ALTERNATIVE METHODOLOGIES FOR TEACHING MATHEMATICS TO ELEMENTARY STUDENTS: A PILOT STUDY USING CHILDREN'S LITERATURE

By

André Sandell Morgan

Submitted to the

Faculty of the College of Arts and Sciences

of American University

in Partial Fulfillment of

the Requirements for the Degree of

Doctor of Philosophy

In

Education

Chair:

Frederic Jacobs, Ph.D.

Cathy Crocker, Ed.D.

Kim Archung, Ph.D.

Dean of the College of Arts and Sciences

20 December 2006

Date

2006

American University

Washington, D.C. 20016

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ABSTRACT

The reform of mathematics education in the Unites States has been debated for many years. Although many mathematics educators concur about the objectives of reform, there is less agreement about the variety and efficacy of methodologies which can be used to improve classroom instruction and student learning.

One such methodology, suggested by Boidy (1994), is to employ storytelling as an instructional strategy in teaching mathematics. According to Boidy, storytelling is a strategy in which children's literature is integrated into the mathematics curriculum. He asserts that storytelling can lead to higher student achievement, and more positive attitudes toward learning mathematics.

In this study, storytelling, through the use of specific selections of children's literature, was implemented in two elementary schools, one private school located in Houston, Texas, and one public school located in Baltimore, Maryland. The total target population (N = 72) consisted of four third grade classes (two classes in each school). Thirty-six students were taught mathematics using storytelling; the remaining thirty-six

students were taught mathematics using traditional methods. Improvement in the following instructional goals had been previously established for the period of the interventions: 1) two and three digit multiplication, and 2) two and three digit division.

The primary hypothesis for this study was that the use of children's literature as a form of storytelling in elementary mathematics classrooms could be an effective method for teaching students to solve numerical and word problems, and should be considered as one of the methodologies that can be used in teaching mathematics. The purpose of this research was to demonstrate that a variety of methodologies could be employed to help students in mathematics.

Of the thirty-six students in the pilot groups, 84.3% benefited from storytelling. All students were given pre-tests and post-tests to compare prior knowledge and skills learned. The pilot groups were also given attitude surveys, and participated in focus groups to obtain perceptions of storytelling. A one-way analysis of variance (ANOVA) was used to analyze significant differences between the pilot and control groups ($p < .05$). Regression analysis of the pre- and post-test scores was conducted to determine if storytelling improved mathematics learning and achievement. Responses to the attitude surveys were analyzed via frequencies.

The findings indicated that the use of children's literature in storytelling is an effective instructional strategy to help elementary students become more interested in learning mathematics, improve skills in solving numerical and word problems, and increase achievement levels in mathematics.

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I thank God for seeing me through this project. Without Him, this degree would have been impossible. Second, I thank my wife, Lisa and son, Justin, who understood how important this degree was and supported me every step of the way.

I also thank my mother, Sandra Moore, mother-in-law, Sylvia Law, brother-in-law, Steven Law, cousin, Barbara Patterson, and friends, Versie Cuthbert and Guillermo Caesar, for all that they did to move me towards the completion of this project.

I would like to express my gratitude to my dissertation committee members, Dr. Frederic Jacobs, Dr. Lynn Fox, Dr. Cathy Crocker, and Dr. Kim Archung. Their guidance, recommendations, and suggestions were appreciated and served as an integral part of this dissertation.

CHAPTER 1

BACKGROUND AND PURPOSE

Introduction

Since the publication of *A Nation at Risk* (National Commission on Excellence, 1983), improving the academic achievement levels of U.S. American students remains at the top of the national policy making agenda. The concern of many policymakers is that numerous U.S. American students have not received the kind of education they need to meet the challenges of twenty-first century life. Academic achievement in the U.S. continues to be linked to the state of the economy and competitiveness in the global market. Since *A Nation at Risk* was published, many schools (public and private), and school districts nationwide have been engaged in reform efforts to improve student achievement in core subject areas, particularly in mathematics.

The National Council of Teachers of Mathematics (NCTM, 1989), the nation's largest mathematics education organization, acknowledged the conclusions and responded to *A Nation at Risk* by developing national mathematics standards for all primary and secondary grade levels. The NCTM standards reflect five goals: (1) that all students learn to value mathematics; (2) that all students become confident in their own abilities to do mathematics; (3) that all students learn to solve mathematical problems;

(4) that all students learn to communicate mathematically; and (5) that all students learn to reason mathematically. The standards collectively describe a high-quality mathematics education, which according to the NCTM will help to develop mathematical power for all students.

The NCTM (1989) defines mathematical power as the ability to conjecture, explore, and reason logically; to communicate about and through mathematics; to solve non-routine problems; and to connect ideas within and between mathematics and other intellectual entities. Mathematical power also involves the development of personal self-confidence and a disposition to seek, evaluate, and use quantitative and spatial information in solving problems and in making decisions. The NCTM believes the best way for all students to develop mathematical power is through "the creation of a curriculum and an environment, in which teaching and learning is to occur, that are very different from much of current practice" (p.3).

The NCTM (1989) recommends that mathematics learning environments promote active learning; the idea of active learning is conveyed in the five goals acknowledged in the national standards. In line with the NCTM national standards, researchers Newmann and Wehlage (1993) identify five qualities that characterize active learning:

- Higher-order thinking. Students combine facts and ideas in order to synthesize, generalize, explain, hypothesize, or arrive at some conclusion or interpretation.
- Depth of knowledge. Lessons raise the central, defining ideas of a discipline. Students are asked to make clear distinctions, develop arguments, solve problems, and construct explanations.

- Connectedness to the world beyond the classroom. Students address real public problems or use personal experiences as a context for applying knowledge.
- Substantive conversation. Student discussion involves sharing ideas and exchanges. The dialogue builds coherently on participants' ideas to promote improved collective understanding of a theme or topic.
- Social support for student achievement. The classroom's social climate nurtures intellectual risk-taking, hard work on challenging content, the assumption that all students can learn, and mutual respect among all members of the class.

Given these qualities for active learning environments, the NCTM (1989) notes that there are instructional strategies that can be used to foster active learning environments, generate more student interest in mathematics, reduce mathematics anxiety among students, increase student achievement levels, and make mathematics more enjoyable for students.

The NCTM (1989) offers ideas on how mathematics can best be taught. One suggestion is to allow students to engage in purposeful activities that grow out of problem situations, requiring reasoning and creative thinking, gathering and applying information, discovering, inventing, and communicating ideas, and testing those ideas through critical reflection and argumentation. This view is in contrast to the belief of mastering concepts and procedures as the end result of instruction. However, the NCTM does not deny the value and place of mathematical concepts and procedures in the curriculum. The NCTM (1989) notes that the value of mathematics lies in the extent to which it is useful in the course of some purposeful activity.

The NCTM (1989) curriculum Standard Four addresses the need for elementary students to learn and practically apply mathematics in their lives. The emphasis is on mathematical connections that help students recognize how ideas in different areas are related. The NCTM curriculum Standard Four suggests that students may need to be taught mathematics differently if 1) they are to learn mathematics and 2) their achievement levels in mathematics are to improve. While many elementary mathematics educators have embraced the objectives of the NCTM curriculum standard four, the subsequent question asked by these teachers is, "What practice/s is/are related to positive outcomes?" In other words, what activities can be implemented in elementary classrooms to help students learn mathematics and practically apply it in their lives? In response to this question, social science researchers (Abrohms, 1992; Ameis, 2002; Welchman-Tischler, 1992; and Whitin, 1992) have examined alternative methods of instruction (also referred to as instructional strategies) that may get more elementary school students involved and interested in mathematics while simultaneously increasing their achievement levels.

Some researchers have examined and recommended a variety of strategies that identify and accommodate individual learning styles while simultaneously engaging students. This study will focus on one strategy, storytelling, which has been identified as a method of instruction that engages students in mathematics learning.

Background

One common practice in many elementary mathematics classrooms is to have students engage in individualized work with paper and pencil assignments (Secada, 1990;

Thompson, 1992). According to the NCTM (1998) and researchers Stipek, Salmon, Givvin, Kazemi, Saxe and MacGyvers (1998), this instructional method can shut down the math learning process for many students because it does not allow students to become engaged in mathematics. When students are not engaged in mathematics, they do not learn the concepts being taught, and it is likely that they will not apply the efforts that are needed to master mathematics knowledge and skills. Additionally, students do not learn to value mathematics, which is one of the goals identified in the NCTM national standards. Not only can individualized work with repetitive paper-and-pencil assignments facilitate a lack of learning on the part of the student, but it often contributes to low achievement levels in mathematics; hence, underlying the concern of many policymakers that many U.S. Americans do not receive the kind of education that they need to meet the challenges of twenty-first century life (Stipek et al., 1998).

Statement of the Problem

The concern of numerous policymakers is that many U.S. American students have not received the kind of education that they need to meet the challenges of twenty-first century life. According to Secada (1990), the demands of the U.S. American workforce, military needs, participation in government, and shifts in the world's economic systems, demonstrate the need for all U.S. American people to possess strong mathematical skills. Unfortunately, performances on international comparisons of achievement indicate that U.S. students do not possess strong skills in mathematics. For example, data from the Third International Mathematics and Science Study (TIMSS) suggest that the relative international standing of U.S. students declines as they progress through school.

Academic achievement in the U.S. continues to be linked to the state of the economy and the competitive standing in the global market. U.S. policymakers have made the U.S education system responsible for promoting student achievement in what has been defined as the basic knowledge relevant to life in the global market.

Since the 1980's, the NCTM has played a major role in the reformation of mathematics. It created professional standards for teaching mathematics as well as standards for mathematics curriculum and evaluation in order to guide reform in school mathematics. *The Professional Standards for Teaching Mathematics* spells out what teachers need to know in order to teach new goals for mathematics education. *The Curriculum and Evaluation Standards for School Mathematics* is an operational plan for instruction that details what students need to know, how students are to achieve the identified curricular goals, what teachers are to do to help students develop their mathematical knowledge, and the context in which learning and teaching should occur.

Research studies (Abrohms, 1992; Ameis, 2002; Welchman-Tischler, 1992; and Whitin, 1992) have shown that elementary school students can be stimulated in mathematics. Specific research in cognitive psychology, supported by observations in elementary schools, shows that students learn not by passively absorbing information, but by integrating the new ideas that they encounter into their existing knowledge and skills. According to Bernstein (1999), in order to get students excited about mathematics, teachers must create conditions that allow for discovery, whereby children are able to see what they are learning; it is at that point that mathematics becomes meaningful.

While there are several researchers who share similar sentiments to Bernstein (1999), there are also researchers, not in favor of the implementation of alternative instructional strategies. These researchers contend that despite research that examines alternative methods of instruction, there is really little change in the way mathematics classes are conducted today than ten to fifteen (15) years ago (NCTM, 1989; National Research Council, 1989; Weiss, 1989). According to these researchers, many mathematics teachers continue to use traditional methods of instruction that have yielded minimal achievement results. Battista (1999) asks, "How would you react if your doctor treated you or your children with methods that were ten to fifteen years out of date, ignored current scientific findings about diseases and medical treatment, and contradicted all professional recommendations for practice?" The response that Battista gives is that one would not passively ignore such a practice. Yet, that is exactly what happens with traditional mathematics teaching, which according to Batista (1999), Johnson and Packer (1987), and Secada (1990) is still our nation's norm in primary and secondary schools.

Purpose of the Study

This study focuses on increasing mathematics achievement through an alternative instructional strategy, storytelling, using children's literature. The study was designed to investigate methods of using children's literature to teach elementary students how to solve numerical and word problems and increase achievement. Four selections of children's literature were used to help facilitate specific mathematics skills with native English speakers, all of whom were on grade level readers.

Significance of the Study

While researchers (Abrohms, 1992; Ameis, 2002; Welchman-Tischler, 1992; and Whitin, 1992) have examined using children's literature as a strategy in several mathematics content areas, there is little research involving the implementation of storytelling in two and three digit multiplication and two and three digit division. The significance of this study is that it will involve the implementation of storytelling in these two content areas, hence contributing to the existing research citing storytelling as a credible instructional method for mathematics.

The impact of using children's literature on mathematics achievement and numerical and word problem solving skills may inform mathematics teachers, school administrators, teacher educators, and policy-makers about the effectiveness of storytelling as an instructional strategy in two and three digit multiplication and two and three digit division. The identification of this method may be linked to positive outcomes. Additionally, this study may provide a means through which individual schools and school districts may enhance their existing methods of teaching mathematics in elementary school classrooms. Finally, this study may influence educational policy, teacher education programs, teacher staff development, and teacher training by identifying one instructional strategy that can be implemented in the elementary classroom to enhance and improve student learning and achievement. In the long run, this instructional strategy could strengthen our nation's welfare. In a society saturated with quantitative information, according to the NCTM (1998), having strong

mathematical skills, will help students understand and make informed decisions about the things that affect them in this world.

Research Questions

1. How does using children's literature help elementary students solve numerical and word problems?
2. Is the achievement gain in mathematics greater when children's literature is used in the elementary school mathematics classroom?
3. Does using children's literature enhance the attitudes of elementary students towards mathematics when it is employed?

Hypothesis

The use of storytelling, through children's literature in elementary mathematics classrooms, is an effective method for teaching students how to solve numerical and word problems and increasing mathematics test scores. The null hypothesis that will be tested by this study states that there will be no significant difference in the development of numerical and word problem solving skills and no significant difference in the test scores of elementary school students who are exposed to mathematics through storytelling.

Definition of Terms

There are several terms used in this research that require some definition for clarity sake.

Children's Literature — Stories written by authors, whose primary audience is young children.

Classroom Teacher	A certified teacher, who is responsible for teaching a group of children. This person holds at minimum a baccalaureate degree and has fulfilled teacher requirements for the state.
Instructional Strategy	A technique utilized by classroom teachers in order to enable students to achieve success in a mainstream classroom setting.
Mathematics	A field of study that deals with the systematic treatment of magnitude, relationships between figures and forms, and relations between quantities expressed symbolically.
Mathematics Learning	Knowledge acquired by a systematic study in mathematics.
Numerical Problem Solving	The ability to find an answer or a solution to a question about mathematical objects and structures that require explanation.
Storytelling	An instructional strategy whereby children's literature is implanted in the mathematics curriculum to teach mathematics to elementary school children. For the

	purposes of this study, the term storytelling is often used synonymously with children's literature.
Student Achievement in Mathematics	The ability of students to master and practically apply mathematical content on assessments.
Teacher Assistant	A para-professional school staff person who provides instructional support to classroom teachers.
Word Problem Solving	The ability to find an answer to non-routine problems that do not lay out specific and detailed steps to follow.

Limitations

All of the children in this study are native English speakers. There were no students in the private or public schools that spoke English as a second language; hence, it is not possible to generalize whether or not this instructional strategy is effective with populations of students who are English second language learners. A second limitation is that all of the students in this study were reading at the appropriate grade level. There were no students reading on a grade level lower than the third grade. Consequently, the literature selected for this study is designed for readers in the third grade.

Summary of Chapters

This research is organized in five chapters.

Chapter 1 offers an introduction, statement of the problem, research questions, significance of the study and the limitations, and definition of terms that are used throughout the study.

Chapter 2 is a synthesis of the literature reviewed on storytelling as an alternative instructional strategy used in mathematics classrooms.

Chapter 3 includes the hypotheses and methodologies, including the design of the study, the instruments, and the methods of data collection. It also provides an overview of the study and describes the research procedures. The types of data analyses to be used in evaluating the significance are also described.

Chapter 4 consists of the presentation of descriptive data of the sample, the statistical analysis of the hypotheses, and an exploration of the relationship between identifying and constructing the appropriate courses of action.

Chapter 5 contains the conclusions, implications of this study, and recommendations for further research.

CHAPTER 2

LITERATURE REVIEW

Introduction

The demands of the American workforce, military needs, participation in government, and shifts in the world's economic systems demonstrate the need for all U.S. American citizens to possess strong mathematics skills (Secada, 1990). Johnson and Packer (1987), Secada, and Reyes (2002) believe that if some type of reform is not undertaken in mathematics education, disparities in academic achievement, and careers are likely to increase, resulting in the creation of a permanently unemployable underclass who will represent a threat to the U.S. economic well-being and who will strain the country's legal and social systems.

Since the publication of *A Nation at Risk* (National Commission on Excellence, 1983), improving the academic achievement levels of students remains at the top of the U.S. national policy making agenda. According to Brown and Walberg (1993), parents, educators, business people, politicians and the general public continue to be concerned about the poor performance of U.S. students on international comparisons of achievement, particularly in mathematics.

In response to *A Nation at Risk* (1983), national mathematics standards were developed by the National Council of Teachers of Mathematics (NCTM), currently the nation's largest mathematics education organization. Since the 1980s, the NCTM has

played a major role in the reformation of mathematics. The NCTM standards reflect five (5) goals: that all students learn: (1) to value mathematics, (2) become confident in their own abilities to do mathematics, (3) to solve mathematical problems, (4) to communicate mathematically, and (5) to reason mathematically (1989, 2000). The NCTM (1989) believes that the best way for students to effectively learn mathematics is through the creation of a curriculum and an environment where the teaching and learning that occurs is different from much of current practice. Mathematics instruction, according to Thompson (1992) should engage students in purposeful activities that grow out of problem situations, requiring reasoning, creative thinking, gathering and applying information, discovering, inventing, communicating ideas, and testing those ideas through critical reflection and argumentation.

The NCTM curriculum Standard Four addresses the need for elementary students to learn and practically apply mathematics in their lives. The emphasis is on mathematical connections that help students recognize and apply what they learn to real life situations. The NCTM curriculum Standard Four suggests that students may need to be taught mathematics differently 1) if they are to learn, understand, and apply mathematics and 2) if their achievement levels in mathematics are to improve. While many elementary mathematics educators have embraced the objectives of the NCTM curriculum Standard Four, the subsequent question asked by these educators is, "What practice/s is/are related to positive outcomes?" In other words, what activities can be implemented in elementary classrooms to help students learn and achieve in mathematics and then practically apply these skills in their lives?

One common practice in many elementary mathematics classrooms is to have students perform paper and pencil assignments. The reason for this is twofold: (1) mathematics is a subject where students must start at a particular point and build on what they have learned in previous lessons and (2) the answer to a mathematics problem is either 100% right or 100% wrong; there is no such thing as a partially correct answer. The emphasis in mathematics is on correct answers; little attention is given to helping students develop conceptual ideas, or to connecting the procedures that they learn with the concepts (Secada, 1990, Thompson, 1992).

A problem with mathematics instruction in general, and especially for young children, is students are asked to do mathematics activities that have little intrinsic meaning and interest to them aside from deriving a correct answer. This problem, according to Secada (1990) and Thompson (1992) becomes more evident when students try to practically apply what they were supposed to have learned without much depth of conceptual understanding. Consequently, many students become disengaged and disinterested and begin to view mathematics as boring and irrelevant to their learning. An inferred message from the NCTM (1989, 2000) curriculum Standard Four is that it is not enough anymore to simply have students memorize facts and perform paper and pencil assignments in mathematics. According to Reyes (2002), if schools continue to do more of what they have always done, they will continue to produce too many students who are uninterested and unmotivated to learn mathematics.

The Reform of Mathematics Education

For years, there has been much discussion about the need to reform mathematics education in the U.S. Mathematics reform has become a pivotal movement to improve mathematics education through varying standards which focus on improving instruction and on improving the student as a learner. Mathematics reform is not a new idea, but it has been gaining momentum since the late 1950s when the Soviet Union launched the Sputnik 1 satellite in 1957. In 1958, Congress passed the National Defense Education Act (NDEA) in response to the launching of the Sputnik 1 satellite. The goal of the NDEA was to help ensure that highly trained individuals would be available to help the U.S. compete with the Soviet Union in scientific and technical fields (U.S. Department of Education, 1999). The U.S. also passed the Elementary and Secondary Education Act (ESEA) in 1965; it was a federal commitment to finance public education. Again, the goal was to help ensure that the U.S. would have highly trained individuals to compete globally in scientific and technical fields.

The impact from the 1950s was evident at the beginning of the 21st Century in the national education goals. The U.S. continues to hold fast to its commitment to make considerable strides in the scientific and technological world, but according to Reyes (2002), U.S. students continue to fall way behind the rest of the world in science and technology. In 1989, President George H.W. Bush and the governors of the fifty states met in Charlottesville, Virginia, for the first National Education Summit. Out of this meeting came a renewed federal commitment to improving educational achievement and increasing the nation's commitment to students, teachers, and schools.

U.S. governors adopted six goals that were incorporated into the Goals 2000: Educate America Act (U.S. Department of Education, 1999). America 2000 National Education Goals, numbers three and five deal specifically with student achievement in mathematics. Under the Goals 2000: Educate America Act (1994), individual states are tasked to develop education improvement plans that include strategies for ensuring that comprehensive, systemic reform is promoted from the bottom up in communities, local educational associations, and schools, as well as guided by coordination and facilitation from state leaders.

The quest for mathematics reform continued beyond the Goals 2000: Educate America Act. Signed by President George W. Bush on January 8, 2002, the No Child Left Behind Act of 2001 (NCLBA) was made a law. This reform was created in an attempt to improve the academic performance of America's primary and secondary school students, particularly in mathematics and science. The NCLBA (2002, P.L. 107-110) is grounded in a framework that U.S. students must develop functional mathematics skills if they are to compete in a global, technologically-oriented society. This act prescribes high standards, accountability for all, and the belief that all children can learn, regardless of their background or ability.

Milbank (2002) states that the NCLBA is considered to be the most ambitious and significant overhaul of the Elementary and Secondary Education Act (ESEA) because for the first time in U.S. history, Congress has ruled, with overwhelming bi-partisan support, that state governments are responsible for the achievement of all of their children. States are now required to test 95% of their students each year to ensure that minimum state

standards are met. The challenge is that by 2014, states are required to ensure that 100% of their students meet minimum state standards (2002, P.L. 107-110). This type of federal control undoubtedly sets a new standard for mathematics education reform. Not since the Brown vs. The Board of Education (1954) decision when the Supreme Court ruled segregation unconstitutional, have schools across the nation been so affected by a federal ruling (Milbank, 2002).

Social science researchers, who support the NCLBA and mathematics reform in general believe that the NCLBA is an effort to realize the vision of *A Nation at Risk* (1983), and a vehicle that promotes changes in the way that mathematics is taught in classrooms around the country (Milbank, 2000). These social science researchers maintain that mathematics teaching should not only be about explaining content, but about engaging students in the processes of doing and applying mathematics. Social science researchers have also suggested that mathematics educators reform how mathematics is taught if students are to experience positive outcomes in mathematics. In short, the mathematics education reform movement requires students to learn differently and teachers to teach differently.

Mathematics educators across the U.S. continue to ask, "What practice/s is/are related to positive outcomes?" As a result of the mathematics reform movement, social science researchers have begun to examine instructional strategies that could be implemented in elementary mathematics classrooms; strategies that encourage students to learn mathematics and are linked to positive outcomes.

There are several strategies that have been studied and are currently being implemented with students in elementary mathematics classrooms. This research will focus on one of these instructional strategies, storytelling.

Student Achievement in Mathematics

In general terms, student achievement refers to the level of success or proficiency (of a student) in relation to a standard measure of performance, or of success in bringing about a desired end. An issue that continues to plague U.S. schools is the decline of mathematics achievement and the subsequent failure of children to acquire functional mathematics skills.

There has been a national concern with mathematics achievement since 1969. It was in this year that the National Assessment of Educational Progress (NAEP) was introduced. The purpose of the NAEP is to measure student achievement in several content areas, including mathematics. Since 1969, the NAEP has conducted ongoing assessments of achievement in mathematics for students in both public and private schools. In addition, NAEP documents the extent to which education reform has been implemented. The Digest of Education Statistics (1995) and the National Center for Education Statistics (2003) reveal that in the last ten years, overall NAEP mathematics scores show small to modest gains for nine year old students, which is the age of many of the participants in this study.

Over the years, social science researchers have attributed the lack of student achievement in mathematics to many factors including gender, race, socio-economics, and instructional environment, to name a few. Despite the attributing factors, some social

science researchers (Abrohms, 1992; Ameis, 2002; Welchman-Tischler, 1992; and Whitin, 1992) support that the manner in which mathematics is being taught is the real culprit to low student achievement. These same social science researchers note that a change in teaching methodology from traditional methods to alternative measures may be what is needed for students to learn and apply mathematics.

Uguroglu and Walberg (1979) note that as students become more involved in their learning, they develop a connection between knowledge and their lives. Subsequently, they are able to apply what they have learned to all aspects of their daily living. Uguroglu and Walberg also suggest that as teaching styles and learning activities change in the classroom to encourage students to become more involved in their learning process, the achievement levels of students will increase. In other words, if the teaching methods change, so will student achievement.

Kilpatrick (1992) also believes that student learning and achievement are correlated to changes in instructional methodology. Kilpatrick notes that the use of alternative instructional strategies can significantly influence student learning and achievement. He also explains that teaching that incorporates students' intuitive solution methods can increase student learning in mathematics, especially when combined with opportunities for student interaction, discussion, and application. Kilpatrick mentions storytelling as an effective alternative strategy and notes that storytelling provides an opportunity for interaction, discussion, and application; hence, the use of storytelling as an instructional strategy may facilitate student achievement in mathematics.

Grouws and Cebulla (2000) note that if achievement levels in mathematics are to increase, teachers must ensure that students are given different opportunities to learn. The researcher's further note that opportunities for learning are more likely to occur when the method of instruction is adjusted, thereby meeting the learning needs of students who do not learn mathematics through individual work with repetitive paper and pencil assignments. If U.S. students do not develop functional mathematical skills at an early age, it is likely that they may not develop functional skills in later years; hence, they will not be able to compete in a global, technologically-oriented society as adults.

Grouws and Cebulla further note that if traditional instructional practices are ineffective with students, elementary mathematics teachers may consider changing the instructional methods so that students have a greater opportunity to learn mathematics. If the instructional methods change, achievement levels may increase; thus, the use of storytelling may facilitate student achievement in mathematics.

According to Marzano, Gaddy, and Dean (2000), teachers can make a difference in student achievement through their choice of instructional strategies. Alternative instructional strategies can help teachers increase the amount of time that students are actively engaged in learning. The researchers note that when students are actively engaged in mathematics, they are more apt to become proficient in that content area; this in turn can lead to greater achievement gains. Marzano, Gaddy, and Dean also note that the use of alternative instructional strategies allows students to practically apply what they are learning at the time so that they reap the maximum benefits of instruction.

The Center for Education (2001) comments that if elementary mathematics teachers focus instruction on the meaningful development of mathematical ideas, student learning is likely to increase and mastery is likely to occur. Instructional methods that emphasize conceptual development, with the goal of developing students' understanding, will facilitate significant mathematics learning gains.

According to the Rand Mathematics Study Panel (2003), mathematics teachers may consider implementing alternative methods of instruction in their classrooms if student achievement is to occur. The researchers note that many mathematics teachers talk about concepts and procedures to students, give them related practice drill exercises, and immediately expect them to understand. However, students hear the concepts and procedures, but they do not understand the concepts and procedures, nor are they equipped to use them in their lives. Hence, students do not become proficient. Instead they become deficient. The Rand researchers suggest the use of alternative instructional strategies in mathematics classrooms; strategies that engage students in problem solving, critical thinking, context learning, and practical application.

The NCTM (1998, 2000) believes that classroom activities have important implications when it comes to achieving excellence in classrooms. Fennema and Franke (1992) suggest that teachers must take their knowledge and somehow change it in their instructional practices so that their students are able to interact with the material and learn. Shulman (1987) states that if teachers transform content knowledge into forms that are pedagogically powerful and yet adaptive to the variations in ability and background

presented by the students, mastery of material will occur. Hence, the use of storytelling as an instructional strategy may correlate to student achievement in mathematics.

The Use of Storytelling as a Construct

Current researchers have concluded that knowledge mastery often develops based on the students' interactions with the subject matter. Many researchers agree that mathematical ideas must be personally constructed by students as they try to make sense of the material. According to the NCTM (1989, 2000), when students construct personal knowledge derived from meaningful experiences, they are much more likely to retain and use what they have learned. According to Waite-Stupiansky and Stupiansky (1998), teachers must create a context to make mathematics relevant. Connections become meaningful in mathematics because children are able to "hook into" new math concepts by connecting them to knowledge they already have. This is known as constructivism.

According to Stahl (1990), constructivism is an approach to teaching and learning based on the premise that learning is the result of mental construction. In other words, students learn by fitting new information together with what they already know. In constructivism, experience provides the basis for gaining new knowledge. According to Stahl (1992), learning is a dynamic, active, problem-solving process, in which existing knowledge is modified, added to, or reconstructed. The implementation of storytelling may provide an experience for students to gain new knowledge and/or reconstruct existing knowledge. Subsequently, storytelling may help students to develop numerical and word problem solving skills and increase mathematics achievement.

The Use of Storytelling as an Instructional Strategy

A current curriculum trend in the education field is to make connections between various disciplines. The use of storytelling is one method that elementary teachers may use to provide their students with a different learning experience in mathematics. According to Smith (1995) and Wicket (2000), storytelling is an ideal vehicle to help students understand the importance of mathematics in their daily lives and one way for teachers to invite children into the world of mathematics. Braddon, Hall, and Taylor (1993) and Coombs and Harcourt (1986) note that storytelling is a powerful medium for placing mathematics in a meaningful context for young students.

Smith (1995) states that the use of storytelling in mathematics instruction provides natural opportunities to make connections between various disciplines. Additionally, storytelling connections with mathematics instruction may provide opportunities for a broader and deeper understanding of mathematics ideas. Boidy (1994) notes that storytelling is a strategy that enhances learning experiences and one that has been shown to lead to higher student achievement and more positive attitudes toward learning mathematics.

According to Ellis (1997), storytelling teaches students higher level thinking skills, which is important in learning mathematics. Storytelling also addresses the needs of students with different learning styles. Storytelling further provides opportunities for building social skills and most importantly, has been shown to build self-esteem, even in the students who are labeled hard to reach. Ellis (1997) further notes that there is no other medium that develops mathematics skills in children as effectively as storytelling.

Research provides some encouraging evidence that the use of storytelling in mathematics can increase numerical and word problem solving skills, student interest, and achievement (Burnett and Wichman, 1997; Hong, 1996; Jennings, Jennings, Richey and Dixon-Krauss, 1992). One study by Lehr (1988) indicates that the use of storytelling in the classroom increases the likelihood of students being able to understand the importance of mathematics in their lives. Reading children's stories also increases the likelihood that students will develop a greater interest in mathematics (1988). According to Welchman-Tischler (1992), children must find mathematics experiences interesting if they are to achieve their mathematical potential. Integrating storytelling in mathematics is one way to potentially accomplish this goal.

Storytelling may be used in several ways as a part of mathematics lessons (Schiro, 1997; Welchman-Tischler, 1992). Schiro (1997) distinguishes using storytelling as a way to integrate mathematics by using the stories as a springboard into mathematics activities. Schiro describes a model that uses storytelling to teach mathematics. In the model, storytelling is introduced to elementary students at the beginning of a mathematics unit. Several stories (all relating to the same topic) are included in a unit. The model, called "mathematics literary criticism and editing," is a problem-solving model that allows children's mathematics and literary development to take place simultaneously. In the model, the stories are read to students who experience, respond to, and solve problems that evolve from the stories.

Welchman-Tischler (1992) also suggests using storytelling as a catalyst into mathematics activities. She notes that the use of stories is most effective when they are

used to provide a context, pose a problem, and then solve a problem. Storytelling should not just be used as a medium of instruction; rather it should be used in a more integrated way. Welchman-Tischler (1992) suggests that following storytelling, discussions and activities should be implemented that are constructed specifically around the story/ies. According to Welchman-Tischler (1992), this is the key to storytelling as an effective strategy in mathematics.

Hopkins (1993) notes that using storytelling as an introduction and supplement to a unit in mathematics instruction has several advantages; it is an effective measure of teaching a mathematical concept to elementary school students, it allows students to make a connection with the content, and it creates an additional opportunity for students to master the content. By incorporating storytelling in a unit, teachers effectively transmit mathematics knowledge to students who learn the material faster and retain it longer.

Storytelling is one way to give mathematics meaning to students. Whitin (1994) notes that using storytelling can help elementary students to realize the situations in which people use mathematics for real purposes. Storytelling can also help students to see how mathematics will be useful to them in the real world (Whitin, 1994). Burns (2002) supports Whitin's assertion by noting that integrating storytelling in a mathematics unit can generate interest in mathematics and also provide contexts that help bring meaning to abstract concepts. According to Burns (2002), the use of storytelling provides a win-win for students and teachers.

Burns (2002) suggests that mathematics teachers, who choose to integrate storytelling, select a book and "just dive in." According to Burns, mathematics teachers should read the story/stories aloud to their classes and then discuss them like any other book. Afterwards, mathematics teachers should introduce a mathematics activity or a series of mathematics activities. Burns (2002) recommends that mathematics teachers keep the emphasis of storytelling on the students' reasoning by asking students to communicate their thinking and solutions, and encouraging discussion among students.

In her own experiences as an elementary mathematics teacher, Burns (2002) used traditional and original literature to teach students how to solve numerical and word problems. Burns (2002) states that after storytelling is introduced in a unit, students performed better on assignments and assessments. One advantage of storytelling, according to Burns (2000), is that the stories engaged students and helped them to understand the concepts; it also made instruction easier on her as the teacher and made mathematics fun for students to learn.

Linking Storytelling to Numerical and Word Problem Solving Skills

One area of mathematics instruction that has been emphasized in recent years is to help students to develop numerical and word problem solving skills. According to researchers (Burns, 2002; Whitin, 1994, 2000; & Hopkins, 1993), storytelling is a great tool to support the learning of numerical and word problem solving. Burns (2002) and Hopkins (1993) note that the book/s may act as word problems, whereby students provide a solution. This may be of some interest to children. Storytelling is also a way to guide

children toward constructive personal values by vicariously placing the listener in situations where the outcome of both wise and unwise actions and decisions can be experienced by way of the imagination (Burns, 2002; Whitin, 1994; & Hopkins, 1993).

According to Braddon, Hall, and Taylor (1993) and Sigurdson and Olson (1992), there are many children's stories that can sharpen numerical and word problem solving skills and demand analytic thinking and logic with elementary students. Stories can explain mathematics and technological principles in an understandable fashion versus individualized work with repetitive paper and pencil assignments. Storytelling may also present the explanations to make sense of the natural world and offer mathematics based story problems that actually make sense (Braddon, Hall, and Taylor, 1993; Sigurdson and Olson, 1992).

Beatty (1994) also notes the effectiveness of using storytelling to help students to develop numerical and word problem skills. The use of story characters to pose mathematics problems harnesses the excitement and imagination of the children and directs that energy towards mathematics learning. When the reason for solving a mathematics problem is intertwined with young children's fascination with fantasy as well as their love of being playful, they will put all their energies into solving the mathematics problems. Thus, the mathematics problems in the stories become relevant and "real" to the children because they are presented within a meaningful, story-based context. Finding solutions to the mathematics problems are of key importance to the characters in the story, and, thus, to the children (Beatty, 1994).

An example of one book that has been cited by several social science researchers to teach numerical and word problem solving skills to elementary students is Pat Hutchins (1986), *The Doorbell Rang*. The mother, "Ma," has made a big plate of cookies and the two children are just about to share them when the doorbell rings. Each ring of the doorbell brings more people who must share the cookies. As the story progresses, more and more friends arrive. The children must continually figure out how many cookies each person should receive. According to Burns (2002), sharing cookies is a situation with which all school children can relate. Additionally, it helps to teach numerical and word problem solving skills (and division) to elementary students.

Another example of a book that has been cited by social science researchers to teach children numerical and word problem solving skills is Stuart Murphy's (2003), *Double the Ducks*. In this story, a little boy cares for five small ducks and discovers that it is not an easy job. Each of the little ducks comes home with a duck friend and both the ducks and the workload doubles. The little boy tries to figure out how to care for ten ducks. According to Murphy (2000), understanding how to double numbers helps children master addition and multiplication while simultaneously teaching numerical and word problem solving skills.

Linking Storytelling to Achievement

Orr (1997) states that listening to stories improves student achievement in mathematics; it teaches students to use words as symbols to create something in the imagination beyond what is immediately observable. In other words, students are able to make greater connections to mathematics content through stories than they can through

individualized work with repetitive paper and pencil assignments. According to Orr (1997), this ability to use symbols to create something new is the same skill used for learning mathematics. Orr (1997) notes that storytelling helps develop students' understanding of mathematics and helps them to apply it in their lives accordingly.

Healy (1990) reports there is a correlation between storytelling and student achievement. In the book, *Endangered Minds*, Healy (1990) discloses a study conducted by social science researchers from the Ontario Institute for Studies in Education (OISE) on the connection between storytelling and student achievement in several content areas, including mathematics. According to Healy, the researchers conducted a multi-year study that followed children from pre-school through elementary school examining achievement based on exposure to storytelling. The researchers found that achievement levels were higher among those students who were exposed to stories and noted that the more time students spent listening to stories, the higher their levels of achievement. The researchers concluded that storytelling was an effective strategy in increasing achievement levels among elementary students.

According to Hiebert and Carpenter (1992), storytelling is one approach that helps to increase student achievement. It allows students an opportunity to mentally construct and translate information into a format that is appropriate to the learner's current state of understanding. Through storytelling, students learn and master content by fitting new information together with what they already know. The authors note that the use of storytelling is an effective strategy in increasing achievement levels among elementary students (1992).

Research on the Use of Storytelling to Teach Numerical and Word Problem Solving Skills and Increase Achievement with Elementary Students in Mathematics

Linking mathematics instruction to storytelling has become increasingly popular in recent years. Some researchers suggest that the literature connection provokes mathematics interest (Welchman-Tischler, 1992), helps students to connect mathematics ideas to their personal experiences, accommodates children with different learning styles, promotes critical thinking skills (Murphy, 2000), and provides a context for using mathematics to solve problems (Jacobs and Rak, 1997; Melser and Leitze, 1999).

Reading stories to young students is generally thought to be important for their language and literacy development (Karweit and Wasik, 1996), but researchers who have conducted studies on instructional strategies in elementary mathematics classrooms have found that the effects of storytelling have strong benefits on mathematics development as well. A review of the literature unveiled the following studies:

O'Neill (2004) conducted a two year study with three and four year old children. Stories were not read to the children; instead, the children were asked to develop their own stories. Each child was shown a book that contained only pictures and asked to develop a story to tell to a puppet. None of the children had seen the picture book prior to the start of the study. The children were not prompted in any way and were free to say as much or as little about each page as they wished. According to O'Neill (2004), this method made it possible to see how well children were able to talk about the feelings or thoughts of the characters in the story and how well children were able to talk about the

different actions of the various characters and switch clearly from talking about one character to another. Additionally, this method created an opportunity for students to create a problem and solve it (O'Neill, 2004).

Two (2) years later, the children were brought back to the laboratory where the study was conducted and were given a mathematics achievement test. What O'Neill (2004) found was that those children who scored high on the achievement test had also scored high on certain measures of their storytelling ability two years earlier. While the methodology of this study is not strong, the study does suggest that there is a correlation between storytelling and mathematics achievement.

Casey (2003) and a team of researchers conducted a field experiment in sixteen kindergarten classrooms in urban and suburban school systems with large minority populations. Casey developed an experimental storytelling curriculum which was designed to teach numerical and word problem solving skills to early childhood and elementary students. Classrooms were randomly assigned to either control or implementation conditions. Teachers in the implementation classrooms supplemented their regular mathematics curriculum with storytelling; teachers in the control classrooms taught only the regular mathematics curriculum without the storytelling. Pre- and post-test assessments were given to the experimental and control classrooms. Casey (2003) reported that the test scores on the post-assessment for students in the experimental classes were significantly greater than the scores earned by students in the control classrooms and concluded that combining storytelling and mathematics may be one of the answers to the question that mathematics teachers are asking, "what practice/s is/are

related to positive outcomes?" Casey further concluded that there is a correlation between storytelling and the development of numerical and word problem solving skills and mathematics achievement.

Another study examining the impact of storytelling on mathematics development was reported by Robert (2002). This study examined the role of storytelling as a strategy to teach elementary students numerical and word problem solving skills. As a part of the experimental curriculum, storytelling was introduced to students. The experimental and control groups were given a pre-test and a post-test. The children, who were exposed to the experimental curriculum, were compared with children who were exposed to instruction consisting primarily of individualized work with repetitive paper/pencil assignments. Robert found that the performance of the students in the experimental group on the post-test was higher (although not significantly) than that of the students in the control group (2002). The findings suggest that storytelling was effective in helping elementary students to develop numerical and word problem-solving skills and in increasing mathematics achievement. It could be inferred from this study that storytelling is an important part of a mathematics classroom culture of teaching numerical and word problem solving while providing an ideal opportunity to integrate reading, writing and language arts.

Ameis (2002) also gives attention to storytelling as a strategy for teaching numerical and word problem solving skills to elementary school students in mathematics. Thirteen elementary school students were randomly assigned to an experimental group and thirteen students were randomly assigned to a control group. The students in the

experimental group were taught numerical and word problem solving skills through storytelling. During the unit, three stories (on the same topic) were used and in-class activities were implemented based on the stories. The control group was taught numerical and word problem-solving skills by way of paper/pencil activities only. A post-test was given to both groups; the scores of students in the experimental group were higher than those achieved by students in the control group. Ameis (2002) noted that the students in the experimental group demonstrated a greater ability to solve mathematics problems during the intervention and the same group of students performed better on the post-test than those students in the control group, who were not exposed to the intervention. Ameis (2002) concluded that storytelling was an effective instructional strategy in teaching numerical and word problem solving skills to and increasing achievement with elementary students.

Tolliver (2001) found storytelling an effective strategy as it provided a context for students to identify and solve a mathematics problem. This study notes that the stories allowed students to become creative thinkers and solve numerical and word problems while improving their language skills. Tolliver notes that the students also developed an ability to organize data into a chart, find relative frequencies, and draw conclusions.

Tolliver (2001) concluded that storytelling was an effective method for teaching elementary students numerical and word problem solving skills and increasing achievement. While the results indicate positive outcomes, it is difficult to accept this conclusion because the methodology is not persuasive. The intervention was limited to one class, in which all of the students participated. There was no control group, no pre-

test (or post-test) measure reported, and limited descriptions of the activities during the storytelling itself. The findings (and conclusions) appear to be based largely on observations. Without a control group or a comparison group, it is not possible for this researcher to determine if any changes were attributable to treatment.

Burk (2000) also explored the effects of storytelling on the development of numerical and word problem solving skills with elementary students in mathematics in a pre-test / post-test experimental design study. The control and experimental groups were equivalent on the pre-test measure. Following the intervention (which according to the author was a repeated procedure), a post-test was given to both groups. The results indicated that the performance of the students in the experimental group was slightly higher (although not significantly) than that of the students in the control group. Burk (2002) concluded that the use of storytelling may have the potential to facilitate a greater understanding of and interest in mathematics concepts among elementary students.

Bainbridge and Pantaleo (1999) conducted a study utilizing the storytelling method to teach numerical and word problem solving skills to elementary school students. The authors examined the use of storytelling not only on mathematics, but with other content areas as well. Students participating in the experimental study were randomly selected for the control and experimental groups. Prior to the intervention, students were given a pre-test and at the conclusion of the intervention, students were given a post-test. The authors note that the post-test scores of students in the experimental group were significantly higher than the post-test scores in the control group in most of the content areas (including mathematics). According to Bainbridge and

Pantaleo (1999), the students in the experimental group demonstrated a stronger aptitude of the content than they did prior to the treatment.

Bainbridge and Pantaleo (1999) concluded that storytelling was successful with elementary students as a method to encourage students to communicate mathematics concepts with words, diagrams and other visual models. They found that the students in their study responded positively to being read to and told interesting stories. Storytelling, according to the authors, helped students to better perform numerical and word problems. Additionally, it helped students to develop critical thinking skills.

Hong (1996) conducted a study with one group of Kindergarten students to determine the effect of storytelling on mathematics achievement. One group of students were given mathematics related stories and compared to a second group of students who were given non-mathematics related stories. Students in both groups were observed to determine the effectiveness of using storytelling to enhance mathematics instruction. The results of the study found that kindergartners exposed to mathematics based storytelling exhibited a greater preference and aptitude for mathematics activities than did those of the comparison group.

Hopkins (1993) implemented storytelling to teach numerical and word problem solving skills to elementary students. Similar to the Tolliver study (2001), this study was limited to one class, in which all of the students participated. The difference between this study and the Tolliver study is that Hopkins split the one class into two groups and randomly assigned them to control and experimental groups. Students in the experimental group were exposed to storytelling while students in the control group were

exposed to paper and pencil assignments. Those students in the experimental group were asked questions that required students to solve a series of problems. The children were given a pre-test and a post-test using an assessment tool that was developed by Hopkins (1993). In the assessment of the intervention, Hopkins concluded that the treatment had a positive impact on developing numerical and word problem solving skills and increasing mathematics achievement.

While this study yielded positive outcomes, it is difficult to accept the conclusions because it is not clear how the researcher was able to facilitate instruction among two groups in the same classroom. Was mathematics being taught to both groups at the same time or were they taught at different times? Were both groups in the same classroom at the same time the experiment was being facilitated? Was there an additional teacher or even a teacher aide who was present during the time frame of this study, who worked specifically with the students in the control group? If not, how were the students in the control group arranged so that they were not exposed to experimental conditions? How were the students arranged in the experimental group so that they were not exposed to the conditions of the control group? Similar to the Tolliver study, it is not possible for this researcher to determine if any changes were attributable to treatment.

Summary of the Research

Based on the available research, what advice can be offered to elementary mathematics teachers on instructional strategies that help to develop numerical and word problem solving skills with elementary school students and improve their academic achievement levels in mathematics? What practice/s is/are related to positive outcomes?

Research on the implementation of storytelling as an instructional strategy in mathematics classrooms indicates that storytelling is one practice that appears to be related to positive outcomes. It is a strategy according to social science researchers that engages students with the basic psychological and intellectual needs in mind. It can be inferred from Maehr and Midgley (1991) that the implementation of storytelling allows students to develop a sense of competency and allows them to develop connections with others. More importantly, storytelling may help students to achieve content mastery, develop numerical and word problem solving skills, and increase achievement.

There is fairly good evidence that there are benefits in implementing storytelling in elementary mathematics classrooms. The studies in this literature review indicate a positive (and in some cases, a significant) impact on students becoming involved and interested in mathematics as a result of storytelling. These research findings can form the basis for systematic examinations of expanded research. Questions for future research may include:

- How does a child's prior experience with storytelling in mathematics affect the outcome and impact of another intervention involving storytelling in mathematics?
- Is storytelling in mathematics an effective technique with middle and high school students?
- Is storytelling an effective instructional strategy with special education students?
- Would storytelling be effective as an instructional strategy if it was extended beyond two content units?

- Does the oral delivery (voice, pitch, tone) of storytelling in mathematics have an impact on mathematics achievement with elementary students?

Summary of the Chapter

Storytelling is an instructional strategy that has been found to be successful in helping elementary students to develop numerical and word problem solving skills and increase achievement. Not only has this instructional strategy been identified as an effective method in helping students to develop numerical and word problem solving skills and increase achievement, it is also regarded as effective in fostering active student learning, generating more interest in math, reducing math anxiety, and making math more enjoyable. This strategy has provided both content and learning support to help students reconstruct the new information being presented to them. The emphasis is on helping students become effective learners adept at dealing with new information.

In general terms, student achievement refers to the level of achievement or proficiency in relation to a standard measure of performance, or of success in bringing about a desired end. An issue that continues to plague U.S. schools is the decline of mathematics achievement and the subsequent failure of children to acquire functional mathematics skills. Over the past decades, researchers have attributed the lack of student achievement in mathematics to many factors including gender, race, socio-economics, and instructional environment, to name a few. Despite the attributing factors, some researchers support that a change in teaching methodology from current trends to alternative measures may be what is needed to increase achievement levels in mathematics.

Current researchers have concluded that knowledge often develops based on the student's interaction with the subject matter. This is known as constructivism. The implementation of storytelling in elementary mathematics classrooms may provide elementary mathematics teachers with the approaches needed to help students to accurately construct new information so that they may understand mathematics and apply it in their lives.

The use of storytelling is one method that elementary school teachers can use to provide their students with a different experience in mathematics. Combining mathematics and storytelling in classroom activities is one way for teachers to invite children into the world of mathematics and it is also an ideal vehicle to help students understand the importance of mathematics in their daily lives. On the basis of the review of literature, the implementation of storytelling as an instructional strategy in elementary mathematics classrooms can be an effective approach in teaching numerical and word problem solving skills and increasing the achievement levels of elementary school students in mathematics.

While it is likely that storytelling will not represent radical shifts in the short run, this alternative instructional strategy is a genuine effort to be more critical of the way in which many elementary school mathematics teachers are teaching mathematics to students and ideally more useful in encouraging mathematics teachers to think and teach alternatively.

CHAPTER 3

METHODOLOGY

Framework

This study was designed to investigate the effectiveness of using storytelling to teach numerical and word problem solving skills to and increase achievement with elementary students. As part of this investigation, storytelling was implemented as an instructional strategy in two elementary schools, one private school located in Houston, Texas and one public school located in Baltimore, Maryland. The target population was four third grade classes (two classes in each school) that were covering the following topics during the time of the interventions: 1) two and three digit multiplication and 2) two and three digit division.

According to the NCTM (1998), mathematics learning environments should be created to promote active learning. To promote such environments, the NCTM recommends the use of learning strategies that can be used to foster active learning environments, generate more student interest in mathematics, reduce math anxiety with students, increase student achievement levels, and make math more enjoyable for students.

In the Literature Review, a summary of storytelling as an instructional strategy in elementary mathematics classrooms was provided. The literature revealed that

storytelling could be successful in helping students to develop numerical and word problem solving skills and increase mathematics achievement.

Importance of Study

While social science researchers have examined storytelling as an instructional strategy in several mathematics content areas (counting, one-digit multiplication, one-digit division, estimation, graphing, and geometry), there is not a great deal of research involving the use of storytelling in two and three-digit multiplication and two and three-digit division. This study involved the implementation of storytelling in these content areas.

While there are studies that have examined storytelling as an instructional strategy to teach mathematics concepts, there has been little attempt to extend storytelling beyond one or two individual lessons. This study went beyond other research in that storytelling was implemented in two complete units.

The impact of storytelling on mathematics achievement and numerical and word problem solving skills may inform mathematics teachers, school administrators, teacher educators, and policy-makers about the effectiveness of storytelling as an instructional strategy in computing two and three-digit multiplication and two and three-digit division and identify one method that may be linked to positive outcomes. Additionally, this study may provide a means through which individual schools and school districts may enhance their existing methods of teaching mathematics in elementary school classrooms. Finally, this study may influence educational policy that impacts formal teacher

education programs, as well as staff development, and teacher training. In a society saturated with quantitative information, proficient mathematical skills, according to the NCTM (1998) will help students to understand and make informed decisions about the things that affect their world.

Purpose of the Study

This study focuses on increasing mathematics achievement through an alternative instructional strategy, storytelling, using children's literature. It was designed to investigate methods of using storytelling to teach elementary students how to solve numerical and word problems and increase achievement. Four selections of children's literature were used to help to facilitate specific mathematics skills with native English speakers that were on grade level readers.

Type of Research

This research was designed as a quasi-experimental design. A quasi-experimental design resembles an experimental design, but lacks random assignment. Participants are not randomly selected from a specified population nor are they randomly assigned to experimental and control groups. According to Martella, Nelson, and Martella (1999), a quasi-experimental design provides a relatively high degree of experimental control in a natural setting and enables researchers to compare the performance of an experimental group with that of a control group. Gribbons, Barry and Herman (1997) note that quasi-experimental designs are especially useful in addressing evaluation questions about the effectiveness and impact of programs.

Research Questions

1. How does using children's literature help elementary students to solve numerical and word problems?
2. Is the achievement gain in mathematics greater when children's literature is used in the elementary school mathematics classroom?
3. Does using children's literature enhance the attitudes of elementary students towards mathematics when it is employed?

Research Objectives

The objective of this research was to determine if the use of storytelling would help elementary students to learn and achieve in mathematics. Taking into consideration that there are many instructional strategies available that promote changes in how numerical and problem solving skills are taught, this study focused on one instructional strategy, storytelling.

Instrumentation

Two elementary schools, both with two third grade classes, were selected as the study sites. Permission from both school's administrations to conduct the study was granted. The extent of the principal's involvement in this study was to sign the *Principal Consent Form* (See Appendices). The principals asked the researcher to participate in status reviews during the study in order to stay abreast of the status (and findings) of the project.

In order to help accomplish the research objectives, the following documentation, instruments, and groups were created, administered, and facilitated:

1. An introductory letter was given to the principals of both schools and to the teachers who participated in this study. The introductory letters are included in the *Appendices* section of this study.
2. Consent forms were signed by the school principals and the teachers. The consent forms are included in the *Appendices* section of this study.
3. A letter describing the study (with consent forms) was sent home to the parents of the study participants. Parents were asked in the letter to sign and return the consent form by a designated date. Signed consent forms were required for students to participate in this study. In the case where consent forms were not returned, the researcher forwarded a second letter to parents for signature and return by a designated date. The parent letter is included in the *Appendices* section of this study.
4. Two pre-test instruments were developed and issued to all students in the third grade classes that participated in this study. There was one pre-test given at the start of the unit on two and three digit multiplication and one pre-test given at the start of the unit on two and three digit division. The pre-test instruments contained numerical and word problems. The pre-test instruments contained questions from the National Assessment of Educational Progress (NAEP). Only those questions that were reported to pose difficulty to nine-year old (third grade) students were included. The purpose of including questions from the

NAEP was to determine if storytelling would make a difference in how students thought about and solved related questions. Questions were included from the 2003 national administration, which was the most recent administration for which test questions were released for public consideration. There has been a 2005 national administration of the NAEP; the test questions are expected to be released for public consideration in late 2006.

On the two- and three-digit multiplication pre-test, the following questions were included on the 2003 administration of the NAEP:

- Question # 4
- Question # 7
- Question # 15
- Question # 16
- Question # 18

On the two- and three-digit division pre-test, the following questions were included on the 2003 administration of the NAEP:

- Question # 4
- Question # 13
- Question # 16
- Question # 17
- Question # 18

The pre-test instruments are included in the Appendices section of this study.

5. Experimental lesson plans were developed for the two content areas, two- and three-digit multiplication and two- and three-digit division. The lesson plans included in-class activities, in-class assignments, and home assignments. The experimental lesson plans were important in this study as the in-class activities and assignments were constructed around four stories. The following four children's stories were implemented in this study:

Two- and Three-digit Multiplication

1. Two of Everything (Lily Hong)
2. One Hundred Hungry Ants (Elinor Pinczes)

Two- and Three-digit Division

3. The Doorbell Rang (Pat Hutchins)
4. 17 Kings and 42 Elephants (Margaret Mahy)

The lesson plans for the two units are included in the *Appendices* section of this study.

6. Two post-test instruments were developed and administered to all students in the two third grade classes that participated in this study. There was one post-test given to both classes at the end of the unit on two- and three-digit multiplication and one post-test given to both classes at the conclusion of the unit on two- and three-digit division. The post-test instruments contained numerical and word problems.

The post-test instruments enabled the researcher to determine whether or not storytelling helped elementary students in mathematics. The use of the data aided the researcher in interpreting the results.

As part of the questions that comprise the post-test instruments, questions from the National Assessment of Educational Progress (NAEP) were included. Only those questions that have been reported to pose difficulty to nine-year old (3rd grade) students were included. The purpose of including questions from the NAEP was to determine if storytelling would make a difference in how students thought about and solved related questions. Questions were included from the 2003 national administration, which was the most recent administration for which test questions were released for public consideration. There has been a 2005 national administration of the NAEP; the test questions are expected to be released for public consideration in 2006.

On the two- and three-digit multiplication post-test, the following questions were included on the 2003 administration of the NAEP:

- Question # 4
- Question # 7
- Question # 15
- Question # 16
- Question # 18

Note: Questions # 15, 16, and 18 are word problems and were slightly modified on the post-test.

On the two- and three-digit division post-test, the following questions were included on the 2003 administration of the NAEP:

- Question # 4
- Question # 13
- Question # 16
- Question # 17
- Question # 18

Note: Questions # 16, 17, and 18 are word problems and were slightly modified on the post-test.

The post-test instruments are included in the Appendices section of this study.

7. A questionnaire was administered to students following the two- and three-digit division post-tests. The questionnaire was used to gather data about the perceptions of third grade students toward storytelling as a method of learning mathematics. Participants responded to each item by choosing one of three likert alternatives, Agree, Uncertain, and Disagree. The questions were measured as possible predictors of mathematics achievement. The questionnaire is included in the Appendices section of this study.

8. In addition to the questionnaire, a focus group was structured in each of the classes. The purpose of the focus group was to obtain additional information about storytelling; for example, did the students enjoy mathematics more? What were their attitudes and feelings about storytelling? What were their attitudes about mathematics are after storytelling? Each focus group was composed of

seven participants and was tape recorded. The focus groups were facilitated following the administration of the questionnaire. Additionally, the focus groups allowed the researcher to probe for greater detail about storytelling and possibly identify areas for research replication.

Hypotheses

1. The use of storytelling in elementary mathematics classrooms is an effective method for teaching students to solve numerical and word problems.
2. The use of storytelling in elementary mathematics classrooms will positively impact post-test scores in two and three digit multiplication and two- and three-digit division.
3. The student responses to the questionnaire will reveal that storytelling helped them in mathematics.

Null Hypothesis

The null hypothesis that was tested by this study states that there was no significant difference in the development of numerical and word problem solving skills and no significant difference in the post-test scores in two- and three-digit multiplication and two and three-digit division. The null hypothesis further states that the student responses to the questionnaire would not reveal positive outcomes as a result of storytelling.

Dependent Variables

The dependent variables in this study included:

1. The scores on the two post-test instruments. The post-test instruments were comprised of numerical and word problems. The results were measured as possible predictors of the development of numerical and word problems and mathematics achievement with students in elementary mathematics classrooms.
2. The student responses to the questionnaire. Participants respond to each item by choosing one of three likert alternatives, Agree, Uncertain, and Disagree. The scoring of alternatives for positive items was weighted from 2 (agree) to 0 (disagree). These weights were reversed for alternatives to negative items. The questions were measured as possible predictors of student attitudes toward mathematics.

Independent Variables

The independent variables in this study were the experimental lesson plans that included storytelling, which were implemented in the experimental classes only.

Population and Sample

This study was conducted using four third grade classes in two elementary schools. Due to agreements of confidentiality, they will be referred to in this study as private school and public school. The private school is located in Houston, Texas. The total number of third grade students in the private school is thirty-two (N=32). The public school is located in Baltimore, Maryland. The total number of third grade students in the public school is forty-six (N=46).

As a quasi-experimental design, there was no random assignment of the participants or the classes. In both schools, there was one control class and one experimental class. The experiences of the control and experimental classes were as identical as possible in all respects except for the introduction of the independent variable to the experimental classes.

Setting

The experimental setting of this research for the private school was in Houston, Texas. All of the participants were elementary school students who were enrolled in the third grade classes in the school. The school is located in a diverse community; that is, there are multiple races and nationalities that reside in the immediate area.

The features of the private school include small classes, individualized attention, and a child-centered pedagogical style. In this school, there were two third grade classes; there was no distinction in the classes based on academic level. Both classes learned the same content simultaneously.

The third grade classes were taught by certified elementary school teachers; one teacher had seven years teaching experience at the elementary level and the other teacher had five years teaching experience at the elementary level. One teacher is male; the other is female. Both classes shared a classroom aide who had three years teaching assistance experience at the elementary level.

The experimental setting of this research for the public school was in Baltimore, Maryland. All of the participants were elementary school students who were enrolled in

the third grade classes in the school. The school is located in a diverse community; that is, there are multiple races and nationalities that reside in the immediate area.

The features of the public school included larger classes, individualized attention where needed, and a child-centered pedagogical style. In this school, there were two third grade classes; there was no distinction in the classes based on academic level. Both classes learned the same content simultaneously.

The third grade classes were taught by certified elementary school teachers; one teacher had twelve years teaching experience at the elementary level and the other teacher had six years teaching experience at the elementary level. Both teachers were female.

Procedure

The intervention was facilitated in the two schools at different times. The intervention for the private school occurred in February and March 2006. The intervention for the public school occurred in March and April 2006.

Following submission of the introductory letter to the administrators of both schools and the four third grade teachers, the researcher met with the third grade teachers in the two schools (at separate times) to further explain the scope of the research and any related instructions that were to be considered when implementing the storytelling strategy. The meeting also provided an opportunity for the teachers to ask any questions that they may have had regarding the study and/or related materials.

In order to assess the effects of storytelling, two pre-test and two post-test instruments were developed and issued to all students in the two third grade classes that

were participating in this study. There was one pre-test given at the start of the unit on two- and three-digit multiplication and one pre-test given at the start of the unit on two- and three-digit division. There was one post-test given at the end of the unit on two- and three-digit multiplication and one post test given at the conclusion of the unit on two- and three-digit division.

Experimental lesson plans were implemented by the third grade teachers. The researcher observed all of the classes during the interventions. The researcher was able to observe all of the classes as the classes were taught mathematics at different times of the day.

Following the two- and three-digit division post-test, students were given a likert-type questionnaire to complete. Participants responded to each item by choosing one of three likert alternatives, Agree, Undecided, and Disagree. Considering the age of the students in this study, the researcher explained the likert alternatives to the students prior to distributing the questionnaire. The questionnaire was used to indicate participants' level of agreement or disagreement with statements about the study. Following the questionnaire, the researcher facilitated a focus group (in both of the schools), which was tape-recorded.

Organization of Stories Used in this Research

At the beginning of each unit, one story was read. Afterwards, students participated in discussions, activities, and assignments that were constructed around the story. A second story was read at the mid-point of the unit. At the conclusion of the story, students participated in discussions, activities, and assignments that were

constructed around the story. The characters in the stories had adventures in which they encountered numerical and word problems. The children solved these mathematical problems within this context, often helping a character/s in the story out of a difficulty.

Through story constructed activities, students participated in hands-on mathematical experiences that facilitate the learning of two and three digit multiplication and two- and three-digit division. Additional home activities were provided to extend, deepen, and individualize the mathematics learning for students.

How Storytelling Will Be Used in this Research

Storytelling was used to provide a context for two- and three-digit multiplication and two- and three-digit division to get students to identify the numerical and word problem/s as the stories unfolded, and then encouraged students to solve the numerical and word problems. The use of story characters to pose numerical and word problems motivates the students and encourages them to direct their energy towards mathematics learning (Sherrill, 1994). The mathematics numerical and word problems that were offered in the four stories may have become relevant to the children because they were presented with a meaningful story based context (Sherrill, 1994). Finding solutions to numerical and word problems were important to the characters in the story and to the students (Sherrill, 1994). More specifically, storytelling fostered the following:

Numerical Problem Solving Skills.

Students developed an ability to demonstrate numerical problem solving skills through adventure stories in which they encountered mathematical contexts. As the

students listened to the stories, they were challenged to identify the numerical problem/s as the stories unfolded. The students further identified and solved numerical problems though guided teacher discussions and collaborations with other students and through applications of story content to in-class and home activities.

Word Problem Solving Skills.

Students developed an ability to solve word problem skills through adventure stories in which they encountered mathematical contexts. As the students listened to the stories, they were challenged to identify and communicate the word problem/s as the stories unfolded. The students further identified and solved word problems though guided teacher discussions and collaborations with other students and through applications of story content to in-class and home activities.

According to Welchman-Tischler (1992), when the reason for solving a mathematics problem is intertwined with young children's fascination, they will put all of their energies into solving the mathematics problems.

Four books were selected as part of the intervention. Two of Everything and One Hundred Hungry Ants were used in the unit on two and three digit multiplication. The Doorbell Rings and 17 Kings and 42 Elephants were used in the unit on two and three digit division.

Two of Everything (Lily Hong)

In the book, a poor farmer, Mr. Haktak, discovered a brass pot in his garden. He placed his coin purse inside for safekeeping and took his discovery home to his wife. After she accidentally dropped her hairpin inside, Mrs. Haktak reached into the pot and

pulled out two identical hairpins and two matching coin purses. She figured out the secret of the pot and told her husband. Both work feverishly to duplicate their few coins, creating enough gold to fill their hut. The happy couple believed their luck had finally changed for the better until Mrs. Haktak fell into the pot and is duplicated.

One Hundred Hungry Ants (Eleanor Pinczes)

In the book, one hundred hungry ants marched off single file to sample a picnic, but when the going became too slow, they divided into two rows of fifty, then four rows of twenty-five, five lines of twenty, and finally, ten lines all in an effort to get to the picnic quickly.

The Doorbell Rings (Pat Hutchins)

In the book, "Ma" has baked enough cookies for two children to share, each getting six cookies. Two friends then arrive and are invited to share the cookies. The doorbell rings twice more and additional friends enter to share the cookies. When there are twelve children and twenty-three cookies, the doorbell rings again. This time, it's Grandma who enters with a tray full of cookies.

17 Kings and 42 Elephants (Margaret Mahy)

Seventeen kings on forty-two elephants embarked on a journey through a jungle on a wet night. During the journey, the kings encountered an array of jungle creatures, who responded to their songs and music. At the end of the journey, the seventeen kings went to their own kingdom and had to take the forty-two elephants with them.

The above stories were selected based on their connection to the content topics; these stories may have helped students to develop numerical and word problem solving

skills and increased their test scores in two and three digit multiplication and two and three digit division.

Research Design

The research design in this study was developed to determine whether or not storytelling was an effective strategy in teaching numerical and word problem solving skills to and raising mathematics test scores with elementary students. Storytelling was used to teach students mathematics as opposed to learning mathematics by way of the traditional method of instruction, individualized work with repetitive paper and pencil assignments. As part of this investigation, storytelling was implemented as an instructional strategy in two elementary schools; one school located in Houston, Texas and the second school located in Baltimore, Maryland. This research design allowed the researcher to obtain an objective understanding of the constraints and opportunities of using storytelling as an instructional strategy in mathematics.

Chapter Summary

This chapter outlined the methodology to be followed in this study. The research questions and hypothesis were restated. The populations of students were described. The selection process of the sample was summarized. The settings were explained, the instruments to be used in this study were depicted, and the procedures were stated.

Data Analysis

The data analysis is described in detail in Chapter 4 of this study.

CHAPTER 4

ANALYSIS OF DATA

Overview

The objective of this study was to determine if storytelling had a positive impact on the development of numerical and word problem solving skills and on achievement. Storytelling was implemented as an instructional strategy in two mathematics classrooms in two elementary schools, one private school located in Houston, Texas and one public school located in Baltimore, Maryland. The target populations were four third grade classes (two classes in each school) that covered the following units during the time of the interventions: 1) two and three digit multiplication and 2) two and three digit division.

Instrumentation

Experimental lesson plans for the two units were developed; each unit included two stories read by the teacher, follow-up discussions on the stories, in-class activities, in-class assignments, and home assignments. The books used in the unit on two- and three-digit multiplication were *Two of Everything* by Lily Hong (1993) and *One Hundred Hungry Ants* by Eleanor Pinczes (1999). The books used in the unit on two- and three-digit division were *The Doorbell Rang* by Pat Hutchins (1986) and *17 Kings and 42 Elephants* by Margaret Mahy (1987). The books were chosen because they were rich in content in relation to the two units

The two classes assigned to the experimental groups (one class in the private school and one class in the public school) received storytelling and participated in class activities that related to the stories. The classes assigned to the control groups (one class in the private school and one class in the public school) did not have stories read to them. The instructional activities included reading of the regular textbook in class, performing practice problems on the board, and completing practice problems (on paper) from the regular textbook.

Two pre- and post-test instruments were administered to the experimental and control groups prior to and following the storytelling interventions. One pre-test was administered prior to the start of and one post-test was given at the conclusion of the unit on two and three digit multiplication. One pre-test was administered prior to the start of and one post-test was given at the conclusion of the unit on two and three digit division. The pre- and post-test instruments contained twenty items; twelve items were numerical problems and eight items were word problems.

As part of the questions that comprised the pre-test instruments, questions from the 2003 national administration of the National Assessment of Educational Progress (NAEP) were included. Only those questions reported to pose difficulty to nine-year old students (third grade) were included. A total of ten numerical and word problem questions were included in the pre-tests for the two units; five questions for two-and three-digit multiplication and five questions for two-and three-digit division. The same ten questions were included and re-worded in the post-tests.

Following the administration of the post-test for the unit on two-and three-digit division, a twenty question attitude scale was administered to students in the experimental classes. Participants responded to each item by choosing one of three likert alternatives, *Agree*, *Uncertain*, and *Disagree*. Students in the control classes were not given the attitude scale as it contained items specific to the storytelling intervention. In addition to the attitude scale, a focus group was structured from each of the experimental classes (one in the private school and one in the public school). Students in the control classes did not participate in the focus group.

Seven participants composed each focus group and was tape recorded. Fifteen questions were asked to each of the focus groups and each participant was asked to respond to each question.

Analysis

A one-way analysis of variance (ANOVA) was used to analyze the achievement data. Regression analysis of the data was conducted to measure the extent to which storytelling impacted mathematics achievement. Responses to the attitude surveys were analyzed via frequencies. Table 1 shows the population sample of the private and public schools experimental and control groups.

Table 1. Population Sample

	Private School				Public School		
Subfield	Total	Boys	Girls		Total	Boys	Girls
Class A (Experimental)	16	7	9		20	8	12
Class B (Control)	14	6	8		22	9	13

Problem Solving

Hypothesis # 1: The use of storytelling in elementary mathematics classrooms is an effective method for teaching students to solve numerical and word problems.

The first hypothesis states that the use of storytelling in elementary mathematics classrooms is an effective method for teaching students to solve numerical and word problems.

In the private and public schools, students in the experimental groups demonstrated a greater ability to solve numerical and word problems during the intervention as observed by performances in problem solving, reinforcement, and home activities. After a story was read in both classes, the teacher and students discuss the story at length and the teachers verbalized problem-solving processes and strategies daily. Through daily in-class and home activities, the teacher gave students opportunities to apply and refine the skills and strategies necessary to solve numerical and word problems.

The teachers of students in the control groups in the private and public schools gave daily paper and pencil tasks. Problem solving is introduced through the textbooks and discussed by the teachers. The textbooks in both classes introduced problem solving by instructing students to draw pictures or make diagrams using the information in the problems. In reviewing the textbooks used by both control groups, the researcher understood that students may have a difficult time comprehending the information in the textbooks, even though the teachers discussed problem solving strategies daily and endeavored to link them to in-class and home assignments. As a result, students may not have been capable of developing appropriate representations of problems. This may be one explanation why students in the control groups did not perform as well on the two post-tests as students in the experimental classes.

The post-tests included ten questions from the 2003 national administration of the NAEP; five questions were specific to two- and three-digit multiplication and five questions were specific to two-and three-division. The NAEP questions included on both post-tests were reported to pose difficulty to nine-year old (3rd grade) students. Table 2 (page 6) shows a comparison of the performances on the two post-tests of the experimental and control groups in the private and public schools on the five NAEP questions. Students in the experimental groups answered more of the NAEP specific questions correctly than students in the control groups.

Table 2. NAEP Comparisons

Two and Three Digit Multiplication	Private School Experimental & Control Groups			Public School Experimental and Control Groups		
Question	Experimental Answer Correct	Control Answer Correct		Experimental Answer Correct	Control Answer Correct	
# 4	11	8		13	5	
# 7	9	7		10	4	
# 15	12	9		14	6	
# 16	10	8		10	5	
# 18	9	7		14	7	
Two and Three Digit Division	Private School Experimental & Control Groups			Public School Experimental and Control Groups		
Question	Experimental Answer Correct	Control Answer Correct		Experimental Answer Correct	Control Answer Correct	
# 4	12	6		13	7	
# 13	12	5		14	5	
# 16	10	5		12	4	
# 17	11	5		10	3	
#18	11	4		11	3	

Achievement

Hypothesis # 2: The use of storytelling in elementary mathematics classrooms will positively impact post-test scores in two- and three-digit multiplication and two- and three- digit division.

Analysis of Two-and Three-Digit Multiplication in the Private School

Table 3 presents the descriptive statistics representing the number of students in the private school experimental and control groups and the mean performances of both groups. The mean post-test score for the experimental group (74.38) is higher than that of the control group (64.29). Likewise, the standard deviations reveal that storytelling had a positive impact on the two-and three-digit multiplication post-test scores.

Table 3. Descriptive Statistics (Private School)

	N	Minimum	Maximum	Mean	Std. Deviation
Exp	16	60	90	74.38	8.921
Cntrl	14	40	90	64.29	14.392

Table 4 presents the comparisons of variance of the private school experimental and control groups. While the experimental group performed better on the multiplication post-test, the differences between the two groups was not significant, $F(1,12) = .0447$, $p = .8361$.

In Figure 1, a difference is shown in the mid range (4-10), however, it is not a significant difference.

Table 4. Results of One-Way Analysis of Variance (Private School)

Summary measures	
Multiple R	0.0609
R-Square	0.0037
Adj R-Square	-0.0793
StErr of Est	9.4394

Table 4 (Continued)

ANOVA Table							
	Source	df	SS	MS	F	p-value	
	Explained	1	3.9836	3.9836	0.0447	0.8361	
	Unexplained	12	1069.2307	89.1026			
Regression coefficients							
		Coefficient	Std Err	t-value	p-value	Lower limit	Upper limit
	Constant	77.1154	11.9628	6.4463	0.0000	51.0508	103.1800
	Control	-0.0385	0.1819	-0.2114	0.8361	-0.4348	0.3579

Analysis of Two-and Three-Digit Multiplication in the Public School

While the results of the experimental group's scores on the two-and three-digit multiplication post-tests were not significant in the private school, the one-way ANOVA and regression analysis yielded significant results between the experimental and control groups in the public school.

Table 5 presents the descriptive statistics representing the number of students in the public school experimental and control groups and the mean performance of both groups. The mean post-test score for the experimental group (79.50) is higher than that of the control group (25.68). Likewise, the standard deviations reveal that storytelling had a positive impact on the two-and three-digit multiplication post-test scores.

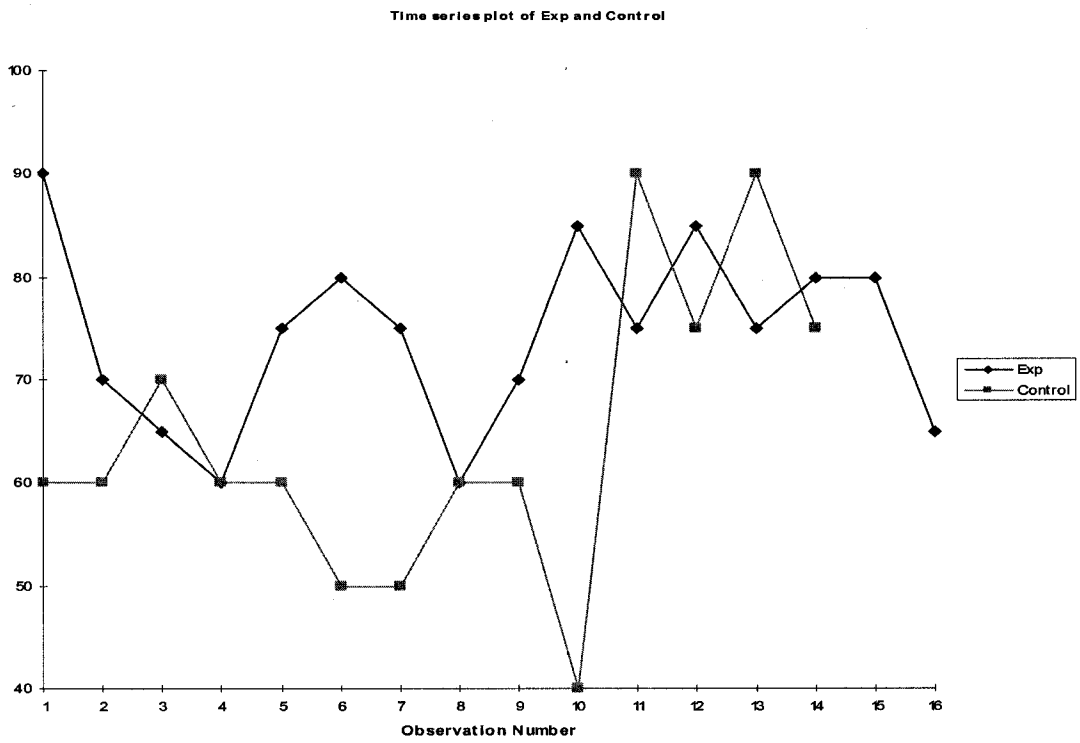


Figure 1. Time Series Plot of Experimental and Control Classes in the Private School

Table 5. Descriptive Statistics (Public School)

	N	Minimum	Maximum	Mean	Std. Deviation
Exp	20	65	95	79.50	8.256
Control	22	10	60	25.68	16.496

Table 6 presents the comparisons of variance of the public school experimental and control groups. The experimental group scored significantly higher on the two- and three- digit multiplication post-test than the control group; $F(1,18) = 1.3436$, $p = 0.2615$.

Figure 2 shows a significant difference in the scores of the public school experimental and control groups.

Table 6. Results of One-Way Analysis of Variance (Public School)

Summary measures							
	Multiple R	0.2636					
	R-Square	0.0695					
	Adj R-Square	0.0178					
	StErr of Est	8.1821					
ANOVA Table							
	Source	df	SS	MS	F	p-value	
	Explained	1	89.9502	89.9502	1.3436	0.2615	
	Unexplained	18	1205.0498	66.9472			
Regression coefficients							
		Coefficient	Std Err	t-value	p-value	Lower limit	Upper limit
	Constant	76.1860	3.3943	22.4454	0.0000	69.0549	83.3172
	Control	0.1262	0.1089	1.1591	0.2615	-0.1026	0.3551

Comparison of Performances Between Experimental Classes in the Private and Public School on Two- and Three-Digit Multiplication Post-Tests

In comparing the post-test performances of the two experimental classes in the public and private schools, the scores were in similar ranges. The mean for the experimental class in the public school (79.5) was slightly higher than the mean for the experimental class in the private school (74.38). Table 7 presents the comparisons of variance of the private and public school experimental groups; it also reveals that the differences in the post-test scores were not significant; $F(1,15) = 0.0383$, $p = 0.8475$.

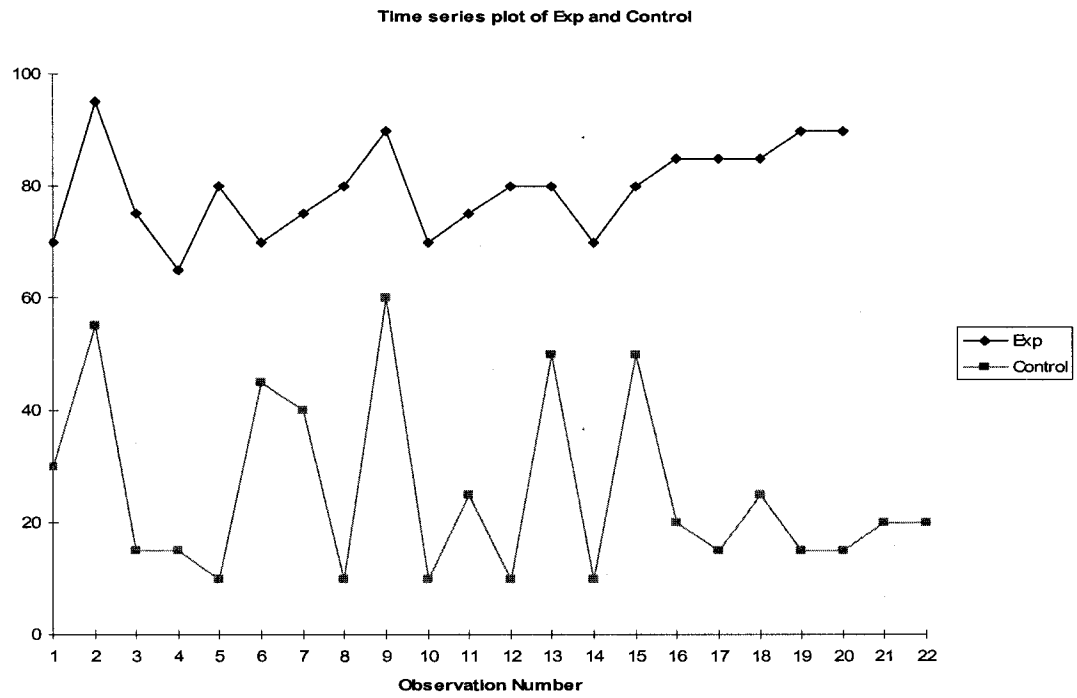


Figure 2. Time Series Plot of Experimental and Control Classes in the Public School

Table 7: Results of One-Way Analysis of Variance Multiplication (Comparison of Experimental Groups in the Private and Public Schools)

Summary Measures							
	Multiple R	0.0505					
	R-Square	0.0025					
	Adj R-Square	-0.0640					
	StErr of Est	9.7294					
ANOVA Table							
	Source	df	SS	MS	F	p-value	
	Explained	1	3.6247	3.6247	0.0383	0.8475	
	Unexplained	15	1419.9047	94.6603			
Regression Coefficients							
		Coefficient	Std Err	t-value	p-value	Lower limit	Upper limit
	Constant	70.6085	24.0609	2.9346	0.0102	19.3239	121.8931
	Exp-Public	0.0601	0.3072	0.1957	0.8475	-0.5947	0.7149

Figure 3 supports that there was not a significant difference on the multiplication post-test scores between the private and public school experimental groups.

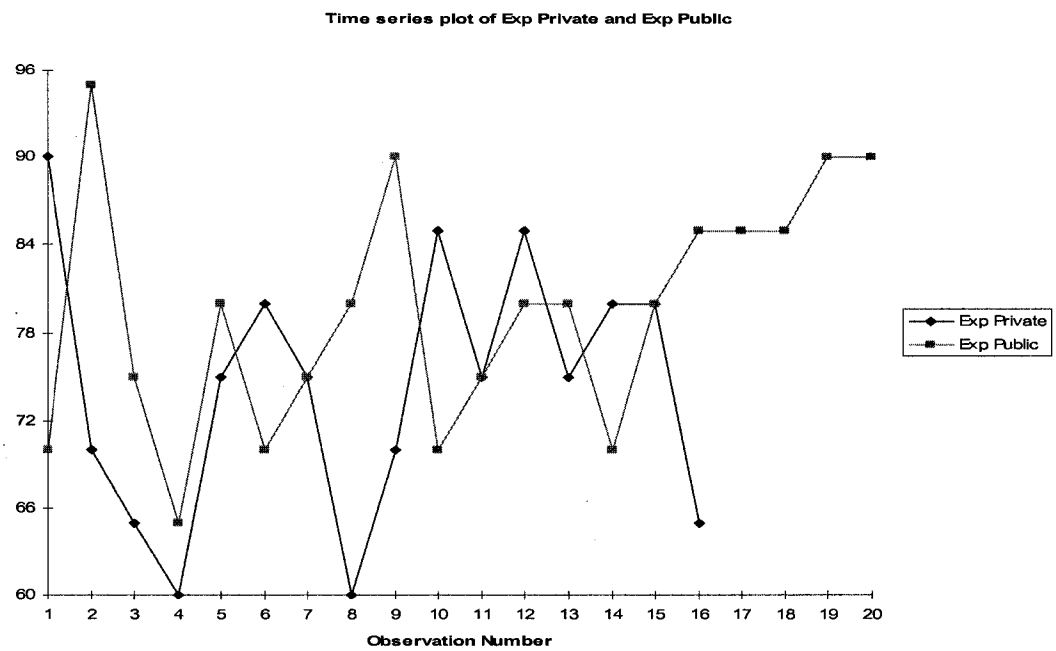


Figure 3. Time Series Plot of Experimental Private and Public School Classes

Comparison of Performances Between Control Classes in the Private and Public School on Two-and Three-Digit Multiplication Post-Tests

In comparing the performance of the two control classes, the scores were significantly different. Figure 4 reveals that students in the private school control class performed better on the two-and three-digit multiplication post-test than students in the public school control class. The mean and standard deviation of the control class in the private school was 64.29 and 14.392. The mean and standard deviation of the control

class in the public school was 25.68 and 16.496. Table 8 and Figure 4 both support a significant difference between the two control groups, $F(1,12) = 1.288$, $p = .407$.

Table 8. Results of One-Way Analysis of Variance Multiplication (Comparison of Control Groups in the Private and Public Schools)

Summary measures							
	Multiple R	0.0000					
	R-Square	0.0000					
	StErr of Est	14.9801					
ANOVA table							
	Source	df	SS	MS	F	p-value	
	Explained	1	1812.857	226.607	1.288	.407	
	Unexplained	12	880.000	176.000			
Regression coefficients							
		Coefficient	Std Err	t-value	p-value	Lower limit	Upper limit
	Constant	64.2857	6.0083	10.6995	0.0000	51.1948	77.3766
	Control Public	0.0000	0.1982	0.0000	1.0000	-0.4318	0.4318

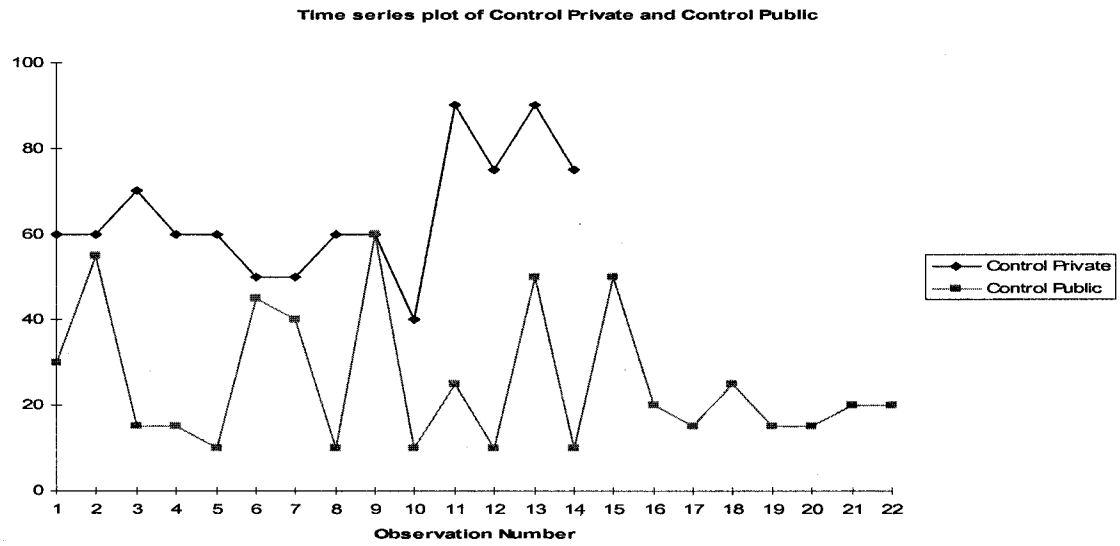


Figure 4. Time Series Plot of Control Private and Public School Classes

Analysis of Two-and Three-Digit Division in the Private School

In the private school, students in the experimental group performed better on the post-test than students in the control group. Table 9 presents the descriptive statistics representing the mean performance on the two- and three-digit division post-test for the private school experimental and control groups. While there was a difference in the scores, the difference did not yield a significant result; $F(1,12) = 0.4244$, $p = 0.5270$. Table 9 reveals that the mean and standard deviation for students in the experimental group was 74.38 and 9.979. The mean and standard deviation for students in the control group was 56.79 and 15.641. The standard deviations reveal that storytelling had a positive impact on the two-and three-digit division post-test scores.

Table 9. Descriptive Statistics (Private School)

	N	Minimum	Maximum	Mean	Std. Deviation
Exp	16	60	95	74.38	9.979
Control	14	35	85	56.79	15.641

Table 10 and Figure 5 (page 16) offer support that the difference in performance was not significant.

Table 10. Results of One-Way Analysis of Variance (Private School)

Summary measures							
	Multiple R	0.1848					
	R-Square	0.0342					
	Adj R-Square	-0.0463					
	StErr of Est	9.9151					
ANOVA Table							

Table 10 (Continue)

	Source	df	SS	MS	F	p-value	
	Explained	1	41.7262	41.7262	0.4244	0.5270	
	Unexplained	12	1179.7024	98.3085			
Regression coefficients							
		Coefficient	Std Err	t-value	p-value	Lower limit	Upper limit
	Constant	80.0758	10.3295	7.7521	0.0000	57.5697	102.5819
	Control Private	-0.1145	0.1758	-0.6515	0.5270	-0.4976	0.2685

Analysis of Two-and Three-Digit Division in the Public School

In the public school, students in the experimental group demonstrated a greater ability to solve numerical and word problems during the intervention as evidenced in the post-test scores. Students in the experimental group performed better than students in the control group. Table 11 presents the descriptive statistics representing the mean performance on the two- and three-digit division post-test for the public school experimental and control groups. The mean and standard deviation of the experimental group was 69.25 and 11.154. The mean and standard deviation of the control group was 54.09 and 14.196.

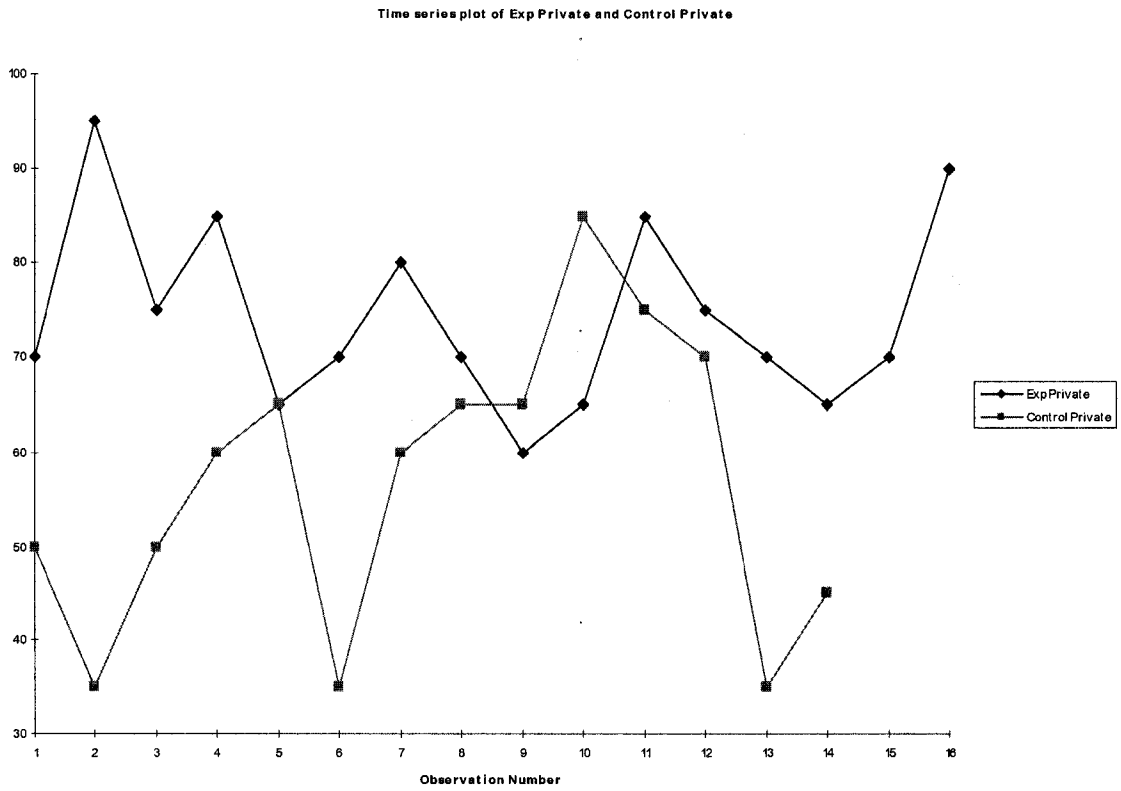


Figure 5. Time Series Plot of Experimental and Control Classes in the Private School

Table 11. Descriptive Statistics (Public School)

	N	Minimum	Maximum	Mean	Std. Deviation
Exp	20	50	90	69.25	11.154
Control	22	30	80	54.09	14.196

While there was a difference in the scores, the difference did not yield a significant result as shown in Table 12; $F(1,18) = 0.4129$, $p = 0.5286$. Figure 6 reveals that there were differences in several ranges (1-7, 14, 18, and 20-22) however, the difference overall was not significant.

Table 12. Results of One-Way Analysis of Variance (Public School)

Summary measures							
	Multiple R	0.1497					
	R-Square	0.0224					
	Adj R-Square	-0.0319					
	StErr of Est	11.1125					
ANOVA Table							
	Source	df	SS	MS	F	p-value	
	Explained	1	50.9880	50.9880	0.4129	0.5286	
	Unexplained	18	2222.7620	123.4868			
Regression coefficients							
		Coefficient	Std Err	t-value	p-value	Lower limit	Upper limit
	Constant	64.2875	9.6061	6.6924	0.0000	44.1058	84.4691
	Control Public	0.1114	0.1734	0.6426	0.5286	-0.2529	0.4758

Comparison of Performances Between Experimental Classes in the Private and Public School on Two-and Three-Digit Division Post-Tests

In comparing the two- and three-digit division post-test performances of the two experimental classes in the public and private schools, the scores were in similar ranges. The mean for the experimental class in the public school (79.5) was slightly higher than the mean for the experimental class in the private school (74.38). Table 13 presents the comparisons of variance of the private and public school experimental groups; it also reveals that the differences in the post-test scores were not significant; $F(1,14) = 0.3442$, $p = 0.5668$.

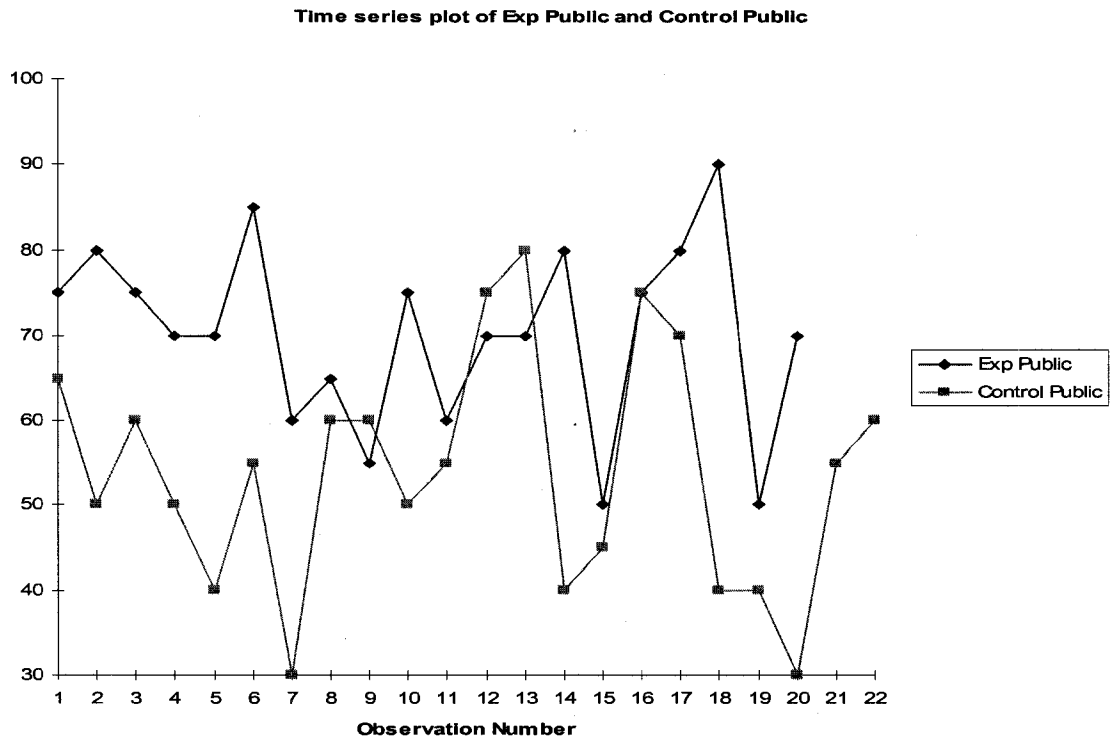


Figure 6: Time Series Plot of Experimental and Control Classes in the Public School

Table 13. Results of One-Way Analysis of Variance Division Post-Test (Comparison of Experimental Groups in the Private and Public Schools)

Summary measures							
	Multiple R	0.1549					
	R-Square	0.0240					
	Adj R-Square	-0.0457					
	StErr of Est	10.2047					
ANOVA Table							
	Source	df	SS	MS	F	p-value	
	Explained	1	35.8433	35.8433	0.3442	0.5668	
	Unexplained	14	1457.9067	104.1362			
Regression coefficients							
		Coefficient	Std Err	t-value	p-value	Lower limit	Upper limit
	Constant	63.1172	19.3578	3.2606	0.0057	21.5988	104.6355
	Exp Public	0.1615	0.2754	0.5867	0.5668	-0.4290	0.7521

Figure 7 reveals differences in the end range (15-20) however, the differences are not significant.

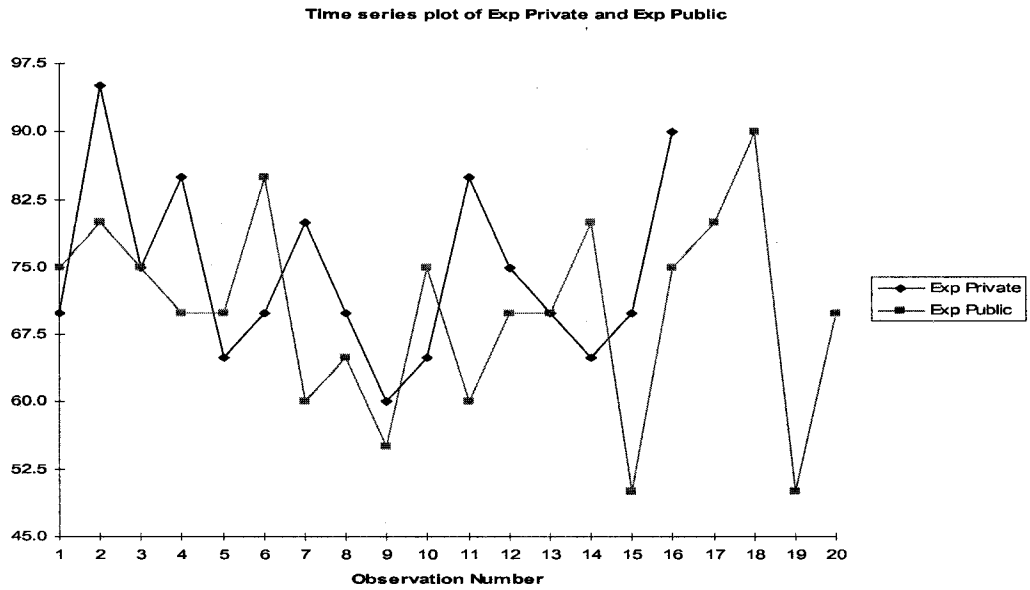


Figure 7. Time Series Plot of Experimental Private and Public School Groups

Comparison of Performances Between Control Classes in the Private and Public School on Two-and Three-Digit Division Post-Tests

In comparing the two- and three-digit division post-test performances of the two control classes in the public and private schools, the scores were in similar ranges. The mean for the control class in the public school (56.79) was slightly higher than the mean for the experimental class in the private school (54.09). Table 14 presents the comparisons of variance of the private and public school experimental groups; it also reveals that the differences in the post-test scores were not significant; $F(1,12) = 0.2301$, $p = 0.6401$.

Table 14. Results of One-Way Analysis of Variance Division Post-Test (Comparison of Control Groups in the Private and Public Schools)

Summary measures							
	Multiple R	0.1372					
	R-Square	0.0188					
	Adj R-Square	-0.0629					
	StErr of Est	16.1259					
ANOVA Table							
	Source	df	SS	MS	F	p-value	
	Explained	1	59.8405	59.8405	0.2301	0.6401	
	Unexplained	12	3120.5166	260.0431			
Regression coefficients							
		Coefficient	Std Err	t-value	p-value	Lower limit	Upper limit
	Constant	65.5623	18.7966	3.4880	0.0045	24.6081	106.5165
	Control Public	-0.1596	0.3327	-0.4797	0.6401	-0.8844	0.5652

Figure 8 reveals differences in the mid and end ranges (7, 10-11, and 15-22) however, the differences were not significant.

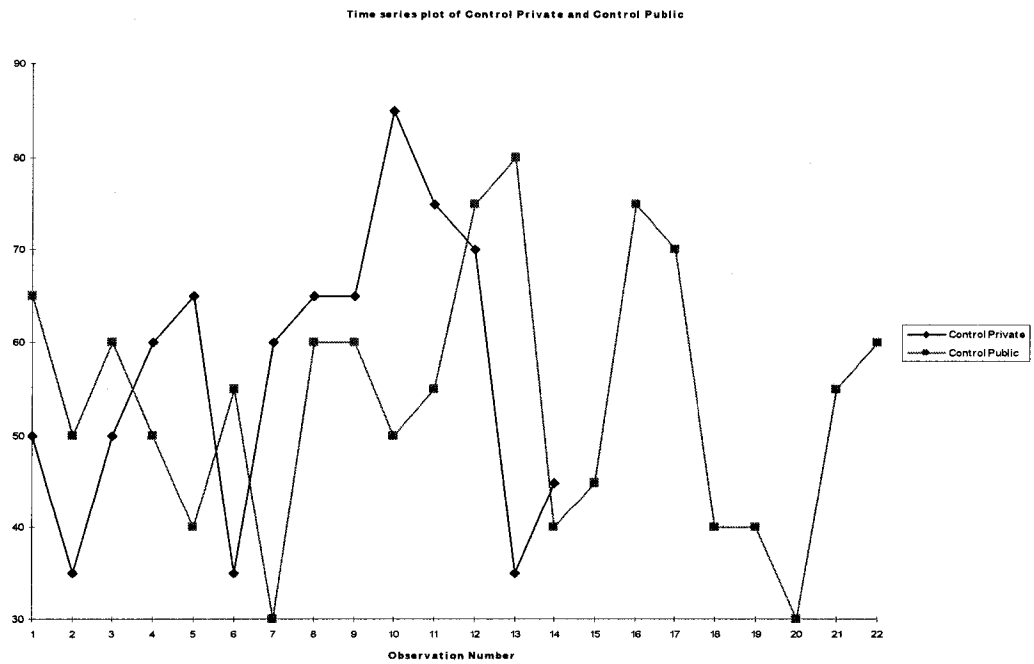


Figure 8. Time Series Plot of Control Private and Public School Groups.

Attitudes – Attitude Scale

Hypothesis # 3: The student responses to the questionnaire will reveal that storytelling helped them in mathematics.

The third hypothesis stated that the student responses to the questionnaire would reveal that storytelling made a difference in their understanding and application of two- and three-digit multiplication and two-and three-digit division.

A twenty question attitude scale was administered to students in the experimental groups following the two- and three-digit division post-tests. The attitude scales were used to gather data about the perceptions of third grade students toward storytelling as a method of learning mathematics. Questions #1 through #12 required participants to respond to each item by choosing one of three likert alternatives, Agree, Uncertain, and Disagree. Questions #13 through #20 were open-ended questions, which required participants to give their opinions about reading stories to learn mathematics. The questions were measured as possible predictors of mathematics achievement.

Table 15 (pages 24-25) reflects the frequency of responses of participants that responded, "Agree" with the statements on the attitude scale. Table 15 (page 26) reflects the frequency of the most common responses of participants to statements on the attitude scale.

Table 15. Frequency Tables (N=36)

Likert Alternatives

Question #	Statements	F	Percent
Question 1	*I am really good in math*		
	Agree	30	83.3
	Uncertain	5	13.9
	Disagree	1	2.8
	Total	36	100.0
Question 2	*Reading stories about multiplication helped me to learn to multiply.*		
	Agree	30	83.3
	Uncertain	5	13.9
	Disagree	1	2.8
	Total	36	100.0
Question 3	*Reading stories about division has helped me to learn how to divide.*		
	Agree	30	83.3
	Uncertain	5	13.9
	Disagree	1	2.8
	Total	36	100.0
Question 4	*Reading stories about multiplication and division has helped me to understand why it is important for me to learn math.*		
	Agree	31	86.1
	Uncertain	4	11.1
	Disagree	1	2.8
	Total	36	100.0
Question 5	*Reading stories about multiplication was fun.*		
	Agree	31	86.1
	Uncertain	3	8.3
	Disagree	2	5.6
	Total	36	100.0
Question 6	*Reading stories about division was fun.*		
	Agree	30	83.3
	Uncertain	4	11.1
	Disagree	2	5.6
	Total	36	100.0

Table 15. Frequency Tables (continued)

Question 7	*Reading stories about multiplication helped me to solve number problems.*		
	Agree	29	80.6
	Uncertain	4	11.1
	Disagree	3	8.3
	Total	36	100.0
Question 8	*Reading stories about division helped me to solve number problems.*		
	Agree	31	86.1
	Uncertain	4	11.1
	Disagree	1	2.8
	Total	36	100.0
Question 9	*Reading stories about multiplication helped me to get more correct answers to word problems.*		
	Agree	28	77.8
	Uncertain	5	13.9
	Disagree	3	8.3
	Total	36	100.0
Question 10	*Reading stories about division helped me to get more correct answers to word problems.*		
	Agree	28	77.8
	Uncertain	3	8.3
	Disagree	5	13.9
	Total	36	100.0
Question 11	*Reading stories about multiplication will help me to do well on my test.*		
	Agree	27	75.0
	Uncertain	7	19.4
	Disagree	2	5.6
	Total	36	100.0
Question 12	*Reading stories about division will help me to do well on my test.*		
	Agree	26	72.2
	Uncertain	7	19.4
	Disagree	3	8.3
	Total	36	100.0

Table 15. Frequency Tables (continued)

Open Ended Questions

	Question	F Most Common Response	Number Responded	Percent
Question 13	While you were learning multiplication, what did you like the most about math class?	Reading stories.	30	83.3
Question 14	While you were learning division, what did you NOT like about math class?	I liked everything.	28	77.8
Question 15	Since we started telling stories in math class, do you think it helped you to understand math?	Yes.	31	86.1
Question 16	What was your favorite story that was read in math class? Why was it your favorite story?	Two of Everything. (Answers Varied).	32	88.9
Question 17	How did telling stories in math class make you feel uncomfortable?	It did not.	36	100.0
Question 18	Why do you think that reading stories in math class was a waste of your time?	It was not.	35	97.2
Question 19	By telling stories, do you think you learned how to use math outside of your class?	Yes.	31	86.1
Question 20	Why do you think that your teacher should continue to read stories in math class?	Because it's fun.	28	77.8

Attitudes - Focus Group

In the private and public schools, fourteen students were selected from the experimental groups to participate in a tape-recorded focus group following completion of the attitude scale. The purpose of the focus groups was to obtain additional information about storytelling. Of the fourteen focus group members (seven in the

private school and seven in the public school), thirteen readily acknowledged that they enjoyed storytelling and acknowledged that they had learned something about mathematics through the stories and the related activities. The focus group members also commented that storytelling helped them to better understand and solve numerical and word problems. Some of the comments included:

- "I knew a little bit about multiplying big numbers before my teacher read stories, but I didn't know how to divide big numbers."
- "I wish my teacher would read stories all the time; it was fun."
- "Reading stories is my favorite part of math now."
- "I wish we could read stories for the rest of the year."
- "I didn't really like math before, but now I like it a little bit."
- "I think doing all the problems with lots of numbers would be really hard if we didn't read stories."
- "The stories helped me a little bit; I learned how to multiply and divide last year at my other school."
- "I think I could have learned how to multiply and divide big numbers if the teacher didn't read stories."
- "The stories made me pay attention in math more."
- "I really liked, "One Hundred Hungry Ants."
- "If our teacher stops reading stories, I won't like math anymore."
- "The second tests were much easier than the first tests."

Summary of Findings

The results of this study were analyzed through quantitative measures. In the discussion that follows in Chapter 5 (Conclusion), the findings will be evaluated further and an interpretation of what this research means will be provided.

Summary of the Chapter

In summary, the data support the hypotheses that storytelling is successful in helping elementary students to develop numerical and word problem solving skills and improving achievement in mathematics.

CHAPTER 5

CONCLUSION

Discussion

The use of storytelling, through children's literature has enormous potential as an instructional strategy to teach mathematics. The findings of this study confirm that storytelling is an effective instructional strategy that helps elementary students to develop numerical and word problem skills and increase achievement. According to Smith (1995) and Wickett (2000), combining mathematics and children's literature is one way for teachers to get students interested in learning mathematics. Storytelling, through the use of children's literature can also increase achievement (Burnett and Wichman, 1997; Hong, 1996; Jennings, Jennings, Richey and Dixon-Krauss, 1992).

If mathematics educators are earnest about reforming the way that mathematics is taught, they may consider implementing storytelling, through the use of children's literature. In considering storytelling as an instructional strategy, mathematics educators may wonder whether or not storytelling can be implemented as a stand alone method. Sound pedagogy suggests that children's literature cannot be used as a replacement for textbooks however; this research has demonstrated that storytelling can be implemented as a stand alone instructional method. While textbooks were utilized in this study, in the experimental groups (in both schools), they were employed as supplements to the lessons.

Should mathematics educators decide to implement storytelling as a stand alone method, it is important to carefully select the literature and develop well structured activities that correlate to the stories. Knowing which books to choose and how to use the literature most effectively with students is important for teachers.

Mathematics educators may also speculate whether or not this strategy can be implemented continuously. Storytelling can play a significant role in children's mathematics success and can be used constantly, provided that the literature is carefully selected and the activities correspond to the stories and learning objectives. The researcher recommends that storytelling not be overused. Mathematics educators should consider various instructional strategies in order to maintain ongoing student interest. The use of children's literature in mathematics is one approach in reforming the way that mathematics is taught. The findings of this study are discussed with regard to the three research questions

Results

Question 1: How does using children's literature help elementary students to solve numerical and word problems?

The findings relative to question # 1 reveal that storytelling, using children's literature, is an effective instructional strategy in helping students solve numerical and word problems. Students in the experimental groups (in both schools) demonstrated a greater ability to solve numerical and word problems during the intervention as observed by performances during in-class activities and grades on home assignments.

Storytelling, as a strategy, is in line with one of the NCTM (1989, 2000) goals, which states that mathematics classrooms that promote problem solving are those in which students learn several ways of representing and solving problems. According to the data in this research, storytelling, using children's literature, increases elementary student's abilities to identify and solve numerical and word problems. In the two units, students in both of the experimental groups performed better on the post-tests than students in the control groups.

Question 2: Is the achievement gain in mathematics greater when children's literature is used in the elementary school mathematics classroom?

The findings relative to question # 2 reveal that the achievement gain in mathematics is greater when storytelling is put into practice. Students in the experimental groups (in both schools) performed better on the two post-tests than the students in the control groups. Orr (1997) states that listening to stories improves student achievement in mathematics; it teaches students to use words as symbols to create something in the imagination beyond what is immediately observable. In other words, students are able to make greater connections to mathematics content through stories than they may through individualized work with repetitive paper and pencil assignments.

Question 3: Does using children's literature enhance the attitudes of elementary students towards mathematics when it is employed?

The findings relative to question # 3 reveal that storytelling, using children's literature does improve the attitudes of elementary students toward mathematics. Student

responses on the attitude scale revealed that storytelling was enjoyable Storytelling helped students learn to multiply and divide two- and three-digit numbers, solve numerical and word problems, and perform better on the two post-tests. According to Wickett (2000), storytelling connections with mathematics instruction may provide opportunities for a broader and deeper understanding of mathematics ideas. Boidy (1994) notes that storytelling is a strategy that enhances learning experiences and one that leads to higher student achievement and more positive attitudes toward learning mathematics.

Positive attitudes about storytelling were also conveyed in the focus groups (in both schools). Of the fourteen focus group members (seven in the private school and seven in the public school), thirteen readily acknowledged that they enjoyed storytelling and acknowledged that they learned something about mathematics through the stories and the related activities. The focus group members also commented that storytelling helped them to better understand and solve numerical and word problems.

Conclusion

The following conclusions about storytelling as an alternative instructional strategy have been developed as a result of this study:

Conclusion # 1: Storytelling, using children's literature, can help students with differing learning styles. According to the Wisconsin Center for Education Research (1998), the bottom line in instruction is always how much learning takes place. Do students demonstrate competence in academic areas? Are they able to formulate

questions? Are they able to propose solutions? Are they able to apply knowledge to new and different situations? Storytelling, through children's literature, can help elementary students with diverse learning styles, demonstrate competence in mathematics, formulate questions, propose solutions, and apply knowledge to new and different situations.

Conclusion # 2: Storytelling, using children's literature, can benefit elementary mathematics teachers. Storytelling can provide a more comprehensive picture of what a student is learning and provide more authentic information about the student, than can ongoing paper and pencil activities.

Conclusion # 3: Storytelling, using children's literature, can help elementary students understand and solve numerical and word problems.

Conclusion # 4: Storytelling, using children's literature, can increase student achievement in mathematics. Combined with opportunities for student interaction, discussion, and application, students develop a connection between the stories and mathematics and are able to apply what they learn to assessments.

Conclusion # 5: Storytelling, using children's literature, can enhance the attitudes of elementary students towards learning mathematics. Storytelling can keep students attentive and focused during instruction.

What do the above conclusions indicate? Limiting mathematics instruction solely to constant paper and pencil activities is not an effective instructional method in helping elementary students learn mathematics. In fact, this method of instruction may cause

students to become disengaged and disinterested in mathematics. Consequently, students begin to view mathematics as boring and irrelevant to their learning. When this happens, the short-term impact is that student achievement levels in mathematics begin to diminish, thus facilitating lower test scores along with an on-going national debate on mathematics reform. The long-term effect of students becoming disengaged in mathematics is a possible increase in the disparities of employment opportunities and careers, which according to Johnson and Packer (1987), Secada (1990), and Reyes (2002), will result in the creation of a permanently unemployable underclass.

Recommendations for Areas of Inclusion

This investigation of storytelling, using children's literature, provided a great deal of evidence that supports its' effectiveness as an instructional strategy in elementary mathematics classrooms. One area that may have been included in this research is an evaluation of the performances of the experimental class students on national norm assessments following the storytelling intervention. How did the students in the experimental groups (in both schools) perform on state and national assessments following the implementation of storytelling? Could storytelling have made an impact on these measurements, particularly on numerical and word problems that focused on two-and three digit multiplication and division?

Recommendations for Practice

This study suggests that some mathematics educators may be teaching mathematics by traditional paper and pencil methods. All mathematics educators need to

be on the same page, as far as mathematical teaching, if students are to advance technologically in the 21st Century.

Teacher education programs should offer pre-service mathematics teachers, courses that focus on alternative instructional strategies in mathematics. Storytelling, using children's literature, should be one of the strategies incorporated in the courses. Pre-service teachers need exposure to the educational benefits of children's literature and must learn ways of effectively sharing literature with their students.

School districts have to become informed about the changes necessary for reform in mathematics teaching and learning. School districts can provide mathematics workshops that are designed to show mathematics educators how to teach mathematics in interesting and enjoyable ways.

Education researchers should conduct studies that focus on alternative instructional strategies that can be used in elementary mathematics classes. Researchers should also conduct studies focusing on the attitudes of students towards mathematics in order to improve the learning of mathematics.

Recommendations for Future Research

The investigation of storytelling as an alternative instructional strategy in mathematics is an essential and valuable course of educational inquiry. Some interesting areas for future research may include the following:

1. Studies that use the same survey instrument as used in this study, but with higher grade level teachers, including the 4-6 configuration, middle school students, and high school students.

2. Studies that utilize other factors for analyzing the impact of storytelling, which could include race, gender, environment, and socio-economic status.
3. Studies that examine teacher attitudes towards storytelling in mathematics.
4. Studies that consider storytelling as an instructional strategy in mathematics with elementary special education students.
5. Studies that explore storytelling as an instructional strategy in mathematics with elementary talented and gifted students.

Studies that look at storytelling as an instructional strategy in mathematics with elementary students who speak English as a second language.

Studies that investigate the effects of storytelling on students that have math anxiety.

Additionally, further studies using an expanded notion of storytelling as a cultural and personal form of passing information, may reveal pertinent and interesting findings. Oral traditions have used storytelling as a means of instruction across time. More in-depth studies exploring cultural and personal storytelling as an instructional strategy in mathematics classrooms, may help us to better understand how this strategy can promote culturally responsive practices and increase the mathematical achievement of culturally diverse students.

Summary

The use of storytelling through children's literature is one method that elementary school teachers may use to provide their students with a different experience in mathematics. According to Smith (1995) and Wickett (2000) combining mathematics and storytelling in classroom activities is one way for teachers to invite children into the

world of mathematics. Ellis (1997) states that storytelling is an ideal vehicle to help students understand the importance of mathematics in their daily lives.

Based on the results of this study, the implementation of storytelling, using children's literature, as an instructional strategy in elementary mathematics classrooms, is an effective approach in teaching numerical and word problem solving skills and increasing achievement with elementary students.

APPENDIX A

INTRODUCTORY LETTER TO PRINCIPAL

Xxxxxx XX, 2006

Xxx. Xxxxxxxx Xxxxxxxx
Xxx Xxxxx Xxxxxx
Xxxxx Xxxxx Xxxx Xxx Xxxx
Xxxxxxx, XX xxxxx

Dear Xxx. Xxxxxxxx:

As a student at the American University in Washington, DC, I am involved in the dissertation phase of the Doctor of Philosophy program in the School of Education. My dissertation will focus on the implementation of storytelling as an alternative instructional strategy in elementary mathematics classrooms. My goal is to determine if the use of storytelling is an effective strategy in teaching problem solving skills and in raising the achievement levels of students in elementary mathematics classrooms.

I thank you for granting permission to conduct this research in your school. Upon approval from the chairperson and members of my dissertation committee to begin this research, I will inform you when the study will begin. I will meet with the two third grade teachers who will participate in this project (prior to the study) to further explain the scope of the research, share the research methodology, provide (and discuss) the experimental lesson plans, and address any inquiries and/or concerns.

One week prior to the start of the unit, an introductory letter (and consent forms) will be given to the third grade teachers to send out to the parents of the students in the weekly Monday courier envelopes. I will request that the consent forms be returned within two days following the distribution to parents. Please note that students must have parental permission to participate in this study.

All data collected during this research will be confidential. The instruments that will be used in this research will be coded to identify the students. In order to properly match each student with scores, the number on the instruments will correspond with each teacher's grade book or class list. For example, if André Anderson is the first student on the class roster, André Anderson should be given the instruments that have the number one on the last page. The distribution and collection of data will be conducted in a

manner so as to limit the disruption of normal school activities. Again, thank you for your assistance.

Sincerely,

Mr. André S. Morgan

APPENDIX B

INTRODUCTORY LETTER TO TEACHER A

Xxxxxxxx XX, 2006

Xx. Xxx Xxxxxx
Xxx Xxxxx Xxxxxx
Xxxxx Xxxxx Xxxx Xxx Xxxx
Xxxxxxx, TX xxxxx

Dear Xx. Xxxxxx:

Thank you for your willingness to assist in the research that I am conducting. My dissertation will focus on the implementation of storytelling as an alternative instructional strategy in elementary mathematics classrooms. My goal is to determine if the use of storytelling is an effective strategy in teaching problem solving skills and in raising the achievement levels of students in elementary mathematics classrooms.

I recognize that this is an extremely busy time of the year; hence, I appreciate your cooperation. I am requesting to meet with you and Xx. Xxxxxx on Xxxxxx xx, xxxx at x:xx PM in Room xxx. During this meeting, I will further explain the scope of the research, share the research methodology, provide (and discuss) the experimental lesson plans, and address any inquiries and/or concerns.

Once the project begins, I will ask you to send home an introductory letter and consent forms to the parents of your students in the weekly Monday courier envelopes. I will request that the consent forms be returned within two days following the distribution to parents. Please note that students must have parental permission to participate in this study.

All data collected during this research will be confidential. The instruments that will be used in this research will be coded to identify the students. In order to properly match each student with scores, the number on the instruments will correspond with your grade book or class list. For example, if André Anderson is the first student on your class roster, André Anderson should be given the instruments that have the number 1 on the last page. The distribution and collection of data will be conducted in a manner so as to limit the disruption of normal school activities.

If you have any questions prior to our meeting or to the study, please do not hesitate to contact me at (xxx) xxx-xxxx. Again, thank you for your assistance.

Sincerely,

Mr. André S. Morgan

INTRODUCTORY LETTER TO TEACHER B

Xxxxxxxx XX, 2006

Xx. Xx Xxxxxx
Xxx Xxxxx Xxxxxx
Xxxxx Xxxxx Xxxx Xxx Xxxx
Xxxxxxx, TX xxxxx

Dear Xx. Xxxxxx:

Thank you for your willingness to assist in the research that I am conducting. My dissertation will focus on the implementation of storytelling as an alternative instructional strategy in elementary mathematics classrooms. My goal is to determine if the use of storytelling is an effective strategy in teaching problem solving skills and in raising the achievement levels of students in elementary mathematics classrooms.

I recognize that this is an extremely busy time of the year; hence, I appreciate your cooperation. I am requesting to meet with you and Xxx. Xxxxxx on Xxxxxx xx, xxxx at x:xx PM in Room xxx. During this meeting, I will further explain the scope of the research, share the research methodology, provide (and discuss) the experimental lesson plans, and address any inquiries and/or concerns.

Once the project begins, I will ask you to send home an introductory letter and consent forms to the parents of your students in the weekly Monday courier envelopes. I will request that the consent forms be returned within two days following the distribution to parents. Please note that students must have parental permission to participate in this study.

All data collected during this research will be confidential. The instruments that will be used in this research will be coded to identify the students. In order to properly match each student with scores, the number on the instruments will correspond with your grade book or class list. For example, if André Anderson is the first student on your class roster, André Anderson should be given the instruments that have the number 1 on the last page. The distribution and collection of data will be conducted in a manner so as to limit the disruption of normal school activities.

If you have any questions prior to our meeting or to the study, please do not hesitate to contact me at (xxx) xxx-xxxx. Again, thank you for your assistance.

Sincerely,

Mr. André S. Morgan

APPENDIX C

INTRODUCTORY LETTER TO PARENTS OF PARTICIPATING

THIRD GRADE STUDENTS

Xxxxxxxx XX, 2006

Dear Third Grade Parents:

As a student at the American University in Washington, DC, I am involved in the dissertation phase of the Doctor of Philosophy program in the School of Education. My dissertation will focus on the implementation of storytelling as an alternative instructional strategy in elementary mathematics classrooms. My goal is to determine if the use of storytelling is an effective strategy in teaching problem solving skills and in raising the achievement levels of students in elementary mathematics classrooms.

I have selected to conduct this research with the two third grade classes at Xxx Xxxxx Xxxxxx. I have met with your child's teacher to explain the scope of the research, share the research methodology, and provide (and discuss) the experimental lesson plans. Students must have parental permission to participate in this study. All data collected during this research will be confidential. The instruments that will be used will be coded to identify the students.

Attached is a consent form for your review and signature. Please return the consent form by Wednesday, Xxxxxx xx, xxxx. The distribution and collection of data will be conducted in a manner so as to limit the disruption of normal school activities.

I thank you in advance for your assistance. If you have any inquiries prior to the study, please do not hesitate to contact me at (xxx) xxx-xxxx.

Sincerely,

Mr. André S. Morgan

APPENDIX D

CONSENT FORM FOR PRINCIPAL

I hereby grant permission for Mr. André Morgan, a candidate in the American University, Doctor of Philosophy Program, to facilitate research for his dissertation project at Xxx Xxxxx Xxxxxx. I understand that Mr. Morgan's research will focus on the implementation of storytelling as an alternative instructional strategy in elementary mathematics classrooms with the goal of determining if the use of storytelling is an effective strategy in teaching problem solving skills and in raising the achievement levels of students.

I consent to the following items:

- A meeting with the two third grade teachers, in which Mr. Morgan will further explain the scope of the research, share the research methodology, provide (and discuss) the experimental lesson plans, and address any inquiries and/or concerns that the teachers may have regarding this research .
- An introductory letter describing the study (with consent forms) to be sent home to the parents of the students participating in this study.
- The administration and collection of the pre-tests and post-tests.
- The administration of experimental lesson plans that the third grade teachers will use in their classrooms.
- Follow-up interviews with students.
- The distribution and collection of a questionnaire to students.
- The inclusion of data in the data analysis section of the research project.

_____ _____

Signature Date

APPENDIX E

CONSENT FORM FOR TEACHERS

I hereby grant permission for Mr. André Morgan, a candidate in the American University, Doctor of Philosophy Program, to facilitate research for his dissertation project in my third grade class. I understand that Mr. Morgan's research will focus on the implementation of storytelling as an alternative instructional strategy in elementary mathematics classrooms with the goal of determining if the use of storytelling is an effective strategy in teaching problem solving skills and in raising the achievement levels of students.

I consent to the following items:

- A meeting, in which Mr. Morgan will further explain the scope of the research, share the research methodology, provide (and discuss) the experimental lesson plans, and address any inquiries and/or concerns that I may have regarding this research.
- An introductory letter describing the study (with consent forms) to be sent home to the parents of the students participating in this study.
- The administration and collection of the pre-tests and post-tests.
- The administration of experimental lesson plans that I will use in my classroom.
- Follow-up interviews with students.
- The distribution and collection of a questionnaire to students.
- The inclusion of data in the data analysis section of the research project.

_____ _____

Signature Date

APPENDIX F

CONSENT FORM FOR PARENTS

I, _____, hereby grant permission for

my child _____ to participate in the

research project that will be conducted by Mr. André Morgan, a candidate in the American University, Doctor of Philosophy Program. I understand that Mr. Morgan's research will focus on the implementation of storytelling as an alternative instructional strategy in elementary mathematics classrooms with the goal of determining if the use of storytelling is an effective strategy in teaching problem solving skills and in raising the achievement levels of students.

I consent to the following items:

- The administration and collection of pre-tests and post-tests.
- Exposure to a condition that is experimental.
- The administration of experimental lesson plans that will be implemented in my child's classroom.
- A follow-up interview (to be conducted by André Morgan) with my son/daughter.
- The distribution and collection of a questionnaire to/from my son/daughter.
- The inclusion of data in the data analysis section of Mr. Morgan's research project.

_____ _____

Signature Date

APPENDIX G

PRE-TEST (MULTIPLICATION)

***Multiplication Problems*. Solve the following problems.**

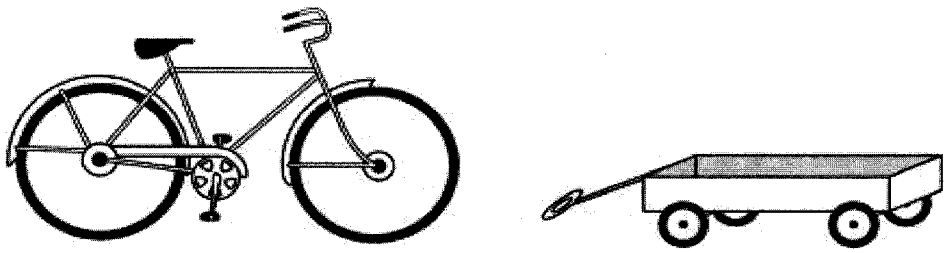
1.	74 × 7	2.	99 × 8	3.	73 × 9
4.	43 × 67	5.	26 × 83	6.	98 × 94
7.	405 x 3	8.	395 x 7	9.	635 x 36
10.	219 × 27	11.	356 x 72	12.	690 x 447

13. $\begin{array}{r} 826 \\ \times\ 244 \\ \hline \end{array}$

14. $\begin{array}{r} 350 \\ \times\ 420 \\ \hline \end{array}$

Word Problems. ***For the following questions, write in the answer or circle the correct letter containing the answer.***

15.



A school yard contains only bicycles and wagons like those in the figure above.

On Monday there were 3 bicycles and 2 wagons in the school yard. How many wheels were in the school yard?

Answer: _____

16. Kim wants to give 7 stickers to each of her 5 friends. To find out how many stickers she needs, she writes the number sentence $7 + 7 + 7 + 7 + 7 = \square$.

Write a number sentence with multiplication that she could use to find the number of stickers she needs.

Answer: _____

17. There are 570 butterflies. Each butterfly has 6 black dots and 5 yellow dots. How many black dots are there in all?

A. 4,420
B. 3,420
C. 2,420
D. 1,420

18. Carla has 12 boxes that each weigh the same amount. What would be a quick way for her to find the total weight of the 12 boxes?

A. Add 12 to the weight of one of the boxes
B. Subtract 12 from the weight of one of the boxes
C. Divide the weight of one of the boxes by 12
D. Multiply the weight of one of the boxes by 12

19. The third grade class trip costs $100 for each child. If there are 47 children in the class, how many dollars will the teacher collect?

A. 4,700
B. 5,000
C. 5,700
D. 6,000

20. If 100 dogs each buried 100 bones, how many bones were buried?

A. 10,000
B. 5,000
C. 1,000
D. 500

APPENDIX H

LESSON PLANS (TWO/THREE DIGIT MULTIPLICATION)

Day 1

Objectives: Students will be introduced to two- and three-digit multiplication.

Students will be introduced to multiplication word problems.

In-Class Activities:

1. Introduction. The teacher will tell students that the purpose of this unit on two- and three-digit multiplication is to help students to multiply larger numbers. The teacher will define multiplication as the process of adding equal sets together. The teacher will tell the students that they will learn how to multiply two and three digits and will also tell students that multiplying two and three digits is as easy as multiplying with one digit. The teacher will then explain to the students why it is important to learn to multiply two- and three-digit numbers noting that by using two- and three-digit multiplication, we can find the product (the answer in a multiplication problem) of an equation a lot faster than counting each individual piece. The teacher will tell students that in a multiplication problem with two digits or more that each place value is multiplied separately, then all products are added together to get the final product. The teacher will tell students that they will begin learning two-digit multiplication and then learn three-digit multiplication.

2. Pre-Reading Activity: Review the ones and tens place value by writing the number forty-six on the board. Explain that when we multiply two digits by two digits we need to line the numbers up in the correct place value column. Write the numbers thirty-three under the six and the four and set up forty-six times thirty-three =. Show students how to solve the problem. The teachers may consider doing a few more problems to begin reinforcing the skill.

3. Storytelling. The teacher will read *Two of Everything* by Lily Hong.

4. Discussion: After reading the story, have students summarize the story, remembering what happened to everything that was put in the pot.

5. Problem Solving: Introduce problem solving to students. Write an example of a word problem on the board. Explain to the class that the first strategy for solving word problems is to read the problem completely. The second strategy for solving problems is to ask yourself what information is needed to solve the problem. Next, find the information needed to solve the problem. Write the information down. Finally, solve the problem. Tell students that some key words in a word problem will let you know when to add, subtract, multiply, and/or divide.

   The teacher will write the following example on the board to review with students:

   Example:

   Each class in a school has thirty-six students. If there are ten classes, how many students are there in the school?

   The teacher should lead the discussion on how to solve this problem, drawing whatever answers are volunteered by the students on how to solve it. The teacher may also refer to the numerical example used in the Pre-Reading Activity.

Home Activity:

Students will complete a two digit multiplication practice worksheet (this comes from the student workbook that the teachers will be using with students).

Day 2

Objectives: Students will calculate the product of two-digit by two-digit numbers.

Students will model a problem situation with objects and solve the problem.

Activities:

1. Storytelling: Ask students to recap *Two of Everything* by Lily Hong, remembering what happened to everything that was put in the pot.

2. Discussion: Brainstorm and discuss how the ants could have made it to the picnic sooner. Ask students why they think the story ended the way that it did? Were the

littlest ant's ideas worth trying? Why or why not? Accept answers volunteered by students.

3. Problem Solving: Draw a chart on the board with two columns, one labeled IN and the other OUT. Challenge students to figure out what is magic about the pot (in the story) as they begin to fill in the chart. As students suggest numbers and write them in the IN column, the teacher will fill in the number that would match it in the OUT column. (e.g. when ten goes IN, twenty comes OUT). Record several numbers until students begin to catch on to the pattern. "It doubles" will likely be the common answer by students. Discuss the idea of doubling.

4. Problem Solving: Divide students into small groups and hand out dominoes to each team. Each team is to multiply each side of the domino to find their product. Students will then drop their domino in the bag labeled with the answer/product. Different colored dominoes can be used to separate the teams. Once everyone has dropped their dominoes, the bags are checked to make sure that the correct dominoes are in each bag. Points can be awarded to determine the winning team.

5. Problem Solving: The same groups will be given a set of ten dominoes and a piece of paper. As a group, the students are to write a number sentence that will match each of their dominoes. Points can be awarded to determine the winning team.

Home Activity:

Students will complete a two-digit multiplication and a word problem practice worksheet (both worksheets comes from the student workbook that the teachers will be using with students).

Day 3

Objective: Students will continue multiplying two-digit by two-digit numbers.

Students will solve multiplication word problems.

Activities:

1. Storytelling: Ask students to recap *Two of Everything* by Lily Hong, remembering what happened to everything that was put in the pot.

2. Problem Solving: Pose this question to students: Could our class line up in two even lines? Ask all the children to stand and try. Select two students to start the lines, standing side by side. If there is an even number of students in the class, the teacher may write on the board "2 rows of 12" and make a quick sketch of it using circles to represent children. If there is an odd number, the teacher may record, "2 rows of 12 and one extra." Then the teacher will ask ask, "What if we got a new student in our class tomorrow: Could we still line up in two even lines?" Solicit responses from students.

   The teacher may then ask whether other classes in the school can line up in two even lines. After the students make predictions, place the students in pairs and ask them to choose one class to investigate. Pairs report back to the class and the teacher records the information on the board.

3. Reinforcement: Write ten two by two-digit multiplication problems on the board and ask students to solve them individually. Accept answers volunteered by students and review correct answers.

Home Activity:

Students will complete two digit multiplication practice exercises and problem solving exercise (this comes from the textbook that the teachers will be using with students).

Day 4

Objective: Students will multiply three-digit numbers by one-digit numbers.

Students will begin multiplying three-digit numbers by two-digit numbers.

Activities:

1. Pre-Reading Activity. The teachers will share with students that we will read another story that will help everyone to learn how to multiply two- and three-digit numbers.

2. Pre-Reading Activity: Review the ones, tens, and hundreds place value by writing the number 460 on the board. Explain that when we multiply three digits by one digit, we need to line the numbers up in the correct place value column. Write the number three under the zero and set up 460 x 3=. Show students how to solve the equation. The teachers may consider doing a few more problems to begin reinforcing the skill.

3. Storytelling. The teacher will read, *One Hundred Hungry Ants* by Elinor Pinczes. Each time the ants rearrange themselves in the story, ask students to predict what the next arrangement might be. After finishing the book, visit the story again and list the different ant formations on the board:
100 x 1... 2 x 50... 4 x 25...5 x 20... 10 x 10...

4. Discussion: After reading the story, have students summarize the story, remembering what happened each time the ants rearranged themselves.

5. Problem Solving: Talk with students about other possible ant arrangements, such as 20 x 5 and 25 x 4. List other possibilities on the board. For one hundred ants, there are nine different formations in all.

6. Problem Solving: Pose a question to students: "What if there were a different number of ants? Could we figure out how many formations would be possible?" Have students work in pairs and investigate this for the numbers from one to thirty. Assign two to three different numbers to each pair, either by distributing cards with the numbers from one to thirty on them or listing the numbers from one to thirty on the board and writing students' names next to them.

7. Review: Review the ones, tens, and hundreds place value by writing the number 460 on the board. Explain that when we multiply three digits by two digits we need to line the numbers up in the correct place value column. Write the numbers thirty-three under the zero and the six and set up 460 x 33=. Show students how to solve the equation. The teachers may consider doing a few more problems to reinforce the skill.

Home Activity:

Students will complete one three digit by one digit multiplication practice worksheet and one three by two multiplication practice worksheet (this comes from the student workbook that the teachers will be using with students).

Day 5

Objective: Students will continue multiplying three-digit numbers by two-digit numbers.

Students will learn to multiply three-digit numbers by three-digit numbers.

Activities:

1. Reinforcement: Write five three by one and five three by two-digit multiplication problems on the board and ask students to solve them individually. Accept answers volunteered by students and review correct answers.

2. Storytelling: Ask students to recap *One Hundred Hungry Ants* by Elinor Pinczes, remembering what happened in the story each time the ants rearranged themselves.

3. Review: Explain that when we multiply three digits by three digits, we need to line the numbers up in the correct place value column. Write the number three under the zero, the three under the six, and the three under the four and set up 460 x 333=. Show students how to solve the equation. The teachers may consider doing a few more problems to reinforce the skill.

4. Pre-Reading: ask them to consider a change in the story. Tell them that the story will be re-read; only this time, the original numbers in the story will be multiplied by three.

5. Storytelling: Re-read *One Hundred Hungry Ants* by Elinor Pinczes, multiplying all of the original numbers in the story by three.

6. Problem Solving: Divide students in pairs and have them to brainstorm to create math word problems that go with the modified story (original numbers in the story multiplied by three). Write all ideas on the board and have students tell how the problems can be solved.

Home Activity:

Students will complete one three-digit by two-digit multiplication practice worksheet, one three-digit by three-digit multiplication practice worksheet, and a word problem exercise (this comes from the student workbook that the teachers will be using with students).

Day 6

Objective: Students will practice multiplying three-digit numbers by two-digit numbers.

Students will practice multiplying three-digit numbers by three-digit numbers.

Activity:

1. Reinforcement: Write five three by two-digit multiplication problems and five three by three-digit multiplication problems on the board and ask students to solve them individually. Accept answers volunteered by students and review correct answers.

2. Practical Application: Multiplication Bingo.

   Instructions:
   Each child needs two pieces of construction paper. Instruct the students to take one piece of paper and do the following:
   a. Fold in half from top to bottom.
   b. Fold again from top to bottom.
   c. Fold in half from side to side.
   d. Fold again from side to side.

   When the students open the paper, there should be sixteen squares. As you call out the products of sixteen multiplication facts, the students write those products in a different square. Keep a list for yourself of the facts that you are using that day.

   Students should fold the second piece of paper exactly as they did the other. Using scissors cut out the squares so that there are sixteen pieces of paper to use on their game board.

   Playing the game:

   Decide which kind of bingo you want to play (i.e. horizontal, vertical, diagonal, postage stamp (four (4) in the top right hand corner), bulls eye (four in the center), picture frame (all but the four in the center), "X" (two diagonals). Using the list of sixteen multiplication facts, call out the factors only. For example, you say "2 x 5". The students must know the product, find it on their game board, and cover it with a piece of paper. Students are not allowed to tell other students what the product is.

   Continue calling out facts until someone gets a bingo. Be sure to mark on your master copy the facts you called, so you can check your winner to see if he/she covered the correct products. Keep a record of who wins the most games. That student could be the first in line for the day, have extra free time, be excused from a future homework assignment, etc.

Home Activity:

Students will complete a three-digit by three-digit multiplication practice worksheet and one word problem exercise (this comes from the student workbook that the teachers will be using with students).

Day 7

Activity:

1. Review: Review the following with students:

   - two by two-digit multiplication
   - two by three-digit multiplication.
   - three by one-digit multiplication.
   - three by two-digit multiplication.
   - three by three-digit multiplication.

   The teacher may use unit worksheets and exercises. The teacher may assign problems to students to work on individually or may have students to work on problems in groups. The teacher will review answers with students once problems are completed.

Day 8

Activity:

1. Achievement: Distribute Multiplication Post-Test.

APPENDIX I

POST-TEST (MULTIPLICATION)

Multiplication Problems*. *Solve the following problems.

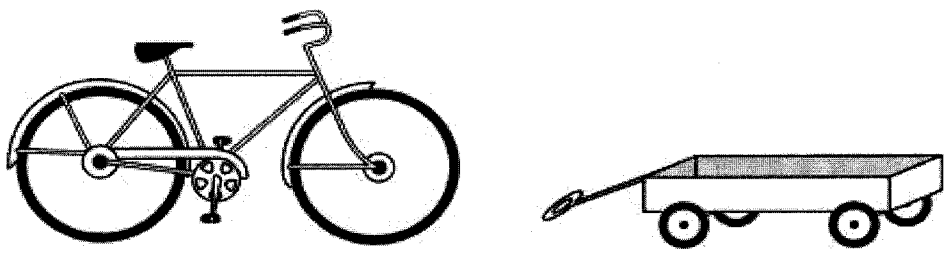
1.	74 × 7	2.	99 × 8	3.	73 × 9
4.	43 × 67	5.	26 × 83	6.	98 × 94
7.	405 x 3	8.	395 x 7	9.	635 x 36
10.	219 × 27	11.	356 x 72	12.	690 x 447

13. $\begin{array}{r} 826 \\ \times\ 244 \\ \hline \end{array}$

14. $\begin{array}{r} 350 \\ \times\ 420 \\ \hline \end{array}$

Word Problems. ***For the following questions, write in the answer or circle the correct letter containing the answer.***

15.



A school yard contains only bicycles and wagons like those in the figure above.

On Monday there were 4 bicycles and 3 wagons in the school yard. How many wheels were in the school yard?

Answer: _____

16. Kenneth wants to give 8 stickers to each of his 5 friends. To find out how many stickers he needs, he writes the number sentence $8 + 8 + 8 + 8 + 8 = \square$.

Write a number sentence with multiplication that he could use to find the number of stickers he needs.

Answer: _____

17. There are 570 butterflies. Each butterfly has 6 black dots and 5 yellow dots. How many yellow dots are there in all?

A. 3,850
B. 2,850
C. 1,850
D. 850

18. Carlos has 14 boxes that each weigh the same amount. What would be a quick way for him to find the total weight of the 14 boxes?

E. Add 14 to the weight of one of the boxes
F. Subtract 14 from the weight of one of the boxes
G. Divide the weight of one of the boxes by 14
H. Multiply the weight of one of the boxes by 14

19. The third grade class trip costs $100 for each child. If there are 37 children in the class, how many dollars will the teacher collect?

A. 3,700
B. 4,000
C. 5,700
D. 6,000

20. If 125 dogs each buried 100 bones, how many bones were buried?

A. 15,500
B. 14,500
C. 13,500
D. 12,500

APPENDIX J

PRE-TEST (DIVISION)

Division Problems*. *Solve the following problems.

1.	$581 \div 7$	2.	$392 \div 4$	3.	$356 \div 5$
4.	$108 \div 9$	5.	$800 \div 40$	6.	$918 \div 20$
7.	$249 \div 83$	8.	$783 \div 87$	9.	$366 \div 122$
10.	$520 \div 260$	11.	$900 \div 150$	12.	$999 \div 300$

<u>Word Problems.</u> For the following questions, write in the answer or circle the correct letter containing the answer.

13. Martha planted 320 seeds. She put 8 seeds in each row. How many rows did she plant? Which of the following could Martha use to solve the problem correctly?

    A. $320 + 8$
    B. $320 - 8$
    C. 320×8
    D. $320 \div 8$

14. One glass of orange juice requires 4 oranges. If 278 oranges are available, how many glasses of orange juice can be made?

    Answer: _____

15. If the sum of 39 and 66 and 105 is divided by 30, the result is:

    A. 20
    B. 17
    C. 10
    D. 7

16. If a store sold 550 tapes in 50 weeks, how many tapes did the store sell each week?

    A. 44
    B. 33
    C. 22
    D. 11

17. A club held a car wash and washed 168 cars. If the club raised $840, how much did it charge per car?

A. $5.00
B. $4.00
C. $3.00
D. $1.00

18. Every hour, a company makes 750 paper plates and puts them in packages of 125 plates each. How many packages are made in one hour?

A. 6
B. 7
C. 8
D. 9

19. Mom bought 402 chocolates for the party. If mom had 134 gift bags, how many chocolates could she put in each bag so that each bag had an equal amount?

Answer: _____

20. A farmer has 900 chickens. He wants to place 225 chickens in each cage. How many cages will he need?

A. 2
B. 4
C. 6
D. 8

APPENDIX K

LESSON PLANS (TWO/THREE-DIGIT DIVISION)

Day 1

Objective: Students will be introduced to two- and three-digit division.
Students will be introduced to problem solving methods.

Activities:

1. Pre-Reading Activity. The teacher will tell students that the purpose of this unit on two- and three-digit division is to help students learn to divide larger numbers. The teacher will define division as the process of finding out how many times one number is contained in another number. The teacher will tell the students that they will learn how to divide two- and three-digits and will also tell students that dividing two- and three-digits is as easy as dividing with one digit. The teacher will then explain to the students why it is important to learn to divide two- and three-digit numbers noting that division helps us to separate numbers into parts.

2. Pre-Reading Activity: Review the ones and tens place value by writing the number forty-six on the board. Explain that when we divide two-digits by two-digits, we need to set the numbers up in the correct place value column. Write the problem $46 \div 23$. Show students how to solve the problem. The teacher may consider doing a few more similar problems to begin reinforcing this skill.

3. Storytelling. Read *The Doorbell Rang* by Pat Hutchins.

4. Discussion: After reading the story, have students summarize the story, remembering what happened each time a child arrived at the house.

5. Problem Solving: Review problem solving with students. Write an example of a word problem on the board. Explain to students that the first step is to read the problem completely. The second strategy for solving problems is to ask yourself what information is needed to solve the problem. Next, find the information needed to solve the problem. Write the information down. Finally, solve the problem. Remind students that some of the key words in a word problem will let you know when to add, subtract, multiply, and/or divide.

The teacher will write the following example on the board to review with students:

Example:

Our school has forty-four students. If they are divided into four sections, how many students are there in each section? The teacher should lead the discussion on how to solve this problem, drawing whatever answers are volunteered by the students on how to solve it.

6. Problem Solving: Return to the story, *The Doorbell Rang*, remembering what happened each time a child arrived at the house. Using a large bag of chocolate chip cookies, ask students how we could equally divide a bag of seventy-two chocolate chip cookies amongst all class members. Accept answers volunteered by students and review correct answer.

Home Activity:

Students will complete a two digit division activity worksheet and a problem solving exercise (this comes from the workbook and textbook that the teachers will be using with students).

Day 2

Objective: Students will divide two-digit numbers by two-digit numbers.

Students will model a problem situation with objects and draw conclusions.

Activities:

1. Storytelling: Ask students to recap *The Doorbell Rang* by Pat Hutchins, remembering what happened each time a child arrived at the house.

2. Problem Solving: Divide students in groups. Pass out twelve cookies and two paper plates to each group. Ask them to solve the following problem: If there are two children, how would they share the cookies equally? After the groups have finished dividing the cookies on the plates, ask them to record their answer on a piece of paper and then justify them.

Then pass out two more paper plates to each group and repeat the above procedure. Then repeat the above procedure after passing out two more paper plates (so each group has a total of six and then a total of twelve paper plates).

3. Reinforcement: Write ten two- by two-digit division problems on the board and ask students to solve them individually. Accept answers volunteered by students and review correct answers.

Home Activity:

Students will complete two-digit by two-digit division exercises and a word problem practice worksheet (both assignments come from the student workbook that the teachers will be using with students).

Day 3

Objective: Students will divide two-digit by two-digit numbers.

Activities:

1. Storytelling: Ask students to recap *The Doorbell Rang* by Pat Hutchins, remembering what happened each time a child arrived at the house.

2. Problem Solving. Divide students in pairs or in groups of three. Allow the groups of students to work together to figure out what would happen if they had half of the students or half of the cookies. The teacher will accept answers from the groups and review aloud.

3. Discussion. Tell students to envision that "Ma," one of the characters in the story, baked ninety-nine oatmeal raisin cookies for her eleven nieces and nephews to share equally. How many cookies will each child get? Ask for volunteers to set up the problem on the board. Discuss with students. Teachers may consider additional problems from the story for reinforcement.

4. Problem Solving: Beginning with a large bag of M&M's, divide the class into teams. Allow each team to estimate how many M&Ms are in the bag. The team with the closest guess gets to divide the bag. Count them up and then have the students divide them equally using different numbers. When they have finished, have them divide the bag by the total number of students in the class, and give each person an equal amount.

5. Problem Solving: Have students brainstorm to create math word problems that go with the story *The Doorbell Rang*. The teacher will write student ideas on the board. Have students tell how the problems can be solved.

Home Activity:

Students will complete two-digit by two-digit division practice exercises (this comes from the textbook that the teachers will be using with students).

Day 4

Objective: Students will learn to divide three-digit numbers by one-digit numbers.

Students will understand the idea of a "remainder" and compute division problems with remainders.

Activities:

1. Reinforcement: Write ten two by two-digit division problems on the board and ask students to solve them individually. Accept answers volunteered by students and review correct answers.

2. Storytelling: Read *17 Kings and 42 Elephants* by Margaret Mahy.

3. Discussion: After reading the story, have students summarize the story, remembering what happened during the story. Explain to the class that at the end of their trip, the seventeen kings each go to their own kingdom. They must take the forty-two elephants with them. Ask the class how they can divide the elephants fairly among the seventeen kings. Accept answers volunteered by students. Explain to students that not all numbers can be divided exactly. Sometimes when you divide a number into equal groups, you have some left over. Explain to students that a remainder occurs when a division problem does not result in a whole number.

4. Problem Solving: Divide the students in groups. Before sending students to start solving, make sure all students understand the problem. Ask each group to write the problem, its' solution, and explain what was done to solve the problem. Have students include a number sentence that represents what they did.

   When students are finished, come back together as a whole class and discuss the problem and the students' solutions. Encourage groups to share their process for solving the problem and defend their solution. The teacher will want to point out how different groups handled the remaining eight elephants. Teachers will

remind students that a remainder occurs when a division problem does not result in a whole number. For example, in the problem six divided by four, four goes into six once leaving a remainder of two.

Discuss ways different kinds of remainders could be handled. What if there were fifty-two elephants to divide among the kings? How many kings would you need to not have any elephants remaining? These may become additional problems for students to solve.

5. Review: Review the ones and tens place value by writing the number 460 on the board. Explain that when we divide three-digits by one-digit we need to set the numbers up in the correct place value column. Write the problem 460 ÷ 4 on the board. Show students how to solve the equation. The teachers may consider doing a few more similar problems to begin reinforcing the skill.

Home Activity:

Students will complete a three-digit by one-digit division word problem exercise (these come from the workbook that the teachers will be using with students).

Day 5

Objective: Students will divide quantities with remainders.

Activities:

1. Storytelling: Recap 17 *Kings and 42 Elephants* by Margaret Mahy, remembering what happened during the story.

2. Problem Solving: Divide students in groups of four. Ask students what should be done with the remaining elephants after all of the elephants have been divided fairly among the kings. When students are finished, come back together as a whole class and discuss the problem and the students' solutions. Encourage groups to share their process for solving the problem and defend their solution.

3. Problem Solving: Keep students in groups of four. Tell the students a story about four children who find a $5 bill. They give it to the school principal who explains that she will keep it for one week in case anyone claims it. If no one has done so after a week, the children can have the money. When the children return in a week, she tells them they can have the money as long as they share it equally among themselves.

The students work in groups of four to determine how to divide $5.00 equally among themselves. They may draw or write an explanation to show how the money is shared equally.

When students have solved this problem, ask them to figure out how to divide $.50 among four people. The teacher may include the use of play money. Students draw or write an explanation of how the money is shared equally.

4. Problem Solving: Ask students to clear their desks and give each child one box of raisins and one sheet of paper. Tell students that they will get to eat the raisings after completing the activity.

   Ask children to guess how many raisins are in their boxes. The teacher will record their guesses on the board, identifying the smallest and largest.

   Ask students to empty the raisins on a sheet of paper. Ask them to group the raisins in some way to count them. On the board, record how many raisins each child reports, and how they grouped them:

Examples:	31	3 groups of 10 and 1 left over
	32	6 groups of 5 and 2 left over
	32	3 groups of 10 and 2 left over

   Next, have students work in groups. Have them decide how many raisins their group has altogether. Then ask students to share the total number of raisins equally with the group. Have students record the total number of raisins. Ask them to write how they did the sharing.

Home Activity:

Students will complete an exercise on division word problems with remainders (this comes from the workbook that the teachers will be using with students).

Day 6

Objective: Students will learn to divide three-digit numbers by two-digit numbers.

Students will continue learning how to divide with remainders.

Activities:

1. Reinforcement: Write ten three by one-digit division problems on the board and ask students to solve them individually. Accept answers volunteered by students and review correct answers.

2. Storytelling / Problem Solving Activity: Recap 17 *Kings and 42 Elephants* by Margaret Mahy, remembering what happened during the story. Ask students the below questions. Ask for responses and how students derived the answer.

   A. *How many footprints did they all make in the jungle?*
   The Kings have two feet each and would make a total of thirty-four footprints in the jungle. The elephants have four feet and would leave footprints in the forest. The total number of footprints would therefore be 202 footprints altogether.

   B. *How many ears and tails did they have altogether?*
   The King's have two ears each and no tails so they would have a total of thirty-four ears. The elephants have two ears, each which is eighty-four ears. They each have one tail, which would total forty-two tails. They would have 118 ears and forty-two tails in total. Altogether, they would have 160 ears and tails.

2. Problem Solving: Tell students that the original numbers in the story will now change. Adding one digit to the original number of elephants in the story, now the numbers in the story will change to 17 kings and 142 elephants. Ask the class how they can divide the 142 elephants fairly among the seventeen kings. Accept answers volunteered by students and review correct answers with students.

3. Review: Review the ones and tens place value by writing the number 460 on the board. Explain when we divide three digits by two digits we need to set the numbers up in the correct place value column. Write the problem $460 \div 23 =$. Show students how to solve the equation. The teachers may consider doing a few more problems to begin reinforcing the skill.

Home Activity:

1. Students will complete a three by two-digit division exercise (this comes from the workbook that the teachers will be using with students).

Day 7

Objective: Students will learn to divide three-digit numbers by three-digit numbers.

Activities:

1. Reinforcement: Write ten three by two-digit division problems on the board and ask students to solve them individually. Accept answers volunteered by students and review correct answers.

2. Pre-Reading Activity: Tell students that the story *17 Kings and 42 Elephants* will be re-read and the original numbers in the story will change.

3. Storytelling: Re-read *17 Kings and 42 Elephants* by Margaret Mahy, adding one digit to the original numbers in the story. Now the numbers in the story will change to 170 kings and 420 elephants.

4. Problem Solving: Divide students in pairs and have them to brainstorm to create math word problems that go with the modified story. Write all ideas on the board and have students tell how the problems can be solved.

5. Reinforcement: Write ten three- by three-digit division problems on the board and ask students to solve them individually. Accept answers volunteered by students and review correct answers.

Home Activity:

Students will complete three by three-digit division and word problem exercises (these come from the workbook that the teachers will be using with students).

Day 8

Objective: Students will practice two- and three-digit division.

Activity:

1. Reinforcement. Write ten three- by three-digit division problems on the board and ask students to solve them individually. Accept answers volunteered by students and review correct answers.

2. Practical Application: Division Bingo.

   Instructions:
   Each child needs two pieces of construction paper. Instruct the students to take one piece of paper and do the following:
   a. Fold in half from top to bottom.
   b. Fold again from top to bottom.

c. Fold in half from side to side.
d. Fold again from side to side.

When the students open the paper, there should be sixteen squares. As the teacher calls out the products of sixteen division facts, the students write those products in a different square. Keep a list for yourself of the facts that you are using that day. Students should fold the second piece of paper exactly as they did the other. Using scissors, cut out the squares so that there are sixteen pieces of paper to use on their game board.

Playing the game:

Decide which kind of bingo you want to play (i.e. horizontal, vertical, diagonal, postage stamp (four in the top right hand corner), bulls eye (four in the center), picture frame (all but the four in the center), "X" (two diagonals). Using the list of sixteen division facts, call out the factors only. For example, you say "420 ÷ 20". The students must know the answer, find it on their game board, and cover it with a piece of paper. Students are not allowed to tell other students what the product is.

Continue calling out facts until someone gets a bingo. Be sure to mark on your master copy the facts you called, so you can check your winner to see if he/she covered the correct answers. Keep a record of who wins the most games. That student could be the first in line for the day, have extra free time, be excused from a future homework assignment, etc.

Day 9

Activity:

1. Review: Review two and three digit division. The teacher may write practice problems on the board, use unit worksheets, and exercises. The teacher may assign numerical and word problems to students to work on individually or in groups. The teacher will review answers with students once problems are completed.

Day 10

Activity:

1. Achievement: Distribute Division Post-Test.

APPENDIX L

POST-TEST (DIVISION)

Division Problems*. *Solve the following problems.

1.	$581 \div 7$	2.	$392 \div 4$	3.	$356 \div 5$
4.	$108 \div 9$	5.	$800 \div 40$	6.	$918 \div 20$
7.	$249 \div 83$	8.	$783 \div 87$	9.	$366 \div 122$
10.	$520 \div 260$	11.	$900 \div 150$	12.	$999 \div 300$

Word Problems. ***For the following questions, write in the answer or circle the correct letter containing the answer.***

13. Milton planted 320 seeds. He put 8 seeds in each row. How many rows did he plant? Which of the following could Milton use to solve the problem correctly?

D. $320 + 8$
E. $320 - 8$
F. 320×8
D. $320 \div 8$

14. It takes 4 oranges to make one glass of orange juice. If 278 oranges are available, how many glasses of orange juice can be made?

Answer: _____

15. If the sum of 39 and 66 and 105 is divided by 30, the result is:

A. 20
B. 17
C. 10
D. 7

16. If a store sold 660 tapes in 60 weeks, how many tapes did the store sell each week?

E. 44
F. 33
G. 22
H. 11

17. A club held a car wash and washed 152 cars. If the club raised $760, how much did it charge per car?

E. $5.00
F. $4.00
G. $3.00
H. $1.00

18. Every hour, a company makes 900 plastic forks and puts them in packages of 150 forks each. How many packages are made in one hour?

A. 6
B. 7
C. 8
D. 9

19. Mom bought 500 chocolates for the party. If mom had 125 gift bags, how many chocolates could she put in each bag so that each bag had an equal amount?

Answer: _____

20. A farmer has 860 chickens. He wants to place 215 chickens in each cage. How many cages will he need?

A. 2
B. 4
C. 6
D. 8

APPENDIX M

QUESTIONNAIRE

On this page and the next page is a series of statements. Please circle the statement that answers how you feel. There are no correct answers for these statements. **This is not a test and will not affect your math grade.** Your answers will be kept confidential. Neither your teacher nor your parents will know your responses. Please read the statement and circle one answer per statement. Be sure to answer every statement.

Agree means the statement is true.

Uncertain means you do not know.

Disagree means the statement is false.

1. I am really good in math.

Agree	Uncertain	Disagree

2. Reading stories about multiplication has helped me to learn how to multiply.

Agree	Uncertain	Disagree

3. Reading stories about division has helped me to learn how to divide.

Agree	Uncertain	Disagree

4. Reading stories about multiplication and division has helped me to understand why it is important for me to learn math.

Agree	Uncertain	Disagree

5. Reading stories about multiplication was fun.

Agree	Uncertain	Disagree

6. Reading stories about division was fun.

Agree	Uncertain	Disagree

7. Reading stories about multiplication helped me to solve number problems.

Agree	Uncertain	Disagree

8. Reading stories about division helped me to solve number problems.

Agree	Uncertain	Disagree

9. Reading stories about multiplication helped me to get more correct answers to word problems.

Agree	Uncertain	Disagree

10. Reading stories about division helped me to get more correct answers to word problems.

Agree	Uncertain	Disagree

11. Reading stories about multiplication will help me to do well on my test.

Agree	Uncertain	Disagree

12. Reading stories about division will help me to do well on my test.

Agree	Uncertain	Disagree

On this page and the next page is a series of questions. Please answer each question based on how you feel. There are no correct answers for these statements. **This is not a test and will not affect your math grade.** Your answers will be kept confidential. Neither your teacher nor your parents will know your responses. Please read each question and be sure to answer every question.

13. While you were learning multiplication, what did you like the most about math class?

_____
_____
_____
_____

14. While you were learning division, what did you *NOT* like about math class?

_____
_____
_____
_____

15. Since we started telling stories in math class, do you think it helped you to understand math?

_____
_____
_____
_____

16. What was your favorite story that was read in math class? Why was it your favorite story?

17. How did telling stories in math class make you feel uncomfortable?

18. Why do you think that reading stories in math class was a waste of your time?

19. By telling stories, do you think you learned how to use math outside of your class?

20. Why do you think that your teacher should continue to read stories in math class?

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