Group	Lunch Price	Percentage
Control	Free	17.6%
Control	Reduced	11.8%
Control	Regular	70.6%
Experimental	Free	33.3%
Experimental	Reduced	13.3%
Experimental	Regular	53.3%

The percentage of students that were classified as having learning disabilities was greater in the experimental group than the control group. No students within the control group had learning disabilities. Table 3.9 shows the percentage of students with disabilities for each group that participated in the study.

Table 3.9

Disability of Subjects

Group	Disability	Percentage
Control	Learning Disabled	0%
Control	No disability	100%
Experimental	Learning disabled	13.3%
Experimental	No disability	86.7%

Table 3.10 shows the percentage of students classified as English Language Learners (ELL) for each group that participated in the study. The groups were equivalent as in regards to the percentage of ELL students.

Table 3.10

English Language Learners

Group	Language	Percentage
Control	ELL	0%
Control	Non ELL	100%
Experimental	ELL	0%
Experimental	Non ELL	100%

Two fourth grade mathematics teachers from *Y Elementary School* participated in the experiment. One teacher taught the experimental group and participated in the training, and the other taught the control group with no participation in training.

The teacher of the experimental group was a white female with over 10 years of teaching experience. During her teaching experience, she has taught at three different schools within the school division, and worked under four different leaders.

The teacher of the control group was a white female with over 10 years of teaching experience. During her teaching experience, she has taught at two different schools within the school division, and worked under two different leaders.

For this research project, the teachers were purposely matched according to their characteristics. They both were experienced teachers of mathematics. Also, they were the same race, gender, and close in age. The principal indicated that the scores of their students on previous benchmark assessments and end of the year assessments had been very similar.

Instruments

Two forms of the fourth grade mathematics benchmark test were developed which encompassed all standards that were taught within the designated instructional period. Forms A and B of the Benchmark Assessment for fourth grade mathematics were used as a pretest/posttest. The Benchmark tests were comprised of 35 multiple-choice questions with answer choices A, B, C, D and F, G, H, J. The tests were designed to mimic the *Virginia Standards of Learning* Test. In addition, the benchmark tests were based on the pacing of the standards as set forth in the school division's pacing and curriculum guides. The tests also included review items from the previous nine weeks grading periods. However, the data for this study was derived from analyzing 25 questions that contained content from the third nine weeks' grading period only. Other questions were eliminated prior to analyzing the data. Elimination was based on the assigned *Standard of Learning* objective.

The pretest and posttest were developed using a test bank of questions purchased by the school system from *Tests for Higher Standards*. The bank contained questions by grade level and content areas. Each question was aligned to the *Virginia Standards of Learning* Tests. Therefore, this test was used not only to guide instruction but also as a predictor of performance on the *Virginia Standards of Learning* Test. A level of Bloom's Taxonomy was assigned to each test question.

The publishers of Tests for Higher Standards, Dr. Stuart Flanagan and Dr. David Mott, have provided evidence for both the reliability and validity of their tests. According to Mott (2001), the KR-20 internal consistency reliability estimate for the fifth grade mathematics bank of questions is .88. In addition, Mott reported information on the content validity as well as the predictive score validity. According to Mott (2001), the content validity was established in the beginning by having the authors keep the standards directly in their view as they wrote, reviewed, and revised test items. Each item was directed at measuring a specific, individual standard. Then they had teachers, administrators, and curriculum specialists carefully review all of the tests for content validity. Another highly relevant type of validity is predictive score validity. That is how well the scores on the Tests for Higher Standards predict scores on the Virginia *Standards of Learning* Tests. According to Mott (2001), the fifth grade mathematics pre-post test correlation is .71. At the time of the study, there was no such data for the fourth grade mathematics *Standards of Learning* test. Because it was a new test, no released test was available from which to determine a correlation.

Procedures

The fourth grade students were given Form A of the mathematics benchmark assessment within the first five days of the third nine weeks. The same security measures were followed during benchmark testing within the school division as they were during the week of *SOL* testing. Once the test document and answer sheets were distributed, students had to work on their own. Teachers were not allowed to answer questions once the test began. Treatments were assigned at random.

Because there was no random assignment of subjects, it was not known if the groups were equivalent before the study. After assignments were made, the data showed the groups were relatively equivalent. As previously demonstrated in Table 3.16 and Table 3.17, the gender and race of both groups was very similar. The control group had 47.1 percent males, and the experimental group had 46.7 percent. Similarly, the control group had 52.9 percent females, and the experimental group had 53.3 percent females. When comparing the race of the subjects, the control group had 35.3 percent black and 64.7 percent white. The experimental group had 33.3 percent black and 66.7 percent white. Since there were no significant differences, selection bias was eliminated as a threat to internal validity.

The teacher of the experimental group received a full day of training prior to the implementation of the project. The agenda began with distributing and explaining the materials given for the project. This included a notebook containing the handouts and presentation materials for the daylong training, forms for future use, and references for teacher use on Bloom's Taxonomy. A journal was given to the teacher of the experimental group for her to document her feelings and thoughts as well as the reactions of the students as the project was fully implemented. After the distribution of the materials, the teacher was asked to sign a project agreement and an assessment agreement, which served as affidavits that she would not disclose information given to her throughout the implementation of the project. Appendix A provides a copy of the project agreement the teacher was asked to sign, and Appendix B provides a copy of the assessment agreement.

A PowerPoint presentation was conducted with the teacher of the experimental group during which there were opportunities for hands-on practice to ensure the teacher understood the requirements. The training included a comprehensive review of Bloom's Taxonomy, exploring each level of Bloom's in depth. After the review of the levels of Bloom's, time was spent on effective questioning using Bloom's Taxonomy. Examples were given on how to write effective questions at each level of Bloom's Taxonomy. For hands-on practice, the teacher of the experimental group along with the researcher developed effective questions for each level of Bloom's Taxonomy on the topic of mixed numbers. The next part of the training focused on applying Bloom's Taxonomy with higher order thinking to the development of lesson plans. Much time was spent on higher order thinking referred to as the HOT skills. The HOT skills referred to the levels on Bloom's Taxonomy known as analysis, synthesis, and evaluation. The researcher asked the teacher of the experimental group to use every level of Bloom's Taxonomy within a lesson plan whenever possible.

The remainder of the daylong training was spent on the utilization of the *Virginia Standards of Learning Curriculum Framework* and Bloom's Taxonomy when developing lesson plans. The researcher and teacher of the experimental group collaboratively examined the school division's planning guide and curriculum guide. Both of these documents have been developed around the *Virginia Standards of Learning* and the

Virginia Standards of Learning Curriculum Framework. References were made to both of these documents within the locally developed documents.

The training of the teacher in the experimental group involved making certain she knew the *Standards of Learning* objectives and understood exactly what the state department was asking her to teach. The researcher and the teacher of the experimental group developed a pacing calendar for the entire third nine weeks, noting the mathematics skill to be taught each day. It was noted that the pacing would be modified as needed, depending on days missed for weather or other extenuating circumstances.

A lesson plan format was developed in which the experimental teacher had to denote at what level of Bloom's Taxonomy the lesson was being taught. In addition, she was required to include the *Virginia Standards of Learning* objective for each of the lessons as well as the corresponding page numbers of the *Virginia Standards of Learning Curriculum Framework.* See Appendix C for a copy of the lesson plan. Collaboratively, the teacher of the experimental group and the researcher wrote the lesson plans for the first week of the project.

The teacher of the experimental group documented at least four lessons per week in mathematics that utilized higher level thinking skills during the third nine weeks grading period. The lesson plans were submitted weekly to the principal as they had been in the past. The principal shared a copy of the lesson plans with the researcher each week.

The researcher met with the teacher of the experimental group twice a month for the remainder of the third nine weeks. At the instructional training, strategies were shared for aligning the *Virginia Standards of Learning Curriculum Framework* with Bloom's Taxonomy to incorporate higher level thinking strategies in mathematics. In addition, during this training, the teacher of the experimental group had time to reflect upon the lesson plans, ask questions, and share student reactions to the various activities. More training was provided at each session on questioning with the emphasis on Bloom's Taxonomy. The pacing calendar was modified as needed to accommodate the changes in the schedule. The researcher recorded a summary of each meeting, noting days missed due to weather or other interferences to the schedule. A planning sheet called *Developing Effective Questions* was shared with the teacher of the experimental group as a method to help her with her lesson development and implementation. Appendix D has a copy of the planning sheet.

The teacher of the control group did not participate in the training. She continued to provide instruction as she had in the past. Her lesson plans were submitted using the same format as she had been using.

Students were given Form B of the division's benchmark assessment within the last three days of the third nine weeks grading period. As with the pretest, the answer documents were scanned using the Reports Online System. The same procedures and security measures were followed with the posttest as they were during the pretest. Teachers were not allowed to assist students during the test.

Analysis of Data

Data Organization

The data for the project was organized into tables, charts, and graphs. The demographic information for the division in which the study occurred as well as *Y Elementary School* was presented in multiple tables. In addition, the demographic data of students in both the control group and experimental group was presented in multiple tables.

The Reports Online System (ROS), a formative assessment tool, was utilized to scan the answer documents. Once the answer documents were scanned, ROS disaggregated the data. From ROS, many reports were generated to assist with the analysis of data.

The three main reports utilized for the study were the Item Analysis report, Matrix report, and Progress report. The Item Analysis report provided detailed information of students' responses. The researcher could examine how every student answered each question as well as the total for the control group and the total for the experimental group. The Matrix report allowed the researcher to study the performance of the students by the *NCLB* categories. This provided the data by race, gender, lunch price, disability, and English Language Learners for both the control and experimental groups. The Progress report tracked performance over time sorting the data by *Standards of Learning* objectives. The researcher used this report to compare data from the pretest to the posttest by student and by both the control group and the experimental group.

In addition, a table was used to complete an item-by-item analysis of the scores. The change in individual student's scores on the benchmark tests over time were displayed in a line graph without revealing any identifying student information. Also, information was summarized to denote the differences in the testing results of the experimental and control groups.

Statistical Procedures

An analysis of covariance (ANCOVA) was conducted in SPSS™ to determine if the difference between the two groups was statistically significant. By utilizing the results of the ANCOVA, it was possible to use the scores on the pretest to equate differences in ability of the control group and the experimental group to allow for an appropriate comparison of the posttest scores. A paired-samples t-test was conducted to compare the results of the experimental group's pretest to the results of the experimental group's posttest. To confirm the directional hypothesis, the experimental group needed to perform significantly better on their Form B benchmark assessment than the control group. This would indicate that the implementation of lessons based on Bloom's Taxonomy and the *Virginia Standards of Learning Curriculum Framework* caused an increase in scores on the mathematics benchmark assessment for fourth grade.

CHAPTER 4

Results

As stated in Chapter 1, the purpose of this study was to determine if teachers at *Y Elementary School* who developed lessons based on Bloom's Taxonomy and the *Virginia Standards of Learning Curriculum Framework* saw increased scores on the mathematics benchmark assessment for fourth grade. The results of the pretest and posttest scores of participants were examined to see if there was a difference in academic achievement between the two groups.

Research Questions

1. If the teacher of the experimental group develops lessons aligned to the *Virginia Standards of Learning Curriculum Framework* and based on higher levels of thinking on Bloom's Taxonomy, do students' scores increase on the mathematics benchmark assessments?
2. Do the scores of the students in the experimental group show an increase in the fourth grade mathematics scores between the pretest and posttest by AYP subgroups?

Hypotheses

1. The mean of the Mathematics Benchmark Assessment posttest scores for the experimental group in which the teachers develop lessons using Bloom's Taxonomy will be significantly higher than the mean of the control group which uses traditional, textbook bound instruction as indicated by scores from the Third Nine Weeks Fourth Grade Mathematics Benchmark Assessment.

2. The experimental group in which the teacher develops lessons using Bloom's Taxonomy will yield significant gains as measured by the difference between the pretest and posttest scores on the Third Nine Weeks Fourth Grade Mathematics Benchmark Assessment.

This study utilized a nonrandomized control group, pretest posttest design. This design was selected because the chosen groups already were organized into classes, and they could not be reorganized to accommodate the research study. This design did not allow for random assignment of the subjects to the experimental and control groups. The groups were determined by flipping a coin. The fourth grade students that participated in this experiment all attended *Y Elementary School*. Two intact heterogeneous classes taught by different mathematics teachers participated. There were a total of 31 students comprised of 15 males and 16 females. Thirty-five percent of the children were black, and 65 percent were white. Of all the subjects 26 percent received free lunch, 13 percent received lunch at a reduced rate, and 61 percent paid full price for lunch. The control group and experimental group were similar in their statistical make-up although the classes were intact prior to the beginning of this study. They were compared by race, gender, the price paid for lunch, disabilities, and English Language Learners (ELL) to determine their equivalence.

The teacher of the experimental group participated in instructional training, during which strategies were shared for aligning the *Virginia Standards of Learning Curriculum Framework* with Bloom's Taxonomy to incorporate higher level thinking strategies in mathematics. The lesson plans had to reflect the strategies received throughout the training, including the utilization of higher level thinking skills on Bloom's Taxonomy. In addition, during this training, the teacher of the experimental group had time to reflect upon the lesson plans, ask questions, and share student reactions to the various activities. The teacher of the control group did not participate in the training. She continued to provide instruction as she had in the past. Her lesson plans were submitted using the same format as she had been using prior to the study.

Two forms of the fourth grade mathematics benchmark test were developed which encompassed all standards that were taught within the designated instructional period. Forms A and B of the Benchmark Assessment for fourth grade mathematics were used as a pretest and posttest.

The Data

Tables 4.1, 4.2, and 4.3 give the sample size and mean for each group. There appeared to be a slight difference in the test scores of the control group and experimental group.

Table 4.1

Between Subjects Factors

Group	N
Control	17
Experimental	14

Table 4.2

Descriptive Statistics - PreTest

Group	Mean	Standard Deviation	N
Control	53.4118	12.87953	17
Experimental	48.5714	11.18869	14
Total	50.9916	12.03411	31

Table 4.3

Descriptive Statistics - Dependent Variable: PostTest

Group	Mean	Standard Deviation	N
Control	84.2353	9.32423	17
Experimental	82.5714	13.18341	14
Total	83.4839	11.06306	31

Table 4.4 displays the data for each group's performance on the pretest and posttest. It appears that on the pretest, the control group's mean was four points higher than the experimental group. The results of the posttest indicate that the control group was one point higher than that of the experimental group. However, the results suggest that the mean gain of points for the control group from the pretest to the posttest was 31 points. For the experimental group, it was 34 points. In addition, for the percent passing, the results indicated that the control group gained 76 percentage points from the pretest to the posttest. The experimental group gained 86 percentage points, appearing that the experimental group made a larger gain than did the control group from the beginning of the study until the end.

Table 4.4

PreTest and PostTest Scores for Each Group

Group	Test	N	Mean	Range	Percent Passing
Control	Pretest	17	53.4118	28-72	24
Experimental	Pretest	14	48.5714	28-68	7
Control	Posttest	17	84.2353	68-100	100
Experimental	Posttest	14	82.5714	56-100	93

The data were analyzed by the researcher using SPSS™ and the Reports Online System. An analysis of covariance (ANCOVA) was conducted in SPSS™ to determine if the difference between the two groups was statistically significant. For the ANCOVA, the dependent variable was the posttest, the covariate was the pretest, and the group was the independent variable. By utilizing the results of the ANCOVA, it was possible to use the scores on the pretest to equate differences in ability of the control group and the experimental group to allow for an appropriate comparison of the posttest scores. Table 4.5 and table 4.6 displays the results from the ANCOVA.

Table 4.5

Levene's Test of Equality of Error Variances – Dependent Variable: Posttest

F	df1	df2	Sig.
.716	1	29	.404

ANCOVA results indicate that there is not a significant main effect for the treatment group, F (1, 27) = .722, p = .403. The interaction between the group and the pretest was not significant, F (1, 27) = .859.

Table 4.6

Tests of Between- Subjects Effects - Dependent Variable: Posttest

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1227.147	3	409.049	4.518	.011
Intercept	4702.756	1	4702.756	51.941	.000
Group	65.365	1	65.365	.722	.403
Pretest	1205.637	1	1205.637	13.316	.001
Group * Pretest	77.738	1	77.738	.859	.362
Error	2444.595	27	90.541		
Total	219728.000	31			
Corrected Total	3671.742	30			

Table 4.7 presents the adjusted means for the group and posttest which indicates that the mean for the experimental group was higher than the mean for the control group.

Table 4.7

Adjusted Posttest Scores

Group	Adjusted Mean Post-Test Score
Control	83.344
Experimental	84.391

Hypothesis one stated that the mean of the Mathematics Benchmark Assessment posttest scores for the treatment group in which the teachers develop lessons using Bloom's Taxonomy will be significantly higher than the mean of the group which uses traditional, textbook bound instruction as indicated by scores from the Third Nine Weeks Fourth Grade Mathematics Benchmark. This hypothesis must be rejected because the p value was .403, and a p value of less than .05 is needed to support the hypothesis.

The second hypothesis stated that the experimental group in which the teacher developed lessons using Bloom's Taxonomy would yield significant gains as measured by the difference between the pretest and posttest scores on the Third Nine Weeks Fourth Grade Mathematics Benchmark Assessment. A paired-samples t-test was conducted to compare the results of the experimental group's pretest to the results of the experimental group's posttest. Tables 4.8 and 4.9 display the results of the t-test.

Table 4.8

Paired Samples Statistics: Experimental Group

		Mean	N	Standard Deviation	Standard Error Mean
Pair 1	Pre	48.5714	14	11.18869	2.99030
	Post	82.5714	14	13.18341	3.52341

Table 4.9

Paired Samples Test

Group	n	M	SD	t	P <
Control	17	-30.82353	10.84110	11.723	.05
Experimental	14	-34.000	11.28648	11.272	.05

There is a statistically significant difference between the pretest and posttest for the experimental group. The alignment of the *Virginia Standards of Learning Curriculum Framework* and the use of Bloom's Taxonomy did make a difference. The mean score increased from 48.57 (sd =11.19) on the pretest to 82.57 (sd =13.18) on the posttest. The difference between the two means is statistically significant at the .05 level (t = -11.27, df-13). Thus, the second hypothesis that the experimental group in which the teacher developed lessons using Bloom's Taxonomy would yield significant gains as measured by the difference between the pretest and posttest scores on the Third Nine Weeks Fourth Grade Mathematics Benchmark Assessment can be retained.

Table 4.10 displays the mean and percent passing for the pretest and posttest of the experimental group.

Table 4.10

Pretest and Posttest Scores for the Experimental Group

Group	Test	Mean	Percent Passing
Experimental	Pretest	49	7
Experimental	Posttest	83	93

Overall, the mean of the experimental group from the pretest to the posttest showed significant gains. The percent passing was calculated using 67 as a passing score since a passing score on the *Virginia Standards of Learning* Test is 400 out of 600 which equals 67 percent. The percent passing increased 86 percentage points from the pretest to the posttest for the experimental group which demonstrated a significant gain.

The Reports Online System (ROS), a formative assessment tool, was utilized by the researcher to disaggregate the data. From ROS, several reports were generated to assist with the analysis of data. The three main reports utilized for the study were the Item Analysis report, Matrix report, and Progress report. The Item Analysis report provided detailed information of students' responses. The researcher examined how every student answered each question as well as the total for the control group and the total for the experimental group.

The second research question was whether the scores of the students in the experimental group showed an increase in the fourth grade mathematics scores between the pretest and posttest by AYP subgroups. The Matrix report allowed the researcher to study the performance of the students by the *NCLB* categories. This provided the data for the AYP subgroups which are gender, race, lunch price, disability, and English Language Learners for both the control and experimental groups.

Table 4.11 displays the results from the scores on the pretest and the posttest by gender. Both males and females increased eighty-six percentage points from the pretest to the posttest.

Table 4.11

Results by Gender

Group	Test	Gender	Percent Passing
Control	Pretest	Male	25
Control	Pretest	Female	22
Control	Posttest	Male	100
Control	Posttest	Female	100
Experimental	Pretest	Male	0
Experimental	Pretest	Female	14
Experimental	Posttest	Male	86
Experimental	Posttest	Female	100

Table 4.12 displays the data by race from the pretest to the posttest. Black students increased 80 percentage points from the pretest to the posttest. White students increased by 89 percentage points.

Table 4.12

Results by Race

Group	Test	Race	Percent Passing
Control	Pretest	Black	0
Control	Pretest	White	36
Control	Posttest	Black	100
Control	Posttest	White	100
Experimental	Pretest	Black	0
Experimental	Pretest	White	11
Experimental	Posttest	Black	80
Experimental	Posttest	White	100

Table 4.13 provides the data for the experimental group by free, reduced, and regular lunch prices. The pass rate for students that receive free lunch increased by 80 percentage points. Students that paid reduced lunch price increased 100 percentage points. The pass rate for students that paid full price for lunch increased by 86 percentage points.

Table 4.13

Results by Lunch Price

Group	Test	Lunch Price	Percent Passing
Control	Pretest	Free	33
Control	Pretest	Reduced	0
Control	Pretest	Regular	25
Control	Posttest	Free	100
Control	Posttest	Reduced	100
Control	Posttest	Regular	100
Experimental	Pretest	Free	0
Experimental	Pretest	Reduced	0
Experimental	Pretest	Regular	14
Experimental	Posttest	Free	80
Experimental	Posttest	Reduced	100
Experimental	Posttest	Regular	100

Table 4.14 displays the data for the experimental group by disability. The percent passing for the experimental group from the pretest to the posttest increased 50 percentage points for students labeled as having learning disabilities. For the students with no learning disability, the percent passing increased 92 percentage points.

Table 4.14

Results by Disability

Group	Test	Disability	Percent Passing
Control	Pretest	Learning Disabled	None
Control	Pretest	No disability	24
Control	Posttest	Learning Disabled	None
Control	Posttest	No disability	100
Experimental	Pretest	Learning disabled	0
Experimental	Pretest	No disability	8
Experimental	Posttest	Learning disabled	50
Experimental	Posttest	No disability	100

Table 4.15 shows the data for English Language Learners (ELL). As the data demonstrate, there were no ELL students in the experimental group. All other students in the experimental group increased 86 percentage points from the pretest to the posttest.

Table 4.15

Results of English Language Learners

Group	Test	Language	Percent Passing
Control	Pretest	ELL	None
Control	Pretest	Non ELL	24
Control	Posttest	ELL	None
Control	Posttest	Non ELL	100
Experimental	Pretest	ELL	None
Experimental	Pretest	Non ELL	7
Experimental	Posttest	ELL	None
Experimental	Posttest	Non ELL	93

The Progress report tracked performance over time sorting the data by *Standards of Learning* objectives. The researcher used this report to compare data from the pretest to the posttest for both the control group and the experimental group. Tables 4.16 and 4.17 shows the percent passing by the *Standard of Learning* on the pretest and the posttest. Table 4.16 displays the results for the control group and Table 4.17 shows the results for the experimental group. Most *Standards of Learning* had an increase in the percentage passing from the pretest to the posttest.

Table 4.16

Progress by Standard of Learning for Control Group

Standard of Learning	Percent Passing on Pretest	Percent Passing on Posttest
4.2a	82	88
4.2b	35	82
4.2c	59	59
4.3	66	85
4.4a	44	94
4.4b	6	88
4.4c	71	82
4.9a	9	68
4.9b	53	94
4.9c	24	47
4.14	57	94
4.15a	62	85
4.15b	76	100
4.18	80	100
Test Total	53	84

Table 4.17

Progress by Standard of Learning for Experimental Group

Standard of Learning	Percent Passing on Pretest	Percent Passing on Posttest
4.2a	100	93
4.2b	79	71
4.2c	36	36
4.3	62	84
4.4a	25	89
4.4b	21	86
4.4c	79	100
4.9a	11	64
4.9b	50	100
4.9c	18	54
4.14	40	90
4.15a	25	82
4.15b	79	93
4.18	81	100
Test Total	49	83

In addition, a table was used to complete an item-by-item analysis of the scores. The test included review questions from the previous nine weeks grading periods, but the data for this study was derived from analyzing the questions that contained content from the third nine weeks' grading period only. Other questions were eliminated prior to analyzing the data. Table 4.18 displays the data by question for the experimental group and the control group on the pretest and posttest.

Table 4.18

Item Analysis for Pretest and Posttest

Item Number	Experimental Group Percent Correct on Pretest	Experimental Group Percent Correct on Posttest	Control Group Percent Correct on Pretest	Control Group Percent Correct on Posttest
1	86	93	88	88
2	71	100	82	94
3	100	93	82	88
4	79	71	35	82
5	43	71	29	76
6	50	100	53	94
7	36	36	59	59
8	50	71	65	82
10	21	79	6	100
11	0	50	12	35
13	0	50	6	35
14	36	57	41	59
15	21	86	6	88
16	79	100	71	82
17	21	86	47	94

18	0	79	41	82
19	50	86	59	100
20	29	93	41	94
21	64	100	47	100
22	100	100	100	100
23	43	86	53	82
24	29	100	59	100
27	50	86	82	88
28	79	93	76	100
31	79	100	94	100
Test Total	49	83	53	84

The change in individual student's scores on the benchmark tests over time is displayed in a line graph without revealing any identifying student information. Figure 4.1 displays the pretest and posttest scores of students in the control group. Every student within the control group scored higher on the post test than on the pretest.

Figure 4.1

Comparison of Control Groups' Pretest and Posttest Scores

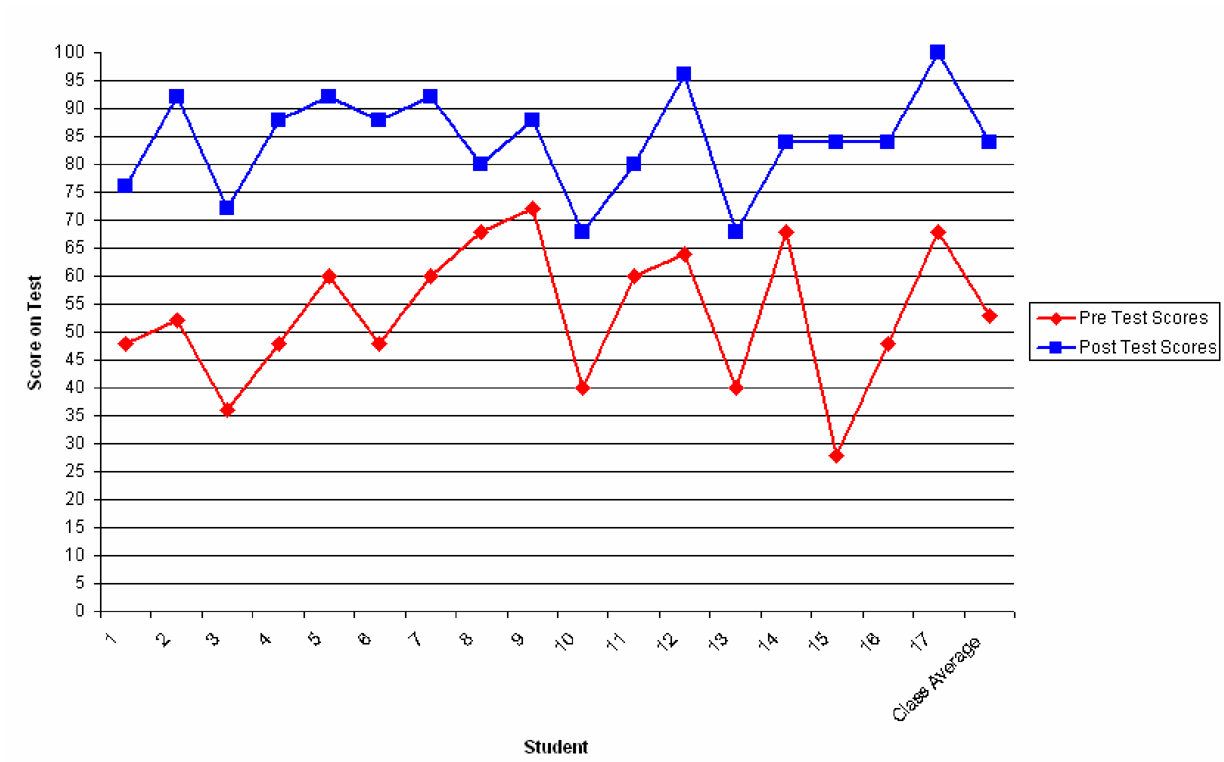

Figure 4.2 displays the pretest and posttest scores of students in the experimental group. As with the control group, every student within the experimental group scored higher on the posttest than on the pretest.

Figure 4.2

Comparison of Experimental Groups' PreTest and PostTest Scores

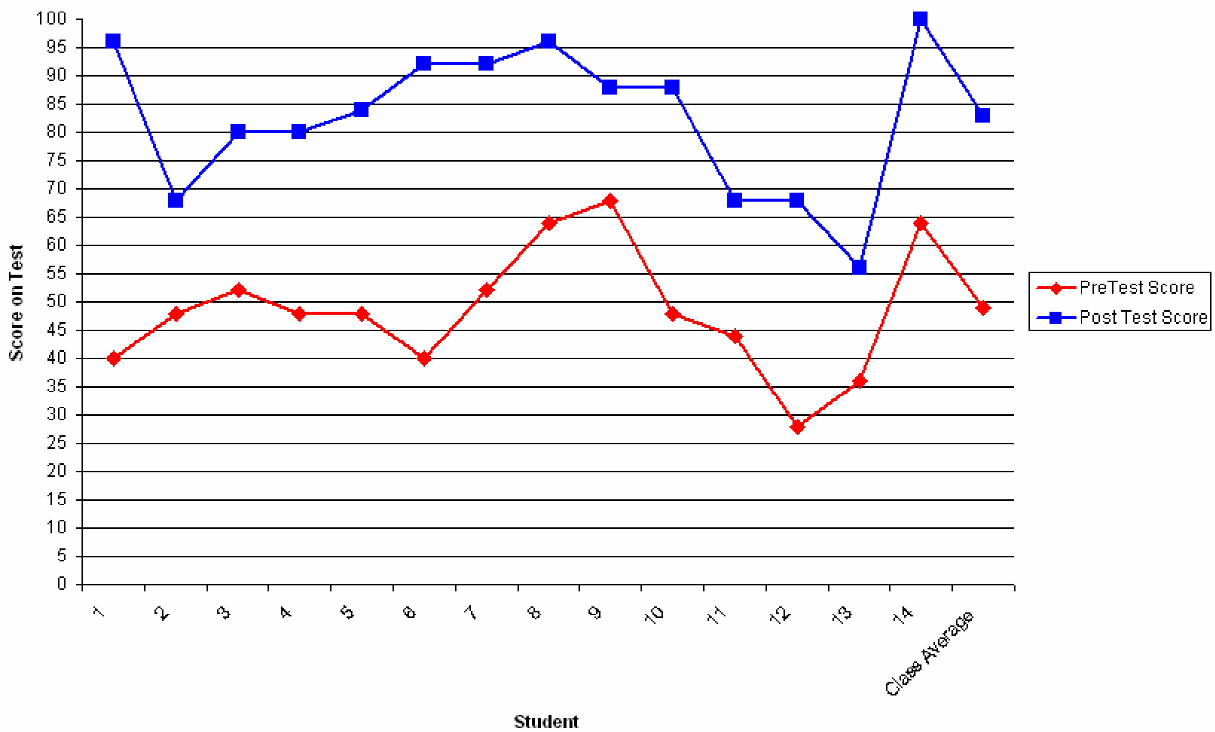

Table 4.19 displays the results of the control group and experimental group on the pretest and posttest when disaggregated by Bloom's Taxonomy. At every level of Bloom's Taxonomy, there was growth shown for both the control group and experimental group from the pretest to the posttest.

Table 4.19

Average Score on Pretest and Posttest by Levels of Blooms Taxonomy

Level of Blooms	Control Group Pretest	Control Group Posttest	Experimental Group Pretest	Experimental Group Posttest
Knowledge	41	82	0	79
Comprehension	51	91	49	87
Application	58	81	53	81
Analysis	47	79	46	71
Synthesis	_	_	_	_
Evaluation	57	80	52	79

Summary

The purpose of this study was to determine if teachers at *Y Elementary School* who developed lessons based on Bloom's Taxonomy and the *Virginia Standards of Learning Curriculum Framework* saw increased scores on the mathematics benchmark assessment for fourth grade. The data from the fourth grade pretests and posttests of both the control group and experimental group were analyzed by the researcher using SPSS™ and the Reports Online System. Two groups of student test scores were analyzed using an analysis of covariance (ANCOVA) with the pretest as a covariate.

It was found that the mean of the Mathematics Benchmark Assessment posttest scores for the experimental group in which the teachers develop lessons using Bloom's Taxonomy was not significantly higher than the mean of the control group which uses traditional, textbook bound instruction as indicated by scores from the Third Nine Weeks Fourth Grade Mathematics Benchmark Assessment. A p value of less than .05 was needed to support the hypothesis, and the p value was .403. The adjusted mean scores demonstrated that the scores of the experimental group were higher than the scores of the control group on the posttest. In addition, a paired-samples t-test was conducted to compare the results of the experimental group's pretest to the results of the experimental group's posttest. It was found that the experimental group in which the teacher developed lessons using Bloom's Taxonomy yielded significant gains as measured by the difference between the pretest and posttest scores on the Third Nine Weeks Fourth Grade Mathematics Benchmark Assessment. The analysis of data also demonstrated that the fourth grade mathematics scores of the students in the experimental group increased between the pretest and posttest by all subgroups as defined by AYP. This included race, gender, lunch price, disability, and English Language Learners.

Chapter 5 contains a discussion on the conclusions drawn from the study. Also, it includes suggestions for instructional applications and future implications for this study.

CHAPTER 5

Summary and Discussion

In this concluding chapter, the general research problem is restated, the methodology is reviewed, and the results are summarized. The discussion will include implications, limitations, applications, and recommendations for future research.

Statement of the Problem

Since fourth grade was new to *Standards of Learning* Tests, no mathematics *Standards of Learning* released tests were available. However, the fifth grade mathematics test included *Standards of Learning* from the fourth grade. So the teachers within the school division utilized those tests to study test questions for fourth grade mathematics.

After examining the fifth grade released test questions that covered the fourth grade *Standards of Learning*, it was noted the questions were more difficult than the teachers within the school division thought. Then it was speculated that the newly formed fourth grade mathematics *Standards of Learning* Tests had moved to higher levels of thinking. Therefore the questions were designed differently than earlier tests. Many of the educators within the school division realized that students had to think in a different way, and may need to be taught in a different way. This prompted the school division to focus more closely on classroom instruction. Therefore, it was necessary to conduct this study to examine the relationship between classroom instruction, Bloom's Taxonomy, and the Virginia Department of Education's *Standards of Learning Curriculum Framework*. This study determined if teachers at *Y Elementary*

School who developed lessons based on Bloom's Taxonomy and the *Virginia Standards of Learning Curriculum Framework* saw increased scores on the mathematics benchmark assessment for fourth grade.

Research Questions

1. If the teacher of the experimental group develops lessons aligned to the *Virginia Standards of Learning Curriculum Framework* and based on higher levels of thinking on Bloom's Taxonomy, do students' scores increase on the mathematics benchmark assessments?
2. Do the scores of the students in the experimental group show an increase in the fourth grade mathematics scores between the pretest and posttest by subgroups?

Hypotheses

1. The mean of the Mathematics Benchmark Assessment posttest scores for the experimental group in which the teachers develop lessons using Bloom's Taxonomy will be significantly higher than the mean of the group which uses traditional, textbook bound instruction as indicated by scores from the Third Nine Weeks Fourth Grade Mathematics Benchmark Assessment.
2. The experimental group in which the teacher develops lessons using Bloom's Taxonomy will yield significant gains as measured by the difference between the pretest and posttest scores on the Third Nine Weeks Fourth Grade Mathematics Benchmark Assessment.

Review of Methodology

Design of the Study

A nonrandomized control group, pretest posttest design was used. This design was selected because the chosen groups already were organized into classes, and they could not be reorganized to accommodate the research study. This design did not allow for random assignment of the subjects to the experimental and control groups. The groups were determined by flipping a coin.

Subjects

Two fourth grade intact heterogeneous classes taught by different mathematics teachers at *Y Elementary School* participated in the study. There were a total of 31 students, comprised of 15 males and 16 females. The control group had 17 students while the experimental group contained 14 students. Thirty-five percent of the students were black, and 65 percent were white. Of all the subjects, 26 percent received free lunch, 13 percent received lunch at a reduced rate, and 61 percent paid full price for lunch. The control group and experimental group were similar in their statistical make-up, although the classes were intact prior to the beginning of this study. The groups were compared by race, gender, the price paid for lunch, disabilities, and English Language Learners (ELL) to determine their equivalence.

Two fourth grade mathematics teachers from *Y Elementary School* participated in the experiment. Both teachers were white females with a little over 10 years of teaching experience. One teacher taught the experimental group and participated in the trainings, and the other taught the control group and did not participate in training.

Instruments

Two forms of the fourth grade mathematics benchmark test were utilized for the study which encompassed all standards that were taught within the designated instructional period. Forms A and B of the Benchmark Assessment for fourth grade mathematics were used as a pretest and posttest. The tests were developed using a test bank of questions purchased by the school system from Tests for Higher Standards. The benchmark tests were comprised of 35 multiple-choice questions with answer choices A, B, C, D and F, G, H, J. The test questions were designed to mimic the format of the Virginia *Standards of Learning* Test. In addition, the benchmark tests were based on the pacing of the standards as set forth in the school division's pacing and curriculum guides. The tests also included review items from the previous nine weeks grading periods. However, the data for this study was derived from analyzing the 25 questions that contained content from the third nine weeks' grading period only.

Procedures

Within the first five days of the third nine weeks, the fourth grade students were given Form A of the mathematics benchmark assessment as a pretest. A coin was flipped to determine which group would be the experimental group and which group would be the control group.

The teacher of the experimental group received a full day of training prior to the implementation of the project. The training included a heavy review of Bloom's Taxonomy, exploring each level of Bloom's in depth. Then time was spent on developing effective questions using Bloom's Taxonomy to make sure students would be assessed at all levels of thinking. The next part of the training focused on applying Bloom's Taxonomy with higher order thinking to the development of lesson plans. The remainder of the training was spent on the utilization of the curriculum framework and Bloom's Taxonomy when developing lesson plans. Collaboratively, the researcher and teacher of the experimental group examined the local school division's planning guide and curriculum guide which had been developed around the *Virginia Standards of Learning* and the *Virginia Standards of Learning Curriculum Framework.*

After the research made certain the teacher of the experimental group knew the *Standards of Learning* objectives and understood exactly what the state department was asking her to teach, a pacing calendar was developed for the entire third nine weeks, indicating the mathematics skill to be taught each day. It was noted that the pacing would be modified as needed, depending on days missed for weather or other extenuating circumstances.

A lesson plan format was developed in which the teacher of the experimental group had to select the appropriate level of Bloom's Taxonomy and include the *Virginia Standards of Learning* objective as well as the corresponding page numbers of the *Virginia Standards of Learning Curriculum Framework*. Collaboratively, the teacher of the experimental group and the researcher wrote the lesson plans for the first week of the project. The teacher of the experimental group documented at least four lessons per week in mathematics that utilized higher level thinking skills during the third nine weeks grading period. As in the past, the lesson plans were submitted weekly to the principal, and the principal shared a copy of the lesson plans with the researcher each week.

The researcher met with the teacher of the experimental group twice a month for the remainder of the third nine weeks. At the instructional trainings, strategies were shared for aligning the *Standards of Learning Curriculum Framework* with Bloom's Taxonomy to incorporate higher level thinking strategies in mathematics. In addition, during these trainings, the teacher of the experimental group had time to reflect upon the lesson plans, ask questions, and share student reactions to the various activities. More training was provided at each session on questioning with the emphasis on Bloom's Taxonomy.

The teacher of the control group did not participate in the trainings. She continued to provide instruction as she had in the past, and her lesson plans were submitted using the same format as she had been using. At the end of the third nine weeks grading period, students were given Form B of the division's benchmark assessment as the posttest.

Summary of the Results

The data from the fourth grade pretests and posttests of both the control group and experimental group were analyzed by the researcher using SPSS and the Reports Online System. An analysis of covariance (ANCOVA) was conducted in SPSS to determine if the difference between the two groups was statistically significant.

It was found that the mean of the Mathematics Benchmark Assessment posttest scores for the experimental group in which the teachers develop lessons using Bloom's Taxonomy was not significantly higher than the mean of the group which uses traditional, textbook bound instruction as indicated by scores from the Third Nine Weeks Fourth Grade Mathematics Benchmark Assessment. This is because the p value was .403, and a p value of less than .05 is needed to support hypothesis one. Therefore, hypothesis one was rejected.

The second hypothesis stated that the experimental group in which the teacher developed lessons using Bloom's Taxonomy would yield significant gains as measured by the difference between the pretest and posttest scores on the Third Nine Weeks Fourth Grade Mathematics Benchmark Assessment. A paired-samples t-test was conducted to compare the results of the experimental group's pretest to the results of the experimental group's posttest. There was a statistically significant difference between the pretest and posttest for the experimental group. The alignment of the *Virginia Standards of Learning*

Curriculum Framework and the use of Bloom's Taxonomy did make a difference. The mean score increased from 48.57 (sd =11.19) on the pretest to 82.57 (sd =13.18) on the posttest. The difference between the two means is statistically significant at the .05 level (t = -11.27, df-13). Thus, the second hypothesis that stated the experimental group in which the teacher developed lessons using Bloom's Taxonomy would yield significant gains as measured by the difference between the pretest and posttest scores on the Third Nine Weeks Fourth Grade Mathematics Benchmark Assessment can be retained.

The Reports Online System was used to analyze the data by subgroups of students as defined by AYP. These subgroups are race, students living in poverty, students with disabilities, and students who are English language learners (Center for Public Education, 2006). The data indicated that the fourth grade mathematics scores of the students in the experimental group increased in all subgroups.

Discussion

Often teachers rely heavily on the textbook for instruction, beginning at the front of the book and following it to the end. Many teachers still feel this is the way to ensure all material is covered by the end of the year. However, often the content required by the state is not covered in the assigned textbook. Many textbooks are written for national goals and are not state specific. To ensure teachers are teaching the correct content, they must utilize the documents that are provided by the state of Virginia. These include the *Virginia Standards of Learning*, the *Virginia Standards of Learning Curriculum Framework*, and *Standards of Learning* Test Blueprints. Then teachers should add to or delete information from the textbook and other materials to better fit the standards and students' learning needs (Guskey, 2005). Textbooks should be used more as an information resource for students rather than a curriculum guide (Virginia Department of

Education, 2006). Within this study, the teacher of the experimental group only used the textbook when needed as a resource. She relied heavily on the *Virginia Standards of Learning Curriculum Framework*.

Alignment of the curriculum being taught in the classroom to the *Virginia Standards of Learning* and the *Virginia Standards of Learning Curriculum Framework* is important. Teachers must know exactly what is to be taught and what is going to be assessed on the end of the year state assessment. According to Schifter (2007), teachers need to develop a deep understanding of the content in order to teach mathematics for conceptual understanding. The *Virginia Standards of Learning Curriculum Framework* does this. It contains three columns called Understanding the Standard, Essential Understandings, and Essential Knowledge and Skills. These columns contain specific background information for teachers as well as detailed information students should know. It is unfair to hold students accountable for knowledge that they were never taught. When teachers rely solely on the textbook without consulting what Virginia has listed to teach, they are holding students accountable for test questions that they may not have taught. Without aligning the curriculum taught in the classroom to the *Virginia Standards of Learning* and the *Virginia Standards of Learning Curriculum Framework*, educators are setting students up for failure. In turn, if students fail, schools fail, and if schools fail, the school division could possibly fail as well. For a school, school division, or the state of Virginia to make AYP, it must meet or exceed 29 benchmarks (Virginia Department of Education, n.d.d).

There are consequences if schools or school divisions do not make AYP. A school division is moved into improvement status if it fails to make AYP in the same subject area across all grade levels for two consecutive years (Virginia Department of

Education, n.d.d). Any school division in improvement must develop an improvement plan to raise achievement of all students. For school divisions that move into the third year of improvement, corrective action can be taken by the state.

Title I schools, schools that receive federal funds to help children in high poverty areas that are behind, that do not make AYP for two consecutive years in the same subject are identified for improvement (Virginia Department of Education, n.d.c). This is known as year four of school improvement status. These schools must notify parents of their status prior to the start of school, and they must offer students the opportunity to transfer to another school within the division that is not identified for improvement. In addition to the requirements for not making AYP for two years, a Title I school that does not make AYP for a third consecutive year must offer supplemental educational services to low-achieving students (Virginia Department of Education, n.d.c). Priority for the supplemental educational services is given to low-income students. Title I schools that do not make AYP for the fourth consecutive year must continue with the actions taken in the previous years as well as incorporate one or more corrective actions. School divisions can choose to replace school staff deemed relevant to the failure to make AYP, implement a new curriculum shown by research as effective in raising achievement, decrease the authority of school-level management, appoint an outside expert to advise the school on the implementation plan developed during the first year of school improvement, extend the school year or school day, or restructure the internal organization of the school. School divisions that do not make AYP for the fifth consecutive year, year four of school improvement status must continue to offer public school choice and supplemental services. In addition, they must initiate restructuring plans which may include reopening the school as a charter school, replacing staff relevant to the school's failure to make progress or, turning the management of the school over to a private educational management company with a demonstrated record of effectiveness. If a school moves into year five of improvement, or fails to make AYP for six consecutive years, the must reopen the school as a charter school, replace all or most of the school staff relevant to the school's failure to make adequate yearly progress, turn the management of the school over to a private educational management company or other entity with a demonstrated record of effectiveness, or any other major restructuring of school governance.

Schools also can lose state accreditation if they do not meet the state's requirements. School accreditation in the state of Virginia is based on student achievement of the *SOL* assessments of the previous school year or a three-year average of achievement (Virginia Department of Education, n.d.c). Schools receive one of four ratings, which include fully accredited, accredited with warning, accreditation denied, or conditionally accredited.

Pacing is a critical component to teaching. The state mandated curriculum contains much content and specific objectives that must be covered prior to the end of the year assessments. Although most school divisions have some type of pacing guides in place, they are often more general in nature. The pacing guide for the school division in which the study occurred lists the mathematics concepts and the *Standards of Learning* objective to be covered in each nine weeks grading period. Basically, this serves as a guide for teachers to know which concepts will be on the nine weeks benchmark assessments. It does not offer a suggested amount of time per mathematicsematical concept. Teachers need to plan more specifically for their particular group of students to ensure there is adequate time to cover all of the required content at the correct pacing for their group. This is an on-going process throughout the entire school year because it needs to be adjusted as needed, based on student achievement, days missed from school, and other interruptions to the daily schedule. Curriculum mapping and pacing was identified as one of the seven most effective practices for increasing student achievement (Virginia Department of Education, 2000).

The teacher of the experimental group and the researcher developed a pacing calendar to ensure the teacher would cover all of the required mathematics concepts within the nine weeks grading period. The concept to be covered was written on the day to help the teacher plan the entire nine weeks. The calendar was adjusted as needed for inclement weather, more time necessary for a concept, and review of needed topics. The pacing calendar helps teachers to focus more closely on the amount of content that is left to teach within the allotted time frame. According to McGraw Hill Wright Group (n.d.), students often need multiple exposures over time with review and practice session provided frequently. Within the pacing calendar, time is built in to ensure not only is the content covered but that there is adequate time to remediate, review, and master the material prior to the end of the year assessment. Many students take longer to learn and internalize new skills, and some students have to unlearn material before they relearn it (Burns, 2007). The pacing calendar helps teachers to adequately allow for these differences in learning styles without going too fast or staying on a particular concept too long. A study in Virginia found that outlining an instructional sequence with appropriate timelines was important for curriculum mapping and pacing (Virginia Department of Education, 2000).

It is essential to implement higher level thinking skills with lessons. The questions on the *Virginia Standards of Learning* tests are moving to higher levels of thinking. Students have to be taught the content at those higher levels of thinking if they are going to be assessed at those levels. Even though tests have changed to emphasize higher order thinking skills, some teachers have not changed their approach to daily instruction (Tankersley, 2007). However, before teachers can teacher higher levels of thinking, they have to understand what they are. Many classroom teachers were exposed to Bloom's Taxonomy in some of their teacher preparation classes as an undergraduate student. Unfortunately, when many teachers start teaching, that Taxonomy is never considered again. Teachers need some assistance utilizing Bloom's Taxonomy within their classroom. For this study, the researcher spent time reviewing Bloom's Taxonomy with the teacher of the experimental group as well as devoting a significant amount of time on how to integrate Bloom's Taxonomy within her instruction and assessment. She had a Critical Thinking Wheel from Mentoring Minds® to assist her with the use of verbs on the levels of Bloom's Taxonomy. Also a planning sheet was developed to assist the teacher of the experimental group with planning effective questions and activities throughout her lesson to ensure she covered all levels of Bloom's Taxonomy. The highest level of Bloom's Taxonomy had to be noted in her lesson plan for the day. On her assessments, the teacher of the experimental group had to assign a level of Bloom's to each question. This helped her to make sure she made an assessment which included thinking at all levels on Bloom's Taxonomy. Administrators need to provide professional development to their faculty that not only reviews Bloom's Taxonomy but also that shows teachers how to integrate it within their lessons so they are teaching at the higher levels. Also, professional development needs to focus on how to write good quality questions at each level of Bloom's Taxonomy so they can develop assessments that assess students at all levels of thinking to be in alignment with the end of the year state assessments. Students should master knowledge at the lower level of Bloom's Taxonomy before moving higher on the Taxonomy. Benjamin Bloom demonstrated that mastering prerequisites before moving to more advanced learning has positive effects on the quality of learning and the rate of learning (Bloom, 1985). However, educators must get students to think at the higher levels in order to meet the expectations of the end of the year state assessments.

Lesson planning is an important aspect of teaching. According to Kizlik (2009), the best, most effective teachers are good planners, although it takes time and practice. Teachers need to think through the entire process in order to make sure the information is covered thoroughly and effectively. The lesson plan helps teachers to consider all aspects of the lesson. With the lesson plan template designed during this study, the teacher had to truly focus on the content but also the needs of the individual students. Ongoing assessment was built in throughout the lessons to make sure students were meeting the required objectives. Often teachers wait until they get to the end of a chapter to test students. Many teachers think assessment equals a test. The lesson plan format for this study required the teacher to note the type of assessment so she realized that an end of the chapter test is not the only type of assessment to use in the classroom. It also helped to provide more differentiation within the classroom. Connecting the objectives, activities, and assessment during planning ensures students will achieve the objectives and not spend time on activities that they do not need (Trim, n.d.).

Hands-on activities are an integral part of the learning process and were incorporated throughout the lessons for this study. According to Black and William (2998), teaching and learning must be interactive. Within the study, the teacher of the experimental group utilized various mathematics manipulatives within the lessons which allowed students to visually grasp the concept as well as kinesthetically manipulate the mathematics problems. Even on her assessments, she included mathematics questions that used pictorial representations of the manipulatives which mimicked questions from the end of the year state assessment. According to Clemons (2005), 90 percent of learning is visual, and 85 percent of the brain is wired for visual learning. In addition, the use of technology was integrated within the lesson plans. The technology had to be noted in the lessons plans of the experimental group's teacher. Teachers must realize that today's students have never known life without computers and therefore, they see them as an integral part of the learning process. Their computer is what paper and pencil was to most adults in the past. PowerPoint games were used to review the mathematics concepts during many of the lessons within the study. According to the teacher of the experimental group, the students were eager to play the games even though they were centered on the mathematics skills they needed to master.

Unanticipated Findings

The school division had strongly encouraged teachers to differentiate instruction and had moved to an inclusion model. These initiatives have caused teachers to search for ideas and lessons that incorporate these practices. The teacher of the control group saw the students of the experimental group utilizing more technology and manipulatives during the mathematics instruction. When the teacher of the control group noticed a change in activities and the enthusiasm of the students, she became curious as to the strategies being implemented by the teacher of the experimental group. However, the teacher of the experimental group insisted that she did not share any details of the project with anyone, including the teacher of the control group.

It was discovered that prior to the study the teacher of the control group and the teacher of the experimental group met weekly to write lesson plans collaboratively. The researcher questions whether the two teachers still met on a regular basis to discuss the instruction even though the lesson plans looked different.

During the regularly scheduled instructional training, the teacher of the experimental group constantly made comments to the researcher about how much the students were enjoying the newly implemented activities. Positive comments were made by her about how their excitement about learning caused her to be more excited as well. In fact, during the following school year, the teacher of the experimental group contacted the researcher for permission to use games and activities that had been used during the study.

Implications

The results of this study will increase knowledge in the field of education. Teachers are often reluctant to deviate from the textbook. For years the textbook has been their curriculum. They began at the beginning of the book and attempted to finish the book before school was out for the year. With each state having its own set of standards and most textbooks written for national use, teachers are not going to be successful with end of the year assessments if they rely on the textbook only. They must utilize the documents distributed by the Virginia Department of Education and use the textbook as another resource. Within the study, the teacher of the experimental group used the Virginia Department of Education's documents and used the textbook as a reference.

Since the teacher of the experimental group aligned the curriculum to the *Virginia Standards of Learning Curriculum Framework* and her student's scores increased significantly from the pretest to the posttest, perhaps teachers will be more likely to utilize the documents provided by the Virginia Department of Education. Teachers can still use the textbook but it should not be the curriculum for the class.

Teachers must move to higher levels of thinking in the classroom. Tests are asking questions at much higher levels than in previous years. Students need to be prepared to think at these levels in order to be successful on the end of the year tests. In order for them to think at higher levels on the tests, they need to be challenged to think at those levels daily. Asking basic questions at the lower levels of thinking within daily instruction does not present a clear picture of the true knowledge students have gained. Students need to be able to solve problems analytically and evaluate solutions to be successful on end of the year assessments and the workforce. Employers want individuals the can think and solve problems on their own. According to the research, the students coming out of high school are not able to perform at the level employers desire (National Commission on Excellence in Education, 1984).

The data from the study indicated an increase in the scores of students from the experimental group on each of the AYP subgroups. By using varied methods and strategies throughout the study, the teacher of the experimental group was able to better meet the needs of all students. Many schools struggle with meeting the national criteria on at least one of these subgroups. Using the documents provided by the Virginia Department of Education would help them with *NCLB* requirements, making state accreditation, and making Adequate Yearly Progress within all of the subgroups.

Applications

It was found that teachers who develop lessons based on Bloom's Taxonomy and the *Virginia Standards of Learning Curriculum Framework* saw increased scores on the mathematics quarterly benchmark assessment for fourth grade. Other educators should want to mimic the procedures in the study within their school. It is pertinent that teachers understand the relationship between standardized testing, the *Virginia Standards of Learning Curriculum Framework*, and Bloom's Taxonomy. The state of Virginia has developed the *Virginia Standards of Learning Curriculum Framework* to assist teachers with classroom instruction. The document provides details about the specific knowledge and skills that students must have to meet the standards (Virginia Department of Education, n.d.a). This study showed the relationship between using the *Virginia Standards of Learning Curriculum Framework*, Bloom's Taxonomy, and students' performance on assessments.

According to Guskey (2005), educators must unpack the standards which means to determine the components of each standard that students must know and arrange the components into meaningful learning steps. However, teachers need assistance and training on the unpacking of the standards within the *Virginia Standards of Learning Curriculum Framework* as well as the alignment of the *Virginia Standards of Learning Curriculum Framework* to their instruction. Once the teacher of the experimental group was trained on the unpacking of the *Virginia Standards of Learning Curriculum Framework*, Bloom's Taxonomy, and various research based strategies to help move to higher levels of thinking, she felt more confident and prepared. Teachers need to participate in similar training, focusing on research based strategies that they could implement within their classrooms. By not training our teachers to fully utilize the materials that the Virginia Department of Education has published, we are doing injustice to our students.

Once teachers have been trained, administrators will have to ensure that teachers are aligning instruction to the *Virginia Standards of Learning Curriculum Framework* and reaching higher levels of thinking within their lessons. Lesson plans can be checked to see the types of activities and assessments that are being utilized within the classroom. Also, many school divisions, as the one in which the study was conducted, have implemented Classroom Walkthroughs during which the administrator can gather much information about instruction in a short time period. In the school division in which the study was conducted, administrators are to check the level of Bloom's Taxonomy that they observe during the walk through as well as the type of strategies that are being used. This information is very useful in helping administrators plan the needed professional development that would best help students in the end. According to Checkley (2006), keeping current with research based practices that have demonstrated student learning is critical to continuous improvement and good teaching.

School administrators and teachers are constantly searching for ways to increase student performance on testing. The results of this study should be beneficial and applicable to all educational settings, including the Virginia Department of Education.

Limitations

Within the research project, there were some threats to the validity that need to be considered. Maturation was one potential threat to validity because the biological and psychological changes among students could have affected the research. Subjects could have performed differently on the benchmark assessment due to age and acquiring more information. However, this was not considered a threat because the entire project occurred during only a nine weeks time period, which is a short time period. Therefore, students' maturation rate should not affect the validity of the research.

Diffusion was also a potential threat in that the teacher of the experimental group could have shared information learned in the training sessions with the teacher of the control group. The teacher of the experimental group had to sign an affidavit indicating that learned information would not be shared with other individuals until the end of the project. There was no evidence that the teacher of the experimental group shared any information with the teacher of the control group.

There are several limitations that may impact the generalization of the findings to other areas within education. It may not be applicable to other content area subjects such as language arts, science, or social studies. In addition, the study only included students in fourth grade. Also, the study was conducted using only students from one school. Some schools are departmentalized while others have self-contained classrooms. This could make a difference in the results as well. Another limitation was the time frame during which the study was conducted. The study only lasted for nine weeks. The results may be more or less significant if the study were conducted for a longer period of time such as the entire school year.

Recommendations for Future Research

This study was conducted during one nine weeks grading period only. A future study might be designed to look at a longer time frame such as an entire school year. With that length of a study, the researcher could not only look at the results of the regularly scheduled benchmark assessments but could also look at the results on the end of the year state assessments. Another researcher might want to replicate the study utilizing a different grade level or content area. For this study, fourth grade mathematics was chosen because it was a fairly new test and the school division was interested in improving the scores at the fourth grade level. In addition, a researcher might want to replicate this study in other school divisions that are located in more urban areas to see if the results are consistent with the results of this rural school division. The school in which the study was conducted did not have a high percentage of minority students or free and reduced lunch so a future study in an area with a higher percentage of minority students or disadvantaged students could be useful. The study could also be conducted in a private school to see if the results would be the same as they were in this public school setting. In addition, it would be of interest to design a study in which elementary students had hands-on real life experiences, outside of the school building. For example, to reach students' interests and provide practical use of mathematics skills, have students go out to the racetrack, a farm, or other "real-life" setting. It would be interesting to determine if this had an impact on students' scores and retention of math concepts covered with the instructional program. All of these studies would provide useful data to help school divisions plan the necessary professional development to improve test scores and academic achievement.

Summary

Since the demands placed on schools, school divisions, and state departments of education are increasing with the *No Child Left Behind Act* and maintaining Adequate Yearly Progress, educators are constantly looking for ways to increase student achievement and test scores on the state assessments. Because of this accountability placed on all educators, it is important to examine the curriculum and teaching strategies being used to ensure students are best being prepared for the end of year assessments. Alignment of the curriculum to instruction, higher levels of thinking, and ongoing assessments are critical to providing useful data when making instructional decisions. According to the American Educational Research Association (2003), curriculum materials, teacher professional development, and classroom instruction should all reflect state standards. It would be useful to other educators if there was more research on this topic for other grade levels and content areas.

References

ACT. (2006). *Ready to succeed all students prepared for college and work* Retrieved November 25, 2008 from http://www.act.org/research/policymakers/pdf/ready_to_succeed.pdf

American Educational Research Association. (2003). *Standards and tests: Keeping them aligned* Retrieved December 29, 2008 from http://www.aera.net/uploadedFiles/Journals_and_Publications/Research_Points/RP_Spring03.pdf

Aviles, C.B. (1999). *Understanding and testing for "critical thinking" with bloom's taxonomy of educational objectives* Retrieved April 4, 2009 from http://www.eric.ed.gov/ERICWebPortal/recordDetail?accno=ED446025

Beghetto, Ron. (2003). *Scientifically based research* Retrieved January 19, 2009 from http://www.ericdigests.org/2003-5/based.htm

Bennett, W.J., Fair, W., Finn, C.E., Jr., Flake, F.H., Hirsch, E. D., Jr., Marshall, W., and Ravitch, D. (1998). *A Nation Still at Risk* Retrieved October 4, 2008 from http://www.hoover.org/publications/policyreview/3563967.html

Black, P. and Wiliam D. (1998). *How classroom assessments improve learning* Retrieved December 30, 2008 from http://www.pdkintl.org/kappan/kbla9810.htm

Blanton, M.L. and Kaput, J.J. (2005). Characterizing a classroom practice that promotes algebraic reasoning [Electronic version]. Journal for Research in Mathematics Education, 36 (5), 412-446.

Bloom, B. S. (1985). *Developing talent in young people.* New York: Ballantine Books.

Bloom, B. S., Engelhart, M.D., Furst, E.J., Hill, W. H., & Krathwohl, D.R. (1956).

Taxonomy of educational objectives. New York: David McKay Company, Inc.

Brooks, J.G. (2004). To see beyond the lesson. ***Educational Leadership***, 62, 8-13.

Burns, A. (2005). Teaching experientially with the madeline hunter method: An application in a marketing research course [Electronic version]. *Developments in Business Simulation and Experiential Learning,* 32 (1), 47-53.

Burns, M. (2007). Nine ways to catch kids up [Electronic version]. *Educational Leadership*, 65 (3), 16-21.

Cavey, L.O., Whitenack, J.W., and Lovin, L. (2006) Investigating teachers' mathematics teaching understanding: A case for coordinating perspectives [Electronic version]. *Educational Studies in Mathematics*, 64 (1), 19-43.

Center for Public Education. (2006). *A guide to the no child left behind act* Retrieved September 16, 2008 from http://www.centerforpubliceducation.org/site/c.kjJXJ5MPIwE/b.1505669/k.D349/A_guide_to_the_No_Child_Left_Behind_Act.htm

Center for Teaching Excellence. (n.d.). *Levels and types of questions* Retrieved April 6, 2008 from http://cte.illinois.edu/Did/docs/QUESTION/quest1.htm

Chard, D. (n.d.). *Vocabulary strategies for the mathematics Classroom* Retrieved January 10, 2009 from http://www.eduplace.com/state/pdf/author/chard_hmm05.pdf

Checkley, K. (2006). *The essentials of mathematics, K-6: Effective curriculum, instruction, and assessment*. Alexandria, VA: Association for Supervision and Curriculum Development.

Clemons, S.A. (2005). *Brain based learning: Possible implications for online* *instruction* Retrieved July 8, 2007 from http://www.itdl.org/Journal/Sep_05/article03.htm

Compass Learning. (2008). *Educational Solutions* Retrieved January 19, 2009 from http://www.compasslearningodyssey.com/solutions.html

Countryman, J. (1992). *Writing to learn mathematics*. Portsmouth, HH: Heinemann.

Curriculum Associates (n.d.). *We do it for you virginia* Retrieved January 24, 2009 from http://www.curriculumassociates.com/states/StateSpecific.asp?state=VA&Type=SCH&CustId=113166582401241556293

DeSchryver, D., Petrilli, M., and Youssef, S. (1998) *Fifteen years after a nation at risk* Retrieved October 4, 2008 from http://www.edreform.com/_upload/still-at-risk.pdf

Ediger, M. (2004). Psychology of lesson plans and unit development. ***Reading Improvement, 41*****, 197-207.**

Epstein, J.L. and Salinas, C. (2004). Partnering with families and communities [Electronic version]. *Educational Leadership*, 61 (8), 12-18.

ERIC Clearinghouse on Assessment and Evaluation College Park. (1999) *A Nation Still at Risk* Retrieved January 12, 2009 from http://www.ericdigests.org/1999-4/risk.htm

Forehand, M. (2005) *Bloom's taxonomy from emerging perspectives on learning, teaching, and technology* Retrieved January 12, 2009 from http://projects.coe.uga.edu/epltt/index.php?title=Bloom%27s_Taxonomy

Fredericks, A.D. (2005). *The complete idiot's guide to success as a teacher.* New York: Penguin Group.

Fries-Gaither, J. (2008). *Questioning techniques: Research-based strategies for teachers* Retrieved April 3, 2009 from http://onramp.nsdl.org/eserv/onramp:1244/oct08_pl_tas.html

Garcia, M., Sanchez, V., and Escudero, I. (2006). Learning through reflection in mathematics teacher education [Electronic version]. Educational Studies in Mathematics, 64 (1), 1-17.

Glod, M. (2008). Panel urges schools to emphasize core math skills Retrieved March 17, 2008 from http://www.washingtonpost.com/wpdyn/content/article/2008/03/13/AR2008031301492.html

Guskey, T. R. (2003). *How classroom assessments improve learning* Retrieved December 30, 2008 from http://pdonline.ascd.org/pd_online/teachbehave2/el200302_guskey.html

Herman, J.L. & Baker, E. L. (2005). Making benchmark testing work [Electronic version]. *Educational Leadership*, 63 (3), 48-54.

Holland, R. (2004). *To build a better teacher: The emergence of a competitive education industry*. Westport, CT: Praeger.

Holland, R. (2005) *Merit pay for teachers: Can common sense come to public education?* Retrieved January 24, 2009 from http://www.lexingtoninstitute.org/docs/708.pdf

Hunter, M. (1985). What's wrong with madeline hunter. ***Educational Leadership, February*, 57-60.**

Hussey, J. and Allen, J. (2006). The American education diet: Can U.S. students survive on junk food. Retrieved November 22, 2008 from http://www.edreform.com/_upload/CER_JunkFoodDiet.pdf

Hyde, A. (2007). Mathematics and cognition [Electronic version]. *Educational Leadership*, 65 (3), 43-47.

Janzen, H. (2005). Helping English language learners in the math classroom Retrieved November 9, 2007 from http://www.glencoe.com/sec/teachingtoday/subject/help_ELL_math.phtml

Karwasinski, P. and Shek, K. (2006) *A guide to the no child left behind act* Retrieved January 19, 2009 from http://www.centerforpubliceducation.org/site/pp.aspx?c=kjJXJ5MPIwE&b=1505669&printmode=1

Ketterline-Geller, L.R., Jungjohann, K., Chard, D.J., & Baker, S. (2007). From arithmetic to algebra [Electronic version]. *Educational Leadership*, 65 (3), 66-71.

Kizlik, B. (2009) *Six common mistakes in writing lesson plans and what to do about them* Retrieved January 15, 2009 from http://www.adprima.com/mistakes.htm

Kumar, R. and Lightner, R. (2007). Games as an interactive classroom technique: Perceptions of corporate trainers, college instructors, and students. ***International Journal of Teaching and Learning in Higher Education***, ***19*****, 53-63**.

Linik, J.R. (2005) *When the music stops: The cost of nclb's data demands* Retrieved January 1, 2009 from http://www.nwrel.org/nwedu/10-04/stop/

Lips, D. (2008) *A nation still at risk: The case for federalism and school choice* Retrieved October 4, 2008 from http://www.heritage.org/Research/education/bg2125.cfm

Lu, K. (2005) *Cost study finds nclb underfunded in virginia* Retrieved January 1, 2009 from http://www.schoolfunding.info/news/federal/9-23-05VAnclbcoststudies.php3

Marsh, J.A., Pane, J.F., and Hamilton, L.S. (2006) *Making sense of data-driven decision making in education* Retrieved December 29, 2008 from http://www.rand.org/pubs/occasional_papers/2006/RAND_OP170.pdf

McColskey, W. and McMunn,N. (2000). *Strategies for dealing with high-stakes state tests [Electronic Version]. Phi Delta Kappan*, 82 (2), 115-120.

McGraw Hill Wright Group. (n.d.) *How everyday mathematics offers a better approach to mathematics mastery* Retrieved October 21, 2009 from http://www.everydaymathsuccess.com/pdf/EM_InstructionalDesign.pdf

McTighe, J. & O'Connor (2005). Seven practices for effective learning [Electronic version]. *Educational Leadership*, 63 (3), 10-17.

Mentoring Minds (n.d.). *Research for mentoring minds' critical thinking wheel* Retrieved October 22, 2008 from http://www.mentoringminds.com/critical-thinking-wheel.php

Mott, D. (2001). *Validity and reliability statement tests for higher standards* Retrieved June 19, 2007 from http://www.tfhs.net/validity.pdf

Munday, J. B. (2001). *Applying bloom's taxonomy to teaching and testing* Retrieved April 3, 2009 from http://www.hishelpinschool.com/specneeds/Bloom.html

Murray, B. (2002). *The new teacher's guide to creating lesson plans* Retrieved February 28, 2009 from http://www2.scholastic.com/browse/article.jsp?id=3749707

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics.* Reston, VA: Author.

Newton, D.P. and Newton, L.D. (2006). Could elementary mathematics textbooks help give attention to reasons in the classroom [Electronic version]. *Educational Studies in Mathematics*, 64 (1), 69-84.

Paris, D.C. (1995). *Ideology and educational reform: Theories and themes in public education*. Boulder, CO: Westview Press.

Pearson Education. (2008). *Reach/teach the digital natives success maker* Retrieved January 16, 2009 from http://www.pearsonschool.com/live/assets/200827/SM_core_broch_pagination_10161_1.pdf

Peterson, P.E. (2003). *Our schools and our future*. Standford, CA: Hoover Institution Press.

Pilcher, J. K. and Largue, R. 2007-02-24 "Teacher Classroom Assessment Competence and Performance Indicators: A Question Mark" *Paper presented at the annual meeting of the American Association of Colleges for Teacher Education, Hilton New York, New York, NY Online* <PDF>. 2008-12-11 from http://www.allacademic.com/meta/p142678_index.html

Popham, W.J. (2001) *The truth about testing*. Alexandria, VA: Association for Supervision and Curriculum Development.

Popham, W.J. (2003) *Test better, teach better: The instructional role of assessment*. Alexandria, VA: Association of Supervision and Curriculum Development.

Qaisar, S. (2001). *Scholary teaching: Application of bloom's taxonomy in kentucky's classrooms*. Retrieved January 12, 2009 from http://eric.ed.gov/ERICDocs/data/ericdocs2sql/content_storage_01/0000019b/80/1a/ac/5e.pdf

Qaisar, S. (1999). *Evaluation of first-year teachers' lesson objectives by bloom's* *taxonomy*. Retrieved January 12, 2009 from http://eric.ed.gov/ERICDocs/data/ericdocs2sql/content_storage_01/0000019b/80/15/fa/63.pdf

Rettig, M.D., McCullough, L.L., Santos, K., & Watson, C. (2003). A blueprint for increasing student achievement [Electronic version]. *Educational Leadership*, 61, (3), 71-76.

Richardson, J. (2002) *Leave no teacher behind* Retrieved January 1, 2009 from http://www.nsdc.org/library/publications/results/res9-02rich.cfm

Rimbey, K. (n.d.) *The language in math: Strategies for developing math vocabulary* Retrieved November 12, 2008 from http://smu.edu/education/Language%20in%20math.pdf

Rivera, F.D. (2006). Changing the face of arithmetic: Teaching children algebra [Electronic version]. *Teaching Children Mathematics*, 12 (6), 306-311.

Ryan, J.E. (2004). *The perverse incentives of the no child left behind act* Retrieved January 19, 2009 from http://www3.law.nyu.edu/journals/lawreview/issues/vol79/no3/NYU303.pdf

Scherer, M. (2007). Perspectives: Speaking of math [Electronic version]. *Educational Leadership*, 65 (3), 7-7.

Schifter, D. (2007). What's right about looking at what's wrong [Electronic version]. *Educational Leadership*, 65 (3), 22-27.

SchoolMatters. (2008). Retrieved April 2008 from http://www.schoolmatters.com/schools.aspx/q/page=hm

Schools Moving Up. (n.d.) *Professional development* Retrieved January 2, 2009 from http://www.schoolsmovingup.net/cs/nclb/view/nclb/12

Shanahan, T., Hyde, K., Mann, V. & Manrigque, C. (n.d.) *Integrating curriculum guides, quarterly benchmark assessments, and professional development to improve student learning in mathematics* Retrieved Jun 9, 2007 from http://hub.mspnet.org/media/data/UCI_MSP_Pres_091505.pdf?media_000000002061.pdf

Shellard, E. (2005). *How assessment data can improve instruction* Retrieved December 29, 2008 from http://www.naesp.org/resources/2/Principal/2005/J-Fp30.pdf

Steen, L. A. (2007). How mathematics counts [Electronic version]. *Educational Leadership*, 65 (3), 8-14.

Sugar, S. (2008). *Ten of the very best reasons for using classroom games and for justifying their use in your organization* Retrieved February 5, 2009 from http://www.thegamegroup.com/article1.htm

Supon, Viola. (2008, September 1). High-stakes testing: strategies by teachers and principals for student success **The Free Library**. (2008). Retrieved January 19, 2009 from http://www.thefreelibrary.com/High-stakes testing: strategies by teachers and principals for...-a0188351825

Tankersley, K. (2007). *Tests that teach: Using standardized tests to improve instruction*. Alexandria, VA: Association for Supervision and Curriculum Development.

Tanner, D. & Tanner, L. (1990). *History of the school curriculum*. New York, NY: Macmillan Publishing Company.

Trim, D. (n.d.) *How to create an effective lesson plan* Retrieved February 22, 2009 from http://www.insidetheschool.com/how-to-create-an-effective-lesson-plan

Trimble, S., Gay, A., and Matthews, J. (2005) *Using test score data to focus instruction*

Retrieved February 12, 2008 from http://www.evansnewton.com/News/Customer%20News/Camden%20MSJ.pdf

University of Michigan (2007). Parents want teachers who make children happy, usually Retrieved January 24, 2009 from http://michigantoday.umich.edu/2008/jan/teachers.php

Vidakovic, D., Bevis, J., and Alexander, M. (2004). *Bloom's taxonomy in developing assessment items* Retrieved January 11, 2008 from http://mathdl.maa.org/mathDL/4/?pa=content&sa=viewDocument&nodeId=504&pf=1

Virginia Department of Education (2000). *A study of effective practices in virginia schools* Retrieved November 27, 2009 from http://www.doe.virginia.gov/VDOE/Accountability/effectivepractice.pdf

Virginia Department of Education (2008). *Standards of quality resolution from the board of education to the governor and general assembly* Retrieved January 24, 2009 from http://www.doe.virginia.gov/info_centers/superintendents_memos/2008/12_dec/inf297.html

Virginia Department of Education (n.d.a). *Standards of learning currently in effect for virginia public schools* Retrieved September 16, 2008 from http://www.doe.virginia.gov/go/Sols/home.shtml

Virginia Department of Education (n.d.b). *Virginia school report card: Accountability terminology* Retrieved September 16, 2008 from http://www.doe.virginia.gov/VDOE/src/terminology.shtml

Virginia Department of Education (n.d.c). *Virginia school report card: Accountability* *and virginia public schools* Retrieved June 18, 2007 from http://www.doe.virginia.gov/VDOE/src/vps-accountability.shtml

Virginia Department of Education (n.d.d). *Understanding adequate yearly progress* Retrieved June 18, 2007 from http://www.doe.virginia.gov/VDOE/src/vasrc-understandingayp.shtml

Wagaman, J. (2008) *Encourage student thinking with questions: Different questions that promote higher level thinking* Retrieved April 2, 2009 from http://lesson-plan-help.suite101.com/article.cfm/encourage_student_thinking_with_questions

Waxler, A. (2005). *Bloom's Taxonomy* Retrieved January 12, 2009 from http://www.teaching-tips-machine.com/blooms_taxonomy.htm

Wong, M. and Evans, D. (2007). Improving basic multiplication fact recall for primary school students [Electronic version]. *Mathematics Education Research Journal*, 19 (1), 89-106.

Appendix A

Educational Research Project

2007-2008

Project Security Agreement

I understand that these materials are highly secure. I understand it is my professional responsibility to protect the project materials as follows:

1. I will not copy any part of the project without written permission of the Research Coordinator.

2. I will not reveal the contents of the project to anyone.

3. I will not modify the lesson plans as written.

4. I will not allow the access of project materials to any unauthorized person. Written authorization must be from the Research Coordinator.

Please be sure to sign and return the *Project Security Agreement* to the Research Coordinator.

Signed: ____

Print Name: ____

Position: ____

School: ____

Division: ____

Date: ____

Appendix B

Educational Research Project
2007-2008

Examiner Test Security Agreement

I understand that these materials are highly secure. I understand it is my professional responsibility to protect the test materials as follows:

1. I will not review test items or test booklets, copy or take notes about any part of the test.

2. I will not reveal the contents of the test to anyone.

3. I will not provide answers to test items or modify students' responses.

4. I will not provide unauthorized assistance.

5. I will not allow test materials access to any student or other unauthorized person. Written authorization must be from the Research Coordinator.

All individuals involved in transcriptions of student responses must also read and sign the test security agreement.

Please be sure to sign and return the *Examiner Test Security Agreement* to the Research Coordinator.

Signed: ____

Print Name: ____

Position: ____

School: ____

Division: ____

Date: ____

Appendix C

Lesson Number: Subject: Teacher: Grade: Lesson Duration:

Overview:	Administrator's Objective:

	Teacher Activities	Student Activities	
SOL Objectives ☐ Knowledge ☐ Comprehension ☐ Application ☐ Analysis ☐ Synthesis ☐ Evaluation			**Technology Integration**
Procedures **Verification** ☐ Oral ☐ Questions ☐ Writing ☐ Project ☐ Performance ☐ Test			**Materials Needed**

Lesson Number: Subject: Teacher: Grade: Lesson Duration:

Differentiation ☐ Station Teaching ☐ Team Teaching ☐ 1 Teach/ 1 Observe ☐ 1 Teach/ 1 Assist ☐ Parallel Teaching ☐ Alternative Teaching			
Assessment Method ☐ Teacher Observation ☐ Portfolio ☐ Test ☐ Class Participation ☐ Group Participation ☐ Project/ Product			**Collaboration**
Literature Connection			
Additional Resources			

Appendix D

Developing Effective Questions Worksheet

Topic Identifier: ___________________________________

SOL Framework Identifier:	Bloom's Taxonomy Identifier:
	Knowledge:
	Comprehension:
	Application:
	Analysis:
	Synthesis:
	Evaluation: