The Effects of Explicit Analytic Reading Skills Instruction on the Ability to Solve Mathematical Problems in a Written Format in a Third-Grade Classroom

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Abstract
This study was designed to determine if explicit analytic reading skills instruction used in a third-grade classroom would improve mathematical problem solving. The analytic reading skills instruction consisted of teaching students to analytically read a mathematics problem in order to find the purpose, organize the information, draw conclusions and then begin to plan and implement solutions in order to accurately solve the problem. The intervention for this study consisted of direct teaching and independent practice work four days a week, for eight weeks focusing each day on analytic reading strategies and applying those to mathematical word problems. The intervention was conducted for 50 minutes each day. The students were assessed daily using a scoring rubric. These scores were then compared to the pre-test and post-test scores of the mathematical problem solving assessment, reading, and mathematics tests. Based on the results of the assessments, the mathematical problem solving abilities of the students improved because of explicit analytic reading skills instruction.
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Chapter I

Introduction

The current emphasis on mathematics instruction and the recent implementation of the Common Core State Standards Initiative calling for college and career ready students, requires the ability to read mathematics problems in a written format, then find an accurate solution to that problem (Common Core State Standards Initiative [CCSSI], 2011). Adams (2003) asserts that many students struggle to solve mathematical word problems because they have trouble reading, comprehending and understanding the language of the problem. Additionally, literature (Fuchs, Fuchs, Compton, Powell, Seethaler, Capizzi & Schatschneider, 2006; Fuchs, Fuchs, Prentice, Burch, Hamlett, Owen, Hosp & Jacek, 2003) proposes that children struggle to solve mathematical word story problems because the problems are complex and hard for them to grasp. Numerous experts (Griffin & Jitendra, 2008; Jitendra, Griffin, Deatline-Buchman & Sczeniak, 2007; Jitendra, Griffin, Haria, Leh, Adams & Kaduvettor, 2007) indicate that traditional textbook problem solving instruction lacks effectiveness in improving students’ abilities to solve mathematical problems in a written format; and many teachers do not provide varied instruction required for them to improve the ability to fluently solve these problems. Other literature (Barton, Heidema, Jordan, 2002; Vilenius-Tuohimaa, Aunola, & Nurmi, 2008) suggests that explicit analytic reading skills instruction improves students’ ability to solve mathematical problems in a written format.

Background of the Problem

The National Center for Education Statistics (NCES) (2011) found that many students struggle to achieve basic proficiency in mathematics and reading. They also assert that reading and mathematics are the foundations to success later in school. Adams (2003) proclaims that
students are not fluently and accurately solving mathematical problems in a written format due to the lack of understanding of the specific language, and not comprehending the written text. He also adds that students do not consider mathematical written text a language; and therefore, do not utilize reading strategies in order to understand the text. Furthermore, Jitendra et al. (2007) and Griffin and Jitendra (2008) suggest that students are not properly instructed to solve mathematical word problems. They further assert that teachers rely on the use of textbooks for instruction, which do not effectively teach children to reason and make connections. These experts opine that this hinders students’ ability to effectively solve written format mathematical problems.

Definition of Terms

To facilitate the understanding of this research report, the following terms are defined:

1. Arithmetic skills are defined as the ability to solve math problems that involve whole numbers, fractions, decimals, and percent using solving methods such as addition, subtraction, multiplication and division (Griffin & Jitendra, 2008).

2. Computation is defined as determining an amount or number of a problem using different operations and strategies, such as addition, subtraction, multiplication, and division (Griffin & Jitendra, 2008).

3. Conceptual model word problem diagram is a way to organize story grammar and information and express mathematical relations in word problems (Xin, Wiles, & Lin, 2008).

4. Explicit analytic reading skills instruction is teaching students specific reading strategies that will help them to understand the language and meaning of the text that is written (Barton, Heidema, Jordan, 2002; Vilenius-Tuohimaa, Aunola, & Nurmi,
2008). It has been operationalized for this study to mean an active process that teaches students to analyze a problem, mentally organize information, make decisions based on the text, and bring thoughts and opinions to what they read.

5. Mathematical problems in a written format mean problems that involve printed language of a mathematical problem. (Fuchs, Fuchs, Compton, Powell, Seethaler, Capizzi & Schatschneider, 2006; Fuchs, Fuchs, Prentice, Burch, Hamlett, Owen, Hosp & Jacek, 2003). This term has been operationalized for this study to mean mathematical problems that are text based and not just numeral based.

6. Semantic structure is defined as making connections of meanings, understandings, and relationships to mathematical operations (Griffin & Jitendra, 2008).

7. Visual-spatial displays means mentally constructing information in a variety of ways in order to organize information (Xin, Wiles, & Lin, 2008).

**Purpose and Significance of the Study**

The purpose of this study was to investigate the effects of explicit analytic reading skills instruction on the ability to solve mathematical problems in a written format in one third-grade classroom. The intent was to determine if teaching students how to read analytically to analyze a problem, organize information based on the purpose and the text, make decisions, and engage critically with what they read improves the ability to translate narrative format mathematical problems into numeric operations and then accurately solve the problem. Because explicit analytic reading skills instruction seems to improve students ability to comprehend and solve math problems in a written format successfully, teachers may use these strategies in order to improve students’ abilities to understand and solve mathematical word problems. This study looked at the effects of explicit analytic reading skills instruction on mathematical problems in a
written format in third graders, and the research question was, “Does explicit analytic reading skills instruction improve student’s ability to solve mathematical problems in a written format in one group of third-grade students?”

This research report is organized into five chapters. Chapter I offered a statement of introduction for this study, which was conducted to determine the effects of analytic reading skills instruction on the ability to solve mathematical problems in a written format in third-grade students. Chapter II provides a review of literature concerning mathematical problems in a written format and explicit analytic reading skills instruction. Chapter III serves to explain the methodology for this study. The setting, participants, data collection, procedures, instruments, and analysis are shared. Chapter IV serves to explain the results of this study. Baseline data, during intervention and post intervention analysis are shared. Chapter V draws conclusions and implications, then makes recommendations based on the results of the study are shared.
Chapter II

Review of Literature

This chapter provides a comprehensive, yet not exhaustive, review of literature on mathematical word problems and analytic reading skills instruction. The intent of this chapter is to review relevant research and other literature that supports the argument that teaching students how to analyze a problem, organize information based on the purpose and the text, make decisions, and engage critically with what they read improves the ability to translate narrative format mathematic problems into numeric operations and then accurately solve them. Literature (Fuchs, Fuchs, Compton, Powell, Seethaler, Capizzi & Schatschneider, 2006; Fuchs, Fuchs, Prentice, Burch, Hamlett, Owen, Hosp & Jacek, 2003) suggests that children are struggling to solve mathematical word story problems because of the complexity of the solution process. Additionally, literature (Griffin & Jitendra, 2008; Jitendra, Griffin, Deatline-Buchman & Sczeniak, 2007; Jitendra, Griffin, Haria, Leh, Adams & Kaduvettor, 2007) indicates that traditional textbook problem solving instruction is not effective in improving students’ abilities to solve mathematical problems in a written format. Teachers must provide several different varieties of instruction for students to learn to solve these problems. Adams (2003) suggests that many students who struggle with solving mathematical word problems have trouble reading, comprehending, and understanding the language of the problem. Other literature (Barton, Heidema, Jordan, 2002; Vilenius-Tuohimaa, Aunola, & Nurmi, 2008) suggests that using explicit analytic reading skills instruction improves students’ ability to solve mathematical problems that are in a written format.

This chapter is organized so that literature on mathematic word problem solving and the importance is reviewed first, and then literature detailing issues related to mathematic word
problem solving is discussed. Studies and expert opinion on teaching reading in mathematics is presented, followed by recommendations for teacher instruction to implement these practices in the classroom. Finally, support is given for using analytic reading instruction to improve students’ ability to solve mathematical problems in a written format.

**Mathematical Word Problem Solving**

Research (Jitendra et al., 2007; Griffin & Jitendra, 2008) asserts that story problems present difficulties for many students. These experts say solving these problems poses difficulties because they require students to understand the language and factual information of the problem, and translate the problem with pertinent information to create an acceptable mental representation. The students must then devise and monitor a solution plan, and implement effective technical computations. According to Griffin and Jitendra learning how to solve story problems involves knowledge about semantic structure and mathematical relations. They emphasize the notion that students need to know basic arithmetical skills and strategies in order to solve problems in a written format. Jitendra et al. describe story word problems as critical in helping children make connections of meanings, understandings, and relationships to mathematical operations. A source (National Council of Teachers of Mathematics [NCTM], 2011) emphasizes that problem solving is an essential part of the k-12 mathematics curriculum. The authors emphasize the importance of integrating mathematical word problem solving strategies and skills. They assert that mathematical word problems can promote students’ conceptual understanding, foster their ability to reason and communicate mathematically, and capture their interests and curiosity. The authors further declare that developing students’ abilities to solve problems is not only a fundamental part of mathematics learning across content areas but also an integral part of mathematics learning across grade levels.
Issues Related to Solving Math Problems in a Written Format: Textbooks and Instruction in the Classroom

Research (Jitendra et al., 2007; Griffin & Jitendra, 2008) suggests that many math textbooks do not provide sufficient instruction on reasoning and making connections to help students solve story problems. These researchers point out that many textbooks are organized so each problem is solved by the same procedure therefore hindering students’ ability to distinguish among problems that require different solving methods. These authors further declare that teaching students to look for key words is misleading. They proclaim that this method does not assist students in problem solving because it does not address the meaning and structure of the problem and therefore does not improve reasoning and deciphering solutions. Furthermore, they believe the teachers must scaffold and offer instructional facilitation during the learning process. These authors agree that many classrooms lack in this type of instruction. They go on to proclaim that teachers’ lack of depicting problems visually and graphically and their failure to use explicit instruction and interactions between peers delays student’s ability to solve word problems. In order for students to comprehend solving problems in a written format that teaching instruction must be done using a variety of methods.

Griffin and Jitendra (2008) suggest that providing problem solving and opportunities, emphasizing mathematical thinking and reasoning, are essential for students to problem solve effectively. Fuchs et al. (2003) studied eighty-eight 3rd grade students and their teachers to determine if clearly teaching for transfer by using several different strategies improved students’ abilities to solve word problems. These strategies included promoting a higher level of abstraction, and increasing metacognition in mathematical problem solving. They found that
strong instruction designed to teach rules for problem solution is important in the classroom and will help students to solve story problems efficiently.

**Issues Related to Solving Math Problems in a Written Format: Reading Skills of Students**

Several sources (Adams, 2003; Ponce & Garrison, 2005; Velinius-Tuohimaa, Aunola, Nurmi, 2008) identify many issues related to student’s difficulties solving written mathematical problems. Velinius-Tuohimaa et al. (2008) studied 225 children aged 9-10 to investigate the relationship between mathematical word problem skills and reading comprehension skills. Students’ expository and narrative reading comprehension counting skills were tested. Based on the results, math performance and reading skills are very closely related, and math problem solving performance and comprehension reading skills were correlated to overall reasoning skills. This study suggests there are specific skills needed for students to process written information, such as decoding skills and reading comprehension. It further suggests that these play a role in understanding the overall problem and helps being able to effectively solve the problem. The authors’ affirm that technical reading level and reading comprehension contribute to students’ performance in solving written math problems. Ponce and Garrison (2005) stress the notion that if a student does not have the understanding of what a problem is saying they are not able to figure out the meaning. The authors posit that for these students this becomes an issue of comprehension, and frustrates students because they are not able to effectively solve written format problems.

Adams (2003) urges educators to emphasize the notion that mathematics is a language and not just something that we do: He reminds us that ignoring this means children may miss the concepts of mathematics that enhance and reinforce their understanding. He asserts that the words, terminology and vocabulary used in mathematics are critical factors in comprehending
and communicating answers to problems, and that recognizing and employing formal definitions is essential to understanding and applying important mathematical concepts when reading text. Adams emphasizes the importance of teaching mathematics as a language. He asserts that teachers have to provide different reading strategies in order for students to comprehend mathematical problems in a written format.

**Teaching Reading in Mathematics**

Sources (Barton, Heidema & Jordan, 2002; Gyamfi, Bossé, & Faulconer, 2010) recommend teaching specific reading skills to improve the ability to solve mathematical story problems. They state that the skills that are needed for reading math text are different or may not have been used in other content areas, and thus teaching these specific reading strategies improves student’s ability to solve mathematical word problems. Barton et al. (2002) state that learning to read mathematics is essential in understanding the meaning of the problem and being able to implement a solution effectively. He further suggests that by using specific reading strategies that this is the best way to help students make sense and learn from the mathematical text read. They also express the notion that teachers can incorporate reading and learning strategies that will help activate prior knowledge, master vocabulary, and make sense of unfamiliar text. Similarly, Gyamfi et al. (2010) suggest that reading serves as a means for extracting or receiving mathematical understanding. These authors claim that purposefully directed classroom assessments and instruction are a necessity in order for students to read to learn mathematics. The suggestions of the authors are that teachers include problems that require them to reflect on the ideas, formulating definitions, reading, and expressing those ideas in writing in order to communicate their thinking. Gyamfi et al. note that teaching children reading strategies that will help them analyze, understand the problem, form definitions and express their
own thoughts and ideas are essential to them solving mathematical problems that are in a written format.

**Recommendations for Explicit Analytic Reading Skills Instruction**

The components behind using explicit analytic reading skills instruction are teaching reading strategies that will have children analyze a problem, mentally organize information, make decisions based on the text, and bring thoughts and opinions to what they read. Experts (Barton et al., 2002; Ediger, 2002; Gersten, Jordan & Flojo, 2005) recommend teaching reading skills through targeted interventions in order to help students to accurately solve written mathematical problems. Barton offers several recommendations for teaching children who struggle with the reading of a mathematical problem. She suggests the teachers activate prior knowledge because this prepares students to make meaningful connections, draw conclusions and assimilate new ideas. She claims this helps them better learn from and remember what they have read. Barton also notes the importance of mathematical vocabulary and text style. She says teaching vocabulary instruction should include maps, webs and other graphic organizers to assist students in relating familiar topics to construct visual representations which aid in understanding.

Barton also proclaims that in order for learners to be able to make sense of text style, instruction should be based on finding the main idea of the problem and ignoring all of the irrelevant information. Another method that she suggests can be used by a teacher is to conduct a think aloud on a passage of text that has confusing units, and by modeling how to identify the main ideas and make logical inferences this will aid in the students making reason of the text style.

Xin, Wiles, and Lin, (2008) studied five students’ grades 4 and 5 who were at risk for mathematical disabilities and concluded that teachers should focus on textual analysis of story and analyze the problem mapping key elements of the problem and connecting those elements to
past understanding. The researchers suggest that educators use a conceptual model diagram to prompt the learner to identify different elements in word story problems, and lay out a visual-spatial display for representing those key elements. Xin, Wiles, and Lin (2008) assert that using this method will aid in the understanding of the main ideas and grammar of the word problems. They proclaim that using this method will help in the solving process.

**Explicit Analytic Reading Skills of Mathematical Word Problems**

Many respected researchers, (Barton et al., 2002; Gyamfi et al., 2010; Xin et al., 2008) support the notion that using explicit analytic reading skills instruction in elementary school classrooms can improve the ability to solve mathematical problems that are in a written format. Barton (2002) pronounced that teachers should incorporate different reading and learning techniques to help students draw inferences, understand vocabulary, and illicit meaning from the text. For that reason, other experts (Ediger, 2002; Vilenius et al., 2008) posit that the academic of solving word problems will improve when classroom instruction includes specific reading strategies. Similarly, Ediger (2002) asserts that adopting and implementing explicit analytic reading skills instruction helps the learners build a stronger foundation and understanding of how to solve written mathematical problems. They propose that these practices aid in reading and analyzing the problem, organizing information, understanding specific vocabulary, and formulating answers and opinions, to apply to the solution. Adams (2003) asserts that regarding mathematics as a language enhances and reinforces understanding of problems. Barton agrees that if children understand the language of mathematical word problems, and if teachers supplement instruction to build those reading strategies, then students’ performance on solving written mathematical problems will improve.
Summary

Based on literature (Adams, 2003; Fuchs et al., 2006; Griffin & Jitendra, 2008) that point to the notion that students struggle with solving mathematical problems that are in a written format due to reading, lack of instruction and misleading textbook information, and other experts (Barton et al., 2002; Gyamfi et al., 2010; Vilenius-Tuohimaa et al., 2008) who claim that using explicit analytic reading skills instruction will improve children’s ability to solve mathematical word problems, it appeared that a study examining the impact of explicit analytic reading instruction on mathematical problems in a written format was necessary. The next chapter details the methodology of the study.
Chapter III

Methodology

This study investigated the effects of explicit reading skills instruction on the ability to solve mathematical problems of a written format in a third-grade classroom. It was intended to determine if teaching students how to analyze a problem, organize information based on the purpose and the text, make decisions, and engage critically with what they read improves the ability to translate narrative format mathematic problems into numeric operations and then accurately solve the problem. This chapter describes the setting, the participants, and the confidentiality procedures for this study. How data were collected and the evaluation instruments are also described. The intervention strategy is explained and the methods for analyzing the data are detailed.

District Setting

This study took place at an elementary school in Northwest Arkansas. Demographic information for the school district provided in this section is based on the published information from the 2011-2012 school year (Arkansas Department of Education [ADE], 2012). The school district serves students from pre-kindergarten through grade 12. The district in which the school is located has a total number of 19,376 students in 25 schools, which is an increase in the student population from the 2010-2011 school years of 5.66%. There are 9,428 elementary students, 2,908 middle-school students, 2,763 junior-high students, and 3,711 high-school students. The ethnic breakdown for the school district is as follows: 8,137 White; 356 Asian; 438 Black; 8,359 Hispanic; 94 American Indian; and 1,701 Pacific Islanders (see Figure 1). There are 1,787 students involved in the district’s special education program, and 8,279 students classified as Limited-English-Proficient in the district.
School Setting

The elementary school in this study has a total population of 608 students (ADE, 2012). The student population consists of 264 White students, 250 Hispanic students, 55 Pacific Islander students, 14 Black students, 10 Asian students, and 11 American Indian students (see Figure 2). According to the 2011-2012 District Profile (ADE, 2011), this elementary school had 414 students on free/reduced lunch, which was 68% of the student population. This school houses a hearing-impaired classroom and serves 10 students with hearing impairments. All 10 of the students who are primarily served in this classroom are also included in the appropriate general education classrooms for some portion of each day with necessary provisions and supports. There are 7 faculty members who are part of the special education faculty at this school. Additionally, this elementary school is one of a selected few in the district to implement the Toyota Family Literacy Program, which is a literacy initiative funded in part by Toyota that focuses on increasing literacy among Hispanic families. As a part of this program, interested Hispanic parents attend a class held four mornings per week with lessons and instruction.
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designed to increase their own literacy and English skills while also learning how to help their children improve while at home. There are 6 Literacy and ESL specialists employed by this elementary school that work with the students in this school alongside this program.

![Racial demographics for the elementary school in Northwest Arkansas.](image)

**Figure 2.** Racial demographics for the elementary school in Northwest Arkansas.

**Participants**

This study was conducted in a third-grade general education classroom consisting of 24 students. There are 13 females and 11 males in the classroom. The racial demographics of the students in this classroom are as follows: 12 Hispanic students, 10 White students, 1 Asian/Pacific Islander, and 1 Black student. 19 of these students receive free lunches at school, and 2 receive reduced lunches. There are 12 English Language Learner students in the classroom at varying levels. One student is in the Gifted and Talented program that student goes to the GT room once a week. Additionally, one student receives a variety of special education services. This student goes to the resource room for an hour and a half daily during reading and writing instruction to get supplemental instruction.
**Confidentiality**

Permission to conduct the study was granted by the University of Arkansas Institutional Review Board (see Appendix A), as well as the administration of the elementary school where the study was conducted (see Appendix B). Permission to participate in this study was obtained prior to the commencement of the project. A letter (see Appendix C), along with an Informed Consent (see Appendix D), was sent home with each student in the appropriate language, and a signature from the parent or guardian was required before data for that child were reported. The informed consent explained the purpose and procedures of the study. It explained that participating is completely voluntary and that there is no reward or penalty for participating. It explained that the child may withdraw from the study at any time without penalty. Confidentiality will be maintained and assured by the researcher through the establishment of a code. Each student was assigned by the researcher through the establishment of a code. Each student was assigned a number at random to establish the code. All data were recorded anonymously using the code. Only the researcher had access to the code, and all data were kept

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**Figure 3:** Racial demographics for the elementary school in Northwest Arkansas.
ANALYTIC READING SKILLS INSTRUCTION AND MATHEMATICAL PROBLEM SOLVING

in a locked file cabinet in the project classroom. After this study is defended, the code will be destroyed.

Data Collection

This study was designed to examine the effects of explicit analytic reading skills instruction on the ability to solve mathematical problems in a written form of one group of third-grade students. Data were collected to determine if reading skills instruction structured around teaching students how to read analytically to analyze a problem, organize information based on the purpose and the text, make decisions, and engage critically with what they read improves the ability to translate narrative format mathematical problems into numeric operations and then accurately solve the problem. During the nine week intervention period, the ability to solve mathematical problems in a written format was determined through scores that are recorded daily and weekly and anecdotal records.

Evaluation instruments. In order to get complete understandings of math problem solving skills, ability to read and understand the test, and compute mathematical operations were measured. Three different tools were used to establish skills and abilities to solve mathematical problems before and after the intervention. Released items from the Arkansas Comprehensive Testing, Assessment and Accountability Program (ACTAPP) (see Appendix E for a sample of the assessment) and a researcher developed reading test and a mathematics skills test were used. A fourth tool was used during intervention, a six point analytic scoring scale used to determine students’ ability to solve mathematical problems during the study.

ACTAAP. The ACTAPP is a comprehensive system encompassing high academic standards, professional development, student assessment, and accountability for schools. The focus of ACTAAP is to measure student learning and classroom instruction; provide
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accountability by establishing expected achievement levels and reporting on student achievement; provide program evaluation data; and assist policymakers in the decision-making process. The released items from the math section measure students’ ability to solve mathematical problems in a written format. The problems require students to read, analyze, choose a computation method and compute a solution effectively. Scores on the open response section are calculated using a scoring tool that focuses on the students’ ability to state the correct answer, a correct and completed procedure is shown, or the answer is explained. Scores range from 4, being the highest, to 1, being the lowest. There are 4 points are possible on each problem, 2 points are awarded if each part has the correct answer. Also 2 points are awarded if correct and completed procedure are shown and/or explained of how the response was determined. A response may earn one half of a point if the procedure contains a counting or copy error or is incomplete. A response that meets each of these criteria earns 4 points. A score of 3 is awarded if it earns 3-3 ½ points, a score of 2 is awarded if it earns 2-2 ½ points are earned; and a score of 1 was awarded if it earns ½-1 ½ points. In the multiple-choice section one point is awarded for each correct answer. That is translated into a percentage in order to gain understanding of the abilities of mathematical problem solving.

The test is timed and administered to the entire group at one setting. The testing lasts approximately 40 minutes each time it is administered. The scores are calculated according to the rubric described above, and individual participant scores are recorded in the examiner record book. Each student’s ability to solve mathematical problems is noted.

The written format problem solving scores were classified using the baseline data into three achievement categories: advanced, proficient, and basic. In order to compare end results with baseline data, each of these categories were given a specific range of scores that did not
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change when the end results were analyzed. These ranges were formulated based on the ranges of pretest scores. Scores of 60 and above were classified as advanced; scores between 59 and 31 were classified as proficient; scores of 30 and below were classified as basic. There was 1 advanced, 14 proficient, and 9 basic.

*Researcher developed reading test.* This researcher developed analytic reading test was administered in order to gain an understanding of students’ ability to read and analyze of a story problem. This multiple choice test was developed using some of the questions from the ACTAAP. The questions provide a mathematical story problem which requires the students to read the problem and answer what the story is about by choosing the correct multiple choice answer. This test measured students’ abilities to read a mathematical story problem and be able to analyze it in order to answer what the main idea of the story is (see Appendix F for sample assessment).

The test is not timed and is administered to the entire group at one setting. The scores were calculated by dividing the number of correct responses by the number of questions and converting it into a percentage. The individual participant scores were recorded in the examiner record book to not each student’s reading abilities.

*Researcher developed mathematical computation skills test.* A mathematical computation skills test was administered to gain an understanding of students’ abilities to solve mathematical computations. This test was developed using the ACTAAP test for assessing students’ mathematical problem solving skills. The test requires the students to solve mathematical exercises that were already set up in the form of number aligned with operation symbols provided (see Appendix G for sample assessment).
The test is not timed and administered to the entire group at one setting. The scores are calculated by dividing the number of correct responses by the number of questions and converting it into a percentage. The individual participant scores are recorded in the examiner record book and each student’s mathematical computation skills are noted.

**Analytic scoring scale.** This scale measured students’ ability to analyze a problem, plan a solution, and compute an answer. The scoring tool has three sections: understanding the problem, planning a solution, and getting the answer. Scores range from 6 to 0 with 6 being the highest and 0 being the lowest. Each section has two points possible. The students were asked to learn the different strategies such as analyzing a problem, mentally organizing information, making decisions based on the text, and bringing thoughts and opinions to what they read (see Appendix H for scoring scale).

**Baseline data.** In order to establish a baseline for students’ abilities to solve problems in a written format, released items from the ACTAAP was administered on December 14, 2011. A researcher developed mathematics and reading tests was administered on December 15, 2011. The students’ scores from these tests served to establish the levels of abilities to solve math word problems, and read mathematics problems prior to the implementation of explicit reading skills instruction.

**Other data collection methods.** Data were collected during the intervention period to monitor and record students’ progress related to solving mathematical word problems. Data were collected in the form of daily and weekly scores, as well as by recording observed anecdotes related to solving word problems. Daily scores were recorded as students are taught different reading strategies that aid in solving mathematical word problems. Students were scored using an Analytic Scoring Scale. The students were given a story problem that they analyzed, answered
ANALYTIC READING SKILLS INSTRUCTION AND MATHEMATICAL PROBLEM SOLVING

questions, and found solutions to show understanding of the problem. At the end of each week, students’ mathematical word problem solving abilities were assessed by computing daily scores into weekly averages. Data that were recorded daily and weekly were organized and analyzed to determine results throughout this study.

**Post data analysis.** In order to determine the effectiveness of explicit analytic reading skills instruction on the ability to solve mathematical problems in a written format, released mathematics items from the ACTAAP and two researcher developed mathematics skills and reading tests were re-administered to each student following the same method as utilized before. The post-assessment results were examined and compared to the baseline data. A paired-samples t-test was conducted to determine if a significant difference exists between the pre-test and post-test scores. Data were collected by recording daily and weekly scores and by recording anecdotal records. Anecdotal records were coded and analyzed to determine patterns and themes which may appear. Daily and weekly records, along with pre-test and post-test assessments, and anecdotal records were carefully examined and analyzed to determine changes and trends, and then conclusions were drawn.

**Intervention Strategies**

During the course of this study students learned to implement analytic reading skills to precisely and accurately read and comprehend mathematical text and compute an accurate solution. The specific strategies taught were intended to help students analyze a problem, mentally organize information, make decisions based on the text, and bring thoughts and opinions to what they read. The intervention instruction lasted fifty minutes, 4 days per week, for 9 weeks. Students were taught one of the four strategies each day for the first week of the study, beginning with analytically analyzing a problem and ending with bringing thoughts and opinions
to what they read. The strategies were to analyze a problem, mentally organize information, make decisions based on the text and bring thought and opinions to what they read. The study took place Monday through Thursday of each week during a fifty minute period. Each week followed the same patterns of instruction with a different analytic reading strategy being the focus each day and different mathematical skills and word problem type taught each week (see Appendix I for intervention schedule). The same sequence of instruction followed each week.

**Day 1.** The analytical reading strategy that would be taught that day such as finding the main idea of the word problem was introduced as a whole explicit group instruction. Along with the reading strategy, the mathematics concept for that day was introduced by using explicit whole group instruction. The students were provided with information and data in a written format which they read and analyzed the problem then applied the reading strategy that was learned (see Appendix H for sample lesson plan and Appendix I for student work).

**Day 2.** The reading strategy and mathematical concept from the previous day was reviewed as a whole group instruction. A new analytic reading strategy was introduced, such as finding the supporting details and mathematics concept using direct instruction and moving onto guided practice. The final is independent practice where the students were provided with a type of mathematical problem that included the mathematics concept learned that day (see Appendix J for sample lesson plan and Appendix K for student work).

**Day 3.** The reading strategy and mathematical concept from the previous two days were reviewed as a whole group instruction. A new analytic reading strategy and a mathematics concept was then introduced using explicit direct whole group instruction. The students then applied the information learned from the previous two days in order to correctly find the main idea, and supporting details and then begin to use those to plan and explain a solution. The
students were then provided with independent work that allowed them to apply the reading strategies learned previously and accurately plan and explain a solution (see Appendix L for sample lesson plan).

**Day 4.** The mathematical and reading concepts from the previous three days were reviewed as a whole group instruction. Guided practice was then used to model how to apply the concepts and reading strategies in order to solve mathematical problems in a written format. The students applied all of the mathematical concept knowledge and reading strategies that were previously learned and put it all together in order to accurately solve mathematics word problems. The students were provided with mathematical problems in a written format in which they were to independently put all of the reading strategies together in order to plan, explain, and find an accurate solution (see Appendix M for sample lesson plan and Appendix N1 and N2 for student work).

**Summary**

The CCSSI calls for ensuring all students are college and career ready. They also raise concerns about the current state of mathematics in our school. In order for students to understand mathematical problems in a written format they must first comprehend the language and the text, and be able to effectively implement a solution to the problem. It is suggested that explicit analytic reading skills instruction improves student ability to solve mathematical problems in a written format. This study was intended to examine the effects of explicit analytic reading skills instruction on the ability to solve mathematical problems in a written format. This study was conducted in an elementary school in Northwest Arkansas for a 9-week with obtained approval.
Chapter IV

Results

The purpose of this chapter is to provide analyses of data collected for the study designed to address the research question, “Does explicit analytic reading skills instruction improve the ability to solve mathematical problems of a written format in one group of third-grade students?” Data are presented through narrative text and supported with tables and figures. The purpose of this study was to determine if teaching students how to analyze a problem, organize information based on the purpose and the text, make decisions, and engage critically with what they read improves the ability to translate narrative format mathematic problems into numeric operations and then accurately solve the problem.

Twenty-five students from a local elementary school participated in the study. Over the course of nine weeks, students participated in daily mathematical word problem activities. The ability to solve mathematical problems in a written format was determined by the ability to analytically read the problem in order to find the purpose, organize and eliminate information that is not needed, plan and explain a solution, and accurately compute the solution to the mathematics word problem. Daily and weekly scores for solving mathematical word problems were gathered and recorded during the study using explicit analytic reading skills instruction.

Baseline Data

Baseline data were established by calculating problem solving accuracy on the ACTAPP released items, and 2 researcher developed instruments. The pre-assessment scores for the ACTAAP were obtained during the week of December 12, 2011 and the 2 researcher developed test scores were obtained on December 14 and 15, 2011. The ACTAPP scoring tool focuses on the students’ ability to state the correct answer, show a correct and completed procedure, and
explain the answer of a mathematical problem in a written format. The baseline scores were established by dividing the number of correct responses by the total number of responses; resulting in a percentage. Additionally the analytic reading skill and mathematical computation skills scores were measured by recording as a percent of accuracy. These scores were collected before the commencement of the study to establish baseline word problem solving abilities prior to explicit mathematics instruction focused on using analytic reading skills. Baseline scores were recorded for problem solving skills, analytic reading skills and mathematics computation skills prior to explicit mathematics instruction focused on using analytic reading skills.

Mathematical problem solving. Students’ ability in solving mathematical problems of a written format was measured using ACTAAP. The highest possible ability average was 100, and the lowest possible average was 0. The maximum-recorded score was 62 and the minimum-recorded score was 17. The range was 45. The mean score was 37. The median score was 34. The mode was 31 (see Appendix Q for individual student scores). There was one score that was identified as an outlier because it was greater than 1.5 times the Inter-Quartile Range above the Upper Quartile value and was not included in this t-test.

The mathematical problem solving scores were classified using the baseline data into three achievement categories: advanced, proficient, and basic. In order to compare end results with baseline data, each of these categories were given a specific range of scores that did not change when the end results were analyzed. These ranges were formulated based on the ranges of pretest scores. Scores of 60 and above were classified as advanced; scores between 59 and 31 were classified as proficient; scores of 30 and below were classified as basic. There was 0 advanced, 21 proficient, and 3 basic. Figure 4 illustrates the percentage of students who scored in each achievement category.
Mathematical computation skills. Students’ ability in responding to mathematical computation skills was also measured using a researcher developed test from mathematical problems on the ACTAAP. The ability to solve computations was determined by taking the number of problems worked correctly and dividing it by the total number of problems. These scores were recorded as percentages. Thus, the highest possible accuracy score was 100 and the lowest 0. The maximum-recorded was 82 and the minimum-recorded was 36. Thus, the range was 45. The mean score was 67. The median was 73. The mode was 82 (see Appendix R for individual student scores). There were no scores that were identified as outliers.

The scores were classified using the baseline data into three achievement categories: advanced, proficient, and basic. In order to compare end results with baseline data, each of these categories were given a specific range of scores that did not change when the end results were analyzed. These ranges were formulated based on the ranges of pretest scores. Scores of 90 and above were classified as proficient; scores between 89 and 60 were classified as proficient; and scores of 59 and below were classified as basic. There was 0 scores classified as advanced, 18 scores classified as proficient, and 6 scores classified as basic. Figure 5 illustrates the percentage of students who scored in each achievement category.

Figure 4. Percentage of students’ achievement categories in mathematical problem solving.
Analytic reading skills. Students’ analytic reading skills were determined by scoring the ability to comprehend just the text of the mathematical word problems by taking the number of problems worked correctly, and dividing it by the total number of problems. Scores were established in accuracy percentages. Thus, the highest possible score was 100 and the lowest was 0. The maximum-recorded analytic reading skills score was 100 and the minimum-recorded was 17. Thus, the range was 83. The mean score was 47. The median score was 50. The mode was 33 (see Appendix S for individual student scores). There were four scores that were identified as outliers because 3 were 1.5 times the Inter-Quartile Range above the Upper Quartile value and 1 were 1.5 times the Inter-Quartile Range below the Lower Quartile value.

The analytic reading skills scores were classified using the baseline data into three achievement categories: advanced, proficient, and basic. In order to compare end results with the baseline data, each of these categories were given a specific range of scores that did not change when the end results were analyzed. These ranges were formulated based on the ranges of pretest scores. Scores of 70 and above were classified as advanced; scores between 69 and 30 were classified as proficient; and of 30 and below were classified as basic. There were 3 scores
classified as advanced, 18 scores classified as proficient, 3 scores classified as basic. Figure 6 illustrates the percentage of students who scored in each achievement category.

![Percentage of students in each analytic reading skills achievement category](image)

*Figure 6. Percentage of students in each analytic reading skills achievement category.*

**During Intervention**

In order to measure the ability to solve mathematical problems in a written format during the study, daily individual mathematical problem solving accuracy scores were recorded (see Appendix T for a sample of daily scores). In order to get these scores, each day students participated in analytic reading skills instruction to help them solve written format mathematical problems. These scores were recorded daily then averaged at the end of each week to get a mean of daily achievement for that week. Scores were established by dividing the number of correct responses by the number of problems. The highest possible accuracy score was 100, and the lowest possible accuracy score was 0. A new reading strategy and mathematics concept were taught each day, and the types of mathematics word problems from which the scores were taken differed; but were scored using the same scale each day. (See Figure 8).
Figure 7. The class mean of weekly averages for mathematics word problem solving.

**Post Intervention**

To determine ability to solve mathematical problems in a written format after the intervention, three assessments were administered at the conclusion of the study. The same forms of all three were given in the same manner as before the intervention. The students’ individual written format problem solving abilities, computation skills, and analytic reading skills were measured and analyzed to determine if explicit analytic reading skills instruction impacted their problem solving abilities.

**Mathematical problem solving.** Students’ answered multiple choice word problem questions and released open response items in order to determine their mathematical problem solving abilities. The highest possible score was 100 and the lowest possible score was 0. The maximum recorded score was 86, and the minimum recorded score was 28. The range was 58, the mean was 54, the median was 52.5, and the mode was 52 (see Appendix U for individual post-intervention scores). Figure 7 illustrates individual student pre- and post-intervention written format problem solving skills as measured by the ACTAAP.
Figure 8. Individual student written format problem solving scores.

Post-intervention data were also organized into three categories: advanced, proficient, and basic. There were 9 scores classified as advanced, 14 scores classified as proficient, and 0 scores classified as basic. Figure 8 illustrates the percentage of students in each category for both pre- and post-intervention data.

Mathematical computation skills. The ACTAAP problems were formatted to gather data about the ability to solve computations involved in word problem solving. Students solved
computations that were set up in order to assess their computation skills. Student responses were recorded as an accuracy percentage. The highest possible average was 100 and the lowest possible average was 0. The maximum-recorded score was 55, and the minimum-recorded score was 100. The range was 45, the mean was 82, the median was 82, and the mode was 82 (see Appendix V for individual post-intervention scores). Figure 9 depicts the percentages of students computation skills prior to intervention and following intervention.

**Figure 9**. Individual student mathematical computation skills.

Post-intervention data were also organized the same as the pre-intervention achievement categories into three categories: advanced, proficient, and basic. 8 scores were classified as advanced, 10 scores were classified as proficient, and 4 scores were classified as basic. The achievement categories of the mathematical computation skills are shown in Figure 10. Figure 10 illustrates the percentage of students in each category for both pre- and post-intervention data.
Analytic reading skills. The ACTAAP problems were formatted to gather data regarding analytic reading skills. Students answered multiple-choice questions regarding the main idea and the purpose of the word problem. Student answers were recorded as a percentage. The highest possible average was 100 and the lowest possible average was 0. The maximum-recorded score was 100, and the minimum-recorded score was 66. The range was 34, the mean was 90, the median was 100, and the mode was 100 (see Appendix W for individual post-intervention scores). Figure 11 depicts the percentages of students computation skills prior to intervention and following intervention.

Figure 11. Individual student analytic reading skills scores.
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Post-intervention data were also organized into four categories: advanced, proficient, basic, and below basic. 19 scores were classified as advanced, 5 scores were classified as proficient, and 0 scores were classified as basic. Figure 12 illustrates the percentage of students in each category for both pre- and post-intervention data.

![Figure 12](image)

**Figure 12.** Student achievement scores based on analytic reading skills.

**Data Analysis**

In order to measure mathematical problem solving abilities of students, the ACTAAP was administered before and after the implementation of the intervention. Before explicit instruction regarding analytic reading skills was used, the average mathematical problem solving abilities percentage score of the participants measured by the ACTAAP was 36, and after intervention was 54. The mathematical problem solving results were analyzed using a paired-sample t-test with an alpha level set at .001. This analysis did reveal a significant increase from pre- and post-intervention scores, $t(23)=8.22; t\ Stat=6.78; p<0.001$. The mean increased 18 on the post-test scores which was a significant increase (see Appendix X for complete results). The $t$-test results are presented in Table 1.
Table 1

Results Obtained for t-test for Mathematical Problem Solving Scores

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<th>Post-test</th>
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<td>Mean</td>
<td>N</td>
<td>Mean</td>
<td>t</td>
<td>t Stat</td>
<td>p</td>
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<tr>
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<td>23</td>
<td>54</td>
<td>3.79</td>
<td>6.78</td>
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p=<.001

Subpopulations

The mathematical problem solving scores of subpopulations were also analyzed to determine if there were any relationships in the finding in terms of gender and English Language Learners and non-English Language Learners. Male and female scores were analyzed along with ELL and non-ELL scores. In order to find the results of these subpopulations the difference in means were used and t-test were conducted for both groups.

Male and female. Scores were noted with regards to gender. The difference in the pre- and the post-intervention mathematical problem solving mean scores of male students was 13 while the difference in mean scores of the female students was 21.5. Mathematical problem solving scores for females increased 8.5 of a point more than written format problem solving scores for males (see Appendix Y for male and female pre- and post-test scores). These results were analyzed using a two-sample t-test assuming unequal variances with an alpha level set at .05, and this analysis revealed a significant difference between the change in male and female mathematical problem solving scores (see Appendix Z for complete results). In order to show the results of the t-test conducted a table was created in regards of gender. Table 2 illustrates the pre- and post- intervention means of male and female students for written format problem solving skills.
Table 2

<table>
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<th>N</th>
<th>Pre-test Mean</th>
<th>N</th>
<th>Post-test Mean</th>
<th>T</th>
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<tr>
<td>11</td>
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<td>21.5</td>
<td>2.07</td>
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<td>0.02</td>
</tr>
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</table>

ELL and non-ELL. Scores were also noted with regards to ELL students and non-ELL students. The difference in the pre- and post-intervention mean scores of ELL students was 17 and the difference in mean scores of non-ELL students was 19. Written format problem solving scores for non-ELL students increased 2 points more than ELL students (see Appendix AA for individual ELL and non-ELL pre- and post-test scores). These results were analyzed using a two-sample $t$-test assuming unequal variances with an alpha level set at .05, and this analysis did not reveal a significant difference between the difference in ELL and non-ELL written format problem solving scores (see Appendix BB for complete results).

**Figure 14.** Pre- and post-intervention scores of ELL and non-ELL students.

**Anecdotal Records**

Anecdotes were recorded during the eight-week intervention addressing the research question, “Does explicit analytic reading skills instruction improve the ability to solve mathematical problems of a written format in one group of third-grade students?” Records were
based on observations related to the ability to solve problems of a written format. Records were analyzed and then organized into three categories reflecting the patterns and themes which emerged. These categories are; used strategies in other content areas, used strategies without direct instruction, mathematics concepts difficulties, and reading strategy difficulties among students (see Appendix CC).

Throughout the course of the intervention, the students began to use and apply the analytic reading strategies more frequently in other content areas. Student comments during discussion throughout the day helped the researcher make anecdotal records to indicate when a student used one of the analytic reading strategies that were taught during intervention in content areas instruction other than mathematics. The students began to apply these analytic reading strategies to other content areas beginning week 3 and continued throughout the study. For example, on January 26, 2012, Student O used the summarizing reading strategy to complete a summary based on a chapter that was read during reading instruction. On February 1, 2012, Student U used the visualizing strategy in a writing lesson. Another student was sharing her narrative writing and the student stated, “She did so well of explaining, I could close my eyes and visualize your snowman.” Starting at the fourth week the students started to display more independence in their thinking and problem solving abilities. On February 1, 2012, student R during a mathematics lesson stated, “We can use our mathematics notebook that has resources in it to help us understand how to solve the word problems.”

During the course of this study particularly starting in the third week the researcher noticed many of the students being more confident in reading and being able to understand what the main idea of the story is. These improvements in reading helped many of the students build
comprehension and started prompting them to analyze text and use these strategies while they were reading.

Additionally, some students used strategies they learned during the study intervention without guidance and specifically being told to use those strategies. On February 2, 2012 while working on a mathematics lesson students were asked to use a reading strategy of their choice in order to help figure out the problem and solve it. Student E stated the reason he needed to solve it on his own is so they can independently analyze the problem and figure out a strategy without being told specifically what strategy to use. On February 7, 2012 during mathematics the students were working as pairs and trying to solve a word problem. Student J raised her hand and said, “I know I need to analyze the problem, which means to look and read it closely, and figure out the best strategy to use to solve it. We can also use some of the other reading strategies we have learned to analyze the problem.”

As the study progressed, some reading strategies were difficult for students to use and apply to the mathematics problems. At the beginning of the study the students were frustrated with the strategies and had a hard time being able to apply them to the word problems in order to figure out the main ideas. On January 12, 2012, student K displayed frustrations with the assignment and began crying during the independent practice. In the beginning of the study the extra assistance during independent work was provided due to high frustration levels with applying the reading strategies such as, analyzing the problem for the main ideas and supporting details. In particular the reading strategy that the students struggled with the most apparent was making inferences based on text. Many of the students were familiar with this from reading instruction but had a hard time applying it to solving mathematics word problems. The students also relied heavily on assistance instead of trying to be independent thinkers.
Along with frustrations with reading strategies many of the students struggled with some of the mathematics concepts that were addressed during the course of the intervention. In particular the mathematics concepts that were the hardest to grasp were putting together all of the information learned about data. Many of the students were unfamiliar with data presented in graphs and other forms. Some of the students also struggled with the concept of elapsed time. They knew how to tell time but it was hard for them to answer elapsed time mathematical problems.

**Summary**

This chapter has presented an analysis of all data collected for the purpose of measuring the effects of explicit analytic reading skills instruction on third-grade students’ ability to solve mathematics problems in a written format. The next chapter provides a conclusion of the study, implications that can be drawn from the study, recommendations for further research, and limitation imposed on the research.
Chapter V

Discussion

The foundations to success are mathematics and reading in school and numerous students struggle to achieve basic proficiency in these areas. Research (Jitendra et al., 2007; Griffin & Jitendra, 2008) asserts that story problems present difficulties for many students. These experts say solving these problems poses difficulties because they require students to understand the language and factual information of the problem, and translate the problem with pertinent information to create an acceptable mental representation. A source (National Council of Teachers of Mathematics [NCTM], 2011) emphasizes that problem solving is an essential part of the k-12 mathematics curriculum. They assert that mathematical word problems can promote students’ conceptual understanding, foster their ability to reason and communicate mathematically, and capture their interests and curiosity. Respected researchers, (Barton et al., 2002; Gyamfi et al., 2010; Xin et al., 2008) assert that using explicit analytic reading skills instruction in elementary school classrooms can improve the ability to solve mathematical problems that are in a written format. Additionally, other experts (Ediger, 2002; Velenius et al., 2008) state that the academic of solving word problems will improve when classroom instruction includes specific reading strategies. Studies (Xin, Wiles, and Lin, 2008) conclude that when teachers focus on analyzing the word problem, mapping key elements, and connecting the elements to past understanding this will aid in the mathematical problem solving process. The purpose of this study is to examine the effects of explicit analytic reading skills instruction on mathematical problem solving abilities of one group of 25 students.

This study addressed the research question, “Does explicit analytic reading skills instruction improve the ability to solve mathematical problems of a written format in one group
ANALYTIC READING SKILLS INSTRUCTION AND MATHEMATICAL PROBLEM SOLVING

of third-grade students?” The results of the present study suggest that explicit analytic reading skills instruction improved these students' ability to solve mathematical problems in a written format. The results were obtained by analyzing the daily and weekly performance tasks that showed growth in the student’s ability to solve problems, as well as the pre-tests and post-tests which revealed a significant increase in their problem solving abilities. The ACTAAP was administered before and after the intervention of analytic reading skills instruction to measure written format problem solving abilities, as well as two other researcher adapted forms of the ACTAAP designed to measure analytic reading skills, and computation skills.

The written format problem solving abilities, analytic reading skills, and mathematical computation skills improved significantly from the beginning of this study. After explicit analytic reading skills instruction intervention, eighty-four percent of students' mathematical problem solving skills improved, ninety-six percent of students’ analytic reading skills improved, and ninety-two percent of students’ mathematical computation skills improved. A t-test conducted on the means of mathematical problem solving abilities, analytic reading skills, and mathematical computation skills revealed that the ability to solve mathematical problems, computation skills and analytic reading skills improved significantly. Gender subpopulations were analyzed using the mathematical problem solving scores and showed that the ninety-three percent of the ELL
mathematical problem solving abilities improved notably, and ninety percent of the non-ELL mathematical problem solving abilities improved notably.

Daily tasks required students to demonstrate their mathematics problem solving abilities measured on a mathematical analytic reading problem solving scale from 6 to 0, with 6 being the highest and 0 being the lowest. Daily problem solving scores were averaged to obtain a weekly group percentage average of daily scores. The highest weekly average was 88 which occurred on week 6 which included the mathematical concept of data, and the reading strategies of drawing conclusions and putting all of the reading strategies together. The lowest weekly average of daily scores was 68 which occurred on week 1. Week 1 was the introduction of the following reading strategies: finding the main idea, supporting details, and planning and explaining the solution. The mathematical concepts for the week were regrouping, two digit subtraction problems, and three-digit subtraction problems. Daily scores began to increase from week 1 to week 4 and then there was a slight drop in the scores on week 5 and a slight drop in week 7. Anecdotes that were recorded revealed that students struggled with certain reading concepts such as drawing inferences, and drawing conclusions. Anecdotes also revealed that students began to apply these reading strategies to other content areas, as well as using the reading strategies without direct instruction.

Conclusions

Based on the results of the present study, it appears that explicit analytic reading skills instruction increased the mathematical problem solving abilities for one group of third-grade students. The results indicate a steady increase in the students’ mathematical problem solving abilities from the beginning of the intervention to the end of the intervention. The results of this study also conclude that females mathematical problem solving ability improved significantly
more than males. Furthermore, the results reveal that ELL and non-ELL mathematical problem solving scores increased notably.

Based on the results from the three tests that were used it was concluded that there is a relationship among reading and mathematics. As students began to learn more reading strategies they were able to apply these to mathematical word problems and this began to improve their mathematical problem solving abilities. Based on anecdotes the first few weeks revealed that students were unfamiliar with the reading strategies and were frustrated with mathematic concepts as well as certain reading strategies. As the weeks progressed the students became less frustrated and were able to apply these reading strategies to the math concepts in order to solve the problems effectively.

These results indicate an increase in the students’ ability to understand the problem, organize the information, draw conclusions, find and implement a plan in order to arrive at a correct solution. These findings are similar to those of Fuchs et al. (2003) who suggested that strong instruction designed to teach rules for problem solution is important in the classroom and helps students solve problems efficiently. Additionally, Velinius-Tuohimaa et al. (2008) indicated that mathematics performance and reading skills are extremely important in order to become successful in mathematics. They assert that mathematical problem solving performance and comprehension reading skills play a role in understanding the overall problem and helps being able to effectively solve the problem. Furthermore, sources (Barton et al., 2002; Ediger, 2002; Gersten, Jordan and Flojo, 2005) suggest that teaching reading skills through targeted interventions help students accurately solve written mathematical problems.

The anecdotal records of daily observations of mathematics problem solving abilities revealed that students were able to make connections and apply reading strategies to other
content areas besides mathematics. Students used these reading skills without the explicit instruction of the teacher, and began to analytically read the word problems in order to understand the problem, plan, find and implement a solution effectively. Anecdotal records also show that the students became less frustrated as the weeks progressed and they began to become more confident with the mathematic problem solving process.

**Limitations**

As with any study, there were factors over which the researcher had no control that may have affected the results of this study. Some of the factors may have negatively affected the results, some may have positively affected the scores for mathematical problem solving abilities, and other had an unknown impact. Factors which may have enhanced the mathematical problem solving scores are maturation, additional reading instruction, and additional mathematics practice. As students are progressing through school they go through the natural process of maturation. Students begin to mature academically; therefore, natural growth in mathematics and reading occurred in this 8 week period may have enhanced the students mathematical problem solving abilities. The explicit analytic reading skills instruction was in addition to daily reading instruction. The amount of time and practice that was placed on reading strategies, during daily instruction, built the students skills to analytically read and understand mathematical word problems. In addition to reading instruction, students practiced mathematics daily which was not controlled during this study. Other than daily mathematics instruction, the students practice mathematics through a computer program called SuccessMaker. This program allows students to practice specific mathematics concepts for their level, and problem solving. Continual mathematics practice improves students’ computation and problem solving skills, and therefore had a positive impact on the individual scores.
Some factors that negatively impacted this study were illness. During this study, many students were absent as a result of illness. When students were absent, their mathematical problem solving scores for that day were not averaged into the daily or weekly percentages. The scores may have been different if a mathematics score had been recorded daily for each of the students.

Some factors that may have an unknown impact on the results are the instruments used to measure mathematical problem solving abilities. The ACTAAP measurement tool that was chosen has not been tested for reliability and validity, and therefore was an unknown limitation. Also, the tool that was chosen did not measure all mathematics concepts that were covered during the 8 week intervention period, and some mathematics concepts were unfamiliar to the students.

**Implications**

The results of this study imply that explicit analytic reading skills instruction may improve most students mathematical problem solving abilities. The results of the subpopulation scores imply that explicit analytic reading skills instruction is more effective for increased females than males. These results imply that explicit analytic reading skills instruction improved students’ abilities to solve mathematical problems in a written format. They also imply that explicit analytic reading skills instruction is more effective for girls than boys in improving the mathematical problem solving abilities. Another implication is that explicit analytic reading skills instruction impacted mathematics as well as reading. During the course of this study the anecdotes showed that the students were able to use reading strategies in other content areas besides mathematics. They were also able to use the strategies without explicit instruction from the teacher and apply these to other content areas. Many of the students ability to analytically
read problems in order to gain a strong understanding of what the purpose of the problem is improved. These anecdotes imply that the instruction impacted mathematics as well as reading.

**Recommendations**

Based on the results of the present study, recommendations are made regarding future intervention and research. Recommendations are made for the implementation of explicit analytic reading skills instruction. It is recommended that explicit analytic reading skills instruction be used in regular classroom instruction in order to improve mathematical problem solving abilities.

**Recommendations for future instruction.** It is recommended for future instruction that these strategies can also be applied to more than just mathematics content area and can be incorporated into reading instruction in order to build reading comprehension. Also, it is recommended that one number operation should be focused on in large units instead of focusing on a different mathematic concept daily. Doing this would allow the researcher to choose individual daily assessment tools that accurately reflect the problem solving abilities of students based on the number operation that is being taught. This would also show an accurate display of growth.

Another recommendation based on the results of this study is to incorporate more one-on-one and small group work interventions using the reading strategies. Due to time constraints this was not able to be done during this study, but it is suggested that this would yield higher results for those students that are struggling and need the individual attention and assistance.

**Recommendations for future research.** Recommendations for future research include, longer period of time, different measurement tool, and measuring mathematics and reading attitudes of students. Based on the study it is suggested that the instruction be extended for longer than an 8 week period. These strategies should be incorporated into daily mathematics instruction
ANALYTIC READING SKILLS INSTRUCTION AND MATHEMATICAL PROBLEM SOLVING

throughout the entire academic school year in order for the students to gain a strong understanding of how to analytically read and solve mathematics word problems. Future researchers may implement this same study over a longer period of time to observe additional improvements, patterns, and themes that might appear. It is also recommended that instruments tested for reliability and validity be used to measure mathematical problem solving abilities during the intervention period. Also, measurement instruments should directly reflect the mathematics concepts or operations that are being studied throughout the course of the study. A final recommendation for future researcher is to measure attitude of reading and mathematics word problems before implementing the intervention. This recommendation could help the researcher narrow in on the attitudes and feelings of the students prior to the implementation of the intervention. This could also give insight into specific misconceptions and areas that students are unfamiliar with.

Only mathematical problem solving abilities was tested during this study, but anecdotal records showed the increase in the ability to apply these strategies to other content areas, and ability to apply the strategies without explicit instruction. Therefore, it is recommended that explicit analytic reading skills instruction be tested for other variables such as ability to use in other content areas and the ability to apply the strategies without direct instruction.

**Summary**

This chapter has examined the conclusions of the study along with the implications of the study and recommendations for future research. Additionally, the possible limitations of the study were discussed. Overall, this study examined the effects of explicit analytic reading skills instruction on the improvement of student’s ability to solve mathematical problems in a written format in one group of third-grade students to find that explicit instruction of analytic reading strategies improved this particular group of students’ mathematical problem solving abilities.
References


MEMORANDUM

TO: Megan Long
    Linda Eilers

FROM: Ro Windwalker
      IRB Coordinator

RE: New Protocol Approval

IRB Protocol #: 11-11-246

Protocol Title: The Effects of Explicit Analytic Reading Skills Instruction on the Ability to Solve Mathematical Problems in a Written Format in a Third-Grade Classroom

Review Type: ☒ EXEMPT ☐ EXPEDITED ☐ FULL IRB

Approved Project Period: Start Date: 12/06/2011  Expiration Date: 12/05/2012

Your protocol has been approved by the IRB. Protocols are approved for a maximum period of one year. If you wish to continue the project past the approved project period (see above), you must submit a request, using the form Continuing Review for IRB Approved Projects, prior to the expiration date. This form is available from the IRB Coordinator or on the Research Compliance website (http://vpred.uark.edu/210.php). As a courtesy, you will be sent a reminder two months in advance of that date. However, failure to receive a reminder does not negate your obligation to make the request in sufficient time for review and approval. Federal regulations prohibit retroactive approval of continuation. Failure to receive approval to continue the project prior to the expiration date will result in Termination of the protocol approval. The IRB Coordinator can give you guidance on submission times.

This protocol has been approved for 25 participants. If you wish to make any modifications in the approved protocol, including enrolling more than this number, you must seek approval prior to implementing those changes. All modifications should be requested in writing (email is acceptable) and must provide sufficient detail to assess the impact of the change.

If you have questions or need any assistance from the IRB, please contact me at 210 Administration Building, 5-2208, or irb@uark.edu.
Appendix B

**Thurman G. Smith Elementary School**

Springdale Public Schools

3600 Falcon Road

Springdale, Arkansas 72762

Phone: (479) 750-8846

Fax: (479) 750-8716

Kim Simco
Principal
ksimco@sdale.org

Tonya Woods
Assistant Principal
twoods@sdale.org

November 1, 2011

To Whom It May Concern:

I am aware that Megan Long is conducting a study entitled “The Effects of Explicit Analytic Reading Skills Instruction on the Ability to Solve Mathematical Problems in a Written Format in a Third-Grade Classroom at my school, T.G. Smith Elementary in Springdale. This study has been approved by Dr. Linda H. Eilers, the University of Arkansas Professor, and Megan Long has my permission to conduct this study pending approval of the University of Arkansas Institutional Review Board committee.

Respectfully,

Kim Simco
Principal

Vicky Logue
Classroom Teacher
Dear Parent/Guardian:

I am currently working on a Master of Arts in Teaching degree at the University of Arkansas. As part of the MAT program, I am conducting a research project. While I am an intern in your child's class, I will be conducting my student project to determine if teaching students how to read analytically to analyze a problem, organize information based on the purpose and the text, make decisions, and engage critically with what they read improves the ability to translate narrative format mathematic problems into numeric operations and then accurately solve the problem.

Your student will be participating in several activities and lessons over the next nine weeks to supplement his/her understanding of solving mathematical word problems. The goal of this study is to increase your child’s ability to solve mathematical problems in a written format by using reading strategy instruction.

Participation is voluntary, and there are no negative consequences if you choose to not allow your child to participate. By signing and returning the attached form, you grant permission for me to use your child’s work in the results of this research project. Please note that confidentiality will be maintained and that your child’s name will not be used in reporting results. All results will be reported anonymously.

The attached informed consent form contains a more detailed description of this project. Please take time to read it over, read it with your child, and discuss it carefully. Feel free to call me at the school (479-750-8846) regarding any questions that you may have.

I am very excited about the opportunity to work with your child for the several weeks. Thank you for your time and cooperation.

Sincerely,

Megan Long
Estimado padre / tutor:

Actualmente estoy trabajando en una Maestría en Enseñanza en la Universidad de Arkansas. Como parte del programa de MAT, estoy realizando un proyecto de investigación. Mientras que soy una interna en la clase de su hijo, llevo a cabo un proyecto de estudiantes para determinar si a los estudiantes se les enseña a leer analíticamente para analizar un problema, organizar la información basada en el propósito y el texto, tomar decisiones y comprometerse críticamente con lo que leen y si mejora la capacidad de traducir los problemas de la narrativa en formato matemático en las operaciones numéricas y luego resolver el problema con precisión.

Su hijo va a participar en varias actividades y lecciones sobre las próximas nueve semanas para completar su / su capacidad para resolver problemas matemáticos palabra. El objetivo de este estudio es aumentar la capacidad del niño para resolver problemas matemáticos en forma escrita usando la estrategia de enseñanza de la lectura.

La participación es voluntaria, y no hay consecuencias negativas si decide no permitir que su hijo participe. Al firmar y devolver el formulario adjunto, usted otorga su permiso para que yo use el trabajo de su hijo en los resultados de este proyecto de investigación. Tenga en cuenta que se mantendrá la confidencialidad y que el nombre de su hijo no va a utilizar en los informes de resultados. Todos los resultados serán reportados de manera anónima.

El formulario de consentimiento informado adjunto contiene una descripción más detallada de este proyecto. Por favor, tome tiempo para leer más, leer con su hijo, y analizar con cuidado. No dude en llamarme a la escuela (479750-8846) con respecto a cualquier pregunta que pueda tener.

Estoy muy entusiasmado acerca de las actividades y las lecciones que he planeado para las próximas nueve semanas, y estoy deseando empezar a trabajar con usted y su hijo. Gracias por su cooperación.

Sinceramente,

Megan Long
Universidad de Arkansas Interna
INFORMED CONSENT

Title: The Effects of Explicit Analytic Reading Skills Instruction on the Ability to Solve Mathematical Problems in a Written Format in a Third-Grade Classroom

Reseacher
Megan Long, B.S.E., M.A.T. Graduate Student Coordinator
Dr. Linda H. Eilers, Faculty Advisor
University of Arkansas
College of Education and Health Professions
Department of Curriculum and Instruction
216 Peabody Hall
Fayetteville, AR 72701-1201
(479) 633-3580
Mcl005@uark.edu

Administrator(s):
Ro Windwalker, Compliance Coordinator
Research & Sponsored Programs
Research Compliance
University of Arkansas
ADMIN 210
Fayetteville, AR 72701-1201
(479) 575-2208
irb@uark.edu

Description: The present study is an action research project designed to see if teaching students how to analyze problems, mentally organize information, make decisions, and engage critically with what they read improves their ability to change written problems into numeric equations and work accurately. At the beginning of the project your child will complete 20 word problems that require him or her to read a problem, plans a solution, calculate the solution, and then explain his or her work. The test is timed and your child will complete the test as part of an entire group test at one setting, before and after the project. During instruction, your child will engage in instruction that will teach reading strategies that will have him or her analyze a problem, mentally organize information, make decisions based on the text, and bring thoughts and opinions to what they read. He or She will use these strategies to accurately solve math word problems in a written format. The instruction will take place 50 minutes a day, 4 days a week, for 9 weeks in your child’s third-grade classroom.

Risks and Benefits: There are no risks, other than those associated with regular classroom instruction, anticipated with this project. The benefits are to improve abilities to understand mathematical problems in written format and strengthen solving techniques for word problems in one group of third-grade students. Voluntary Participation: Your child will participate in all classroom activities during this research project. However, the decision to allow your child’s grades and scores to be used in recording and analyzing data for this project is completely voluntary.

Confidentiality: Your child’s scores and grades will remain confidential throughout this project. To ensure confidentiality, a code will be established by randomly assigning a number to each participant. All scores and grades for data analysis will be recorded using this code. The code, as well as all data collected during the study, will be stored in a secure place and will only be accessible to the researcher. Neither your child nor his/her scores or grades will be personally identified. The code will be destroyed at the conclusion of the study.
Appendix D2

*Right to Withdraw:* You are free to refuse to participate in the research and to withdraw from this study at any time. Your decision to withdraw will bring no negative consequences — no penalty to you.

*Informed Consent:* I, _____________________________, have read the description, (Please print your name) including the purpose of the study, the procedures to be used, the potential risks and benefits, how confidentiality will be established and maintained, as well as the option to withdraw. I have read and discussed this project with my child ___________________________. (please print your child’s name)

My signature below indicates that my child and I freely agree his/her scores and grades to be recorded and analyzed as a participant in this project.

____________________                      ________________________                      ______________________
Parent/Guardian                      Child/Participant                      Date
CONSENSUIMENTO INFORMADO

Título: Los Efectos de la Instrucción de Lectura Analítica Explícita en la Capacidad para Resolver Problemas Matemáticos en forma escrita en un aula de Tercer Grado

Investigadora: Megan Long, B.S.E, M.A.T. Graduate Student  
Dr. Linda H. Eitels, Faculty Advisor  
University of Arkansas  
College of Education and Health Professions  
Department of Curriculum and Instruction  
215 Peabody Hall  
Fayetteville, AR 72701-1201  
479-750-8846  
me0005@uark.edu

Descripción: El presente estudio es un proyecto de investigación diseñado para que los alumnos analicen los problemas, organizan mentalmente la información, toman decisiones y comprometerse críticamente con lo que les mejora su capacidad para cambiar los problemas por escrito en las ecuaciones numéricas y trazar con precisión. En el inicio del proyecto su hijo completará 20 problemas verbales que le requiera que lea un problema, los planes de una solución, calcular la solución, y luego explicar su trabajo. La prueba se mide el tiempo y su hijo se completa la prueba como parte de una prueba de todo el grupo en un entorno, antes y después del proyecto. Durante la instrucción, su hijo participará en la instrucción que va a enseñar estrategias de lectura que él o ella analiza un problema, mentalmente organizar la información, tomar decisiones basadas en texto, y llevar ideas y opiniones a lo que leen. Él o ella van a utilizar estas estrategias para resolver problemas de matemáticas con precisión en un formato escrito. La instrucción se llevará a cabo 50 minutos al día, 4 días a la semana, durante 9 semanas en el salón de su hijo en tercer grado.

Riesgos y Beneficios: No hay ningún riesgo, además de los asociados con clases regulares, se anticipa con este proyecto. Los beneficios potenciales incluyen mejorar las habilidades para entender los problemas matemáticos en forma escrita y reforzar las técnicas de resolución de problemas matemáticos en un grupo de estudiantes de tercer grado.

Participación voluntaria: Su hijo participará en todas las actividades en el aula durante este proyecto de investigación. Sin embargo, la decisión de permitir a su hijo, las calificaciones convirtiéndose en protagonista y las respuestas que se utilizarán en el registro y análisis de datos para este proyecto es completamente voluntaria.

Confidencialidad: Su hijo, las calificaciones convirtiéndose en protagonista y respuestas serán confidenciales en todo el proyecto. Para garantizar la confidencialidad, el código se establecerá de forma aleatoria la asignación de un número a cada participante. Todos los resultados y las respuestas para el análisis de los datos se grabarán con este código. El código, así como los datos recogidos durante el estudio, se guardara en un lugar seguro y solo será accesible para el investigador. Si su hijo no / sus resultados o respuestas que se identifican personalmente. El código será destruido al final del estudio.

Derecho de Retiro: Si usted decide permitir que su hijo, las calificaciones convirtiéndose en protagonista a utilizar ahora, pero en cualquier momento y por cualquier razón cambia de opinión, usted puede retirar su consentimiento. En ese caso, su hijo, las calificaciones convirtiéndose en protagonista y las respuestas no se registrarán en los datos del proyecto. No habrá ninguna consecuencia negativa de esta decisión.

Consentimiento Informado

Yo, ____________________________, he leído la descripción de este estudio. Entiendo el propósito de este proyecto, y los procedimientos que se van a utilizar, los riesgos y beneficios potenciales, como la confidencialidad será establecida y mantenida, así como la opción de retirarse. He leído y discutido este proyecto con mi hijo__________________________.

(Por favor escriba el nombre del niño)

Mi firma abajo indica que mi hijo y yo liberen de acuerdo a su / resultados y las respuestas que se registran y se analizan como participante en este proyecto.

Firma del Padre ___________________________  Firma del Estudiante/Participante ___________________________  Fecha ___________________________

Firma del Estudiante/Participante ___________________________  Fecha ___________________________

Personas de Contacto Cumplimiento:  
Ro Windwalker, Compliance Coordinator  
Research & Sponsored Programs  
Research Compliance  
University of Arkansas  
ADMIN 210  
Fayetteville, AR 72701-1201  
479-575-2208  
lib@uark.edu
1. Todd rode his bike for 100 minutes. What is another way to write the amount of time Todd rode his bike?
   - A 1 hour and 0 minutes
   - B 1 hour and 40 minutes
   - C 2 hours and 0 minutes
   - D 3 hours and 10 minutes

2. Point $P$ is located 3 horizontal units to the right of and 1 vertical unit up from point $J$.

Which ordered pair represents the location of point $P$?
   - A (3, 6)
   - B (4, 5)
   - C (5, 4)
   - D (6, 3)
PART II  Released Mathematics Items—2011 Augmented Benchmark Grade 3

3  Hank uses 6 ounces of water to make 1 mug of hot chocolate.
Which number sentence models the number of ounces of water, w, Hank will need to make 12 mugs of hot chocolate?
A  $6 + 12 = w$
B  $6 \times 12 = w$
C  $12 - 6 = w$
D  $12 \div 6 = w$

4  Which tool could a student use to find the mass of a soccer ball?
A  Balance scale
B  Measuring cup
C  Tape measure
D  Thermometer
Which geometric solid can be made from the shapes below?

A cube
B cone
C sphere
D cylinder
6. Julian and Olivia play a game with a numbered spinner. Julian gets 1 point if the spinner lands on an even number. Olivia gets 1 point if the spinner lands on an odd number.

Which spinner makes the game fair for Julian and Olivia?
PART II  Released Mathematics Items—2011 Augmented Benchmark Grade 3

7  A teacher draws a figure on the left side of a segment.

Which drawing shows a slide (translation) of the figure across the segment?

A  

B  

C  

D
The table shows the lengths of four types of snakes.

<table>
<thead>
<tr>
<th>Type of Snake</th>
<th>Length (in feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown</td>
<td>5</td>
</tr>
<tr>
<td>Bushmaster</td>
<td>12</td>
</tr>
<tr>
<td>Diamondback</td>
<td>7</td>
</tr>
<tr>
<td>Gopher</td>
<td>8</td>
</tr>
</tbody>
</table>

Which bar graph shows the data in the table?

9 What is the greatest number of whole weeks in one year?

A 7
B 12
C 52
D 365
The table shows the number of jobs a cleaning company had over five days.

### Cleaning Jobs

<table>
<thead>
<tr>
<th>Day</th>
<th>Number of Jobs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>14</td>
</tr>
<tr>
<td>Tuesday</td>
<td>11</td>
</tr>
<tr>
<td>Wednesday</td>
<td>23</td>
</tr>
<tr>
<td>Thursday</td>
<td>16</td>
</tr>
<tr>
<td>Friday</td>
<td>17</td>
</tr>
</tbody>
</table>

Between which two days was there the greatest change in the number of jobs?

A. Monday and Tuesday  
B. Tuesday and Wednesday  
C. Wednesday and Thursday  
D. Thursday and Friday

Joshua has 8 pencils, 4 crayons, and 2 markers in a bag. If he pulls one writing utensil from the bag without looking, what is the probability he will pull out a crayon?

A. $\frac{4}{12}$  
B. $\frac{2}{14}$  
C. $\frac{4}{14}$  
D. $\frac{8}{14}$

A bank teller is adding up $100 bills. What amount of money will she count after $800?  

A. $700  
B. $801  
C. $810  
D. $900
13 Terrell drew the drawing below in his math journal.

What term describes Terrell’s drawing?
A  Line
B  Line segment
C  Ray
D  Diagonal

14 Tyrese used his inch ruler to draw the figure shown.

What is the perimeter, in inches, of Tyrese’s figure?
A  1 inch
B  2 inches
C  4 inches
D  6 inches
PART II  Released Mathematics Items—2011 Augmented Benchmark Grade 3

15 Mrs. Edmonds has 3 boxes of pencils. Each box has the same number of pencils in it. Mrs. Edmonds has a total of 24 pencils. Which of the following can be used to determine the number of pencils in each box?

A  $3 \times \Box = 24$
B  $3 + \Box = 24$
C  $24 - \Box = 3$
D  $24 + 3 = \Box$

16 Mrs. Warren wrote the number sentence (equation) below on the board for her students.

\[
6 \times 7 = 42
\]

Which statement about the number sentence (equation) is true?

A  42 is a factor.
B  42 is the quotient.
C  6 and 7 are factors.
D  6 and 7 are multiples of 42.
PART II Released Mathematics Items—2011 Augmented Benchmark Grade 3

The picture below shows a figure with one line of symmetry already drawn in it.

Which of these shows the correct location of the second line of symmetry?

A

B

C

D
PART II  Released Mathematics Items—2011 Augmented Benchmark Grade 3

Mathematics Item A—2011 Grade 3

A  Robert, Sally, Toni, and William each have 17 stickers.

1. How many total stickers do Robert, Sally, Toni, and William have? Show your work and/or explain your answer.

2. Allie has 12 stickers. She puts her stickers with the total number of stickers that Robert, Sally, Toni, and William have. The 5 friends decide to share all the stickers equally. How many stickers does each friend receive? Show your work and/or explain your answer.

BE SURE TO LABEL YOUR RESPONSES 1 AND 2.

Mathematics Item A Scoring Rubric—2011 Grade 3

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>The student earns 4 points. The response contains no incorrect work.</td>
</tr>
<tr>
<td>3</td>
<td>The student earns 3–3 3/4 points.</td>
</tr>
<tr>
<td>2</td>
<td>The student earns 2–2 1/4 points.</td>
</tr>
<tr>
<td>1</td>
<td>The student earns 1–1 1/2 points, or minimal understanding is shown.</td>
</tr>
<tr>
<td>0</td>
<td>The student earns 0 points. No understanding is shown.</td>
</tr>
<tr>
<td>B</td>
<td>Blank—No Response. A score of &quot;B&quot; will be reported as &quot;NA.&quot; (No attempt to answer the item. Score of &quot;0&quot; is assigned for the item.)</td>
</tr>
</tbody>
</table>
## PART II  Released Mathematics Items—2011 Augmented Benchmark Grade 3

### Solution and Scoring

<table>
<thead>
<tr>
<th>Part</th>
<th>Points</th>
</tr>
</thead>
</table>
| 1    | 2 points possible  
     | 1 point: Correct answer: 68 (stickers)  
     | AND  
     | 1 point: Correct and complete procedure shown and/or explained of how the answer was determined. Give credit for one of the following or equivalent:  
     |   • 17 × 4 = #  
     |   • 17 + 17 + 17 + 17 = #  
     | Or  
     | ½ point: Procedure contains a counting error +/- 1 or a copy error: Give credit for one of the following or equivalent:  
     |   • 17 × 3 = #  
     |   • 17 + 17 + 17 = #  
     |   • 17 × 5 = #  
     |   • 17 + 17 + 17 + 17 + 17 = #  
     |   • 16 × 4 = #  
     |   • 16 + 16 + 16 + 16 = #  
| 2    | 2 points possible  
     | 1 point: Correct answer: 16 (stickers)  
     | (or correct answer based on an incorrect answer in Part I, e.g., for a response with an answer of 51 in Part I a correct answer will be 51 + 12 = 63, 63 ÷ 3 = 12.6)  
     | AND  
     | 1 point: Correct and complete procedure shown and/or explained of how the answer was determined. **Work may be based on an incorrect answer in Part I.** Give credit for one of the following or equivalent:  
     |   • 63 + 12 = 80, 80 ÷ 5 = #  
     |   • 17 + 17 + 17 + 17 + 17 + 17 = 80, 80 ÷ 5 = #  
     |   • 63 + 12 = 80, 16 × 5 = 80 (Guess & Check)  
     |   • 63 + 12 = 80, with a graphic depiction of 5 groups, clearly consisting of 16 units each, totaling 80.  
     | Or  
     | ½ point: Correct but incomplete procedure, with the step of adding the total stickers up or dividing the total stickers by 5 not shown. **Work may be based on an incorrect answer in Part I.** Give credit for one of the following or equivalent:  
     |   • 80 ÷ 5 = #  
     |   • 16 × 5 = 80 (Guess & Check)  
     |   • 68 + 12 = #  

---

2011 G3 RB
Lucy made a pictograph of the types of trees on Blossom Lane.

**Trees on Blossom Lane**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Birch</td>
<td>🍃 🍃</td>
</tr>
<tr>
<td>Elm</td>
<td>🍃 🍃 🍃 🍃 🍃 🍃 🍃 🍃</td>
</tr>
<tr>
<td>Maple</td>
<td>🍃 🍃 🍃 🍃 🍃 🍃 🍃 🍃</td>
</tr>
<tr>
<td>Oak</td>
<td>🍃 🍃 🍃 🍃 🍃 🍃 🍃 🍃</td>
</tr>
<tr>
<td>Pine</td>
<td>🍃 🍃 🍃 🍃 🍃 🍃 🍃 🍃</td>
</tr>
</tbody>
</table>

Each 🍃 represents 2 trees.

1. How many total trees are on Blossom Lane? Show your work and/or explain your answer.

2. Jimmy also made a pictograph of the types of trees on Blossom Lane. His pictograph has a key of 1 leaf represents 4 trees. How many leaves did Jimmy draw to represent the elm trees on Blossom Lane? Show your work and/or explain your answer.

BE SURE TO LABEL YOUR RESPONSES 1 AND 2.
# Mathematics Item B Scoring Rubric—2011 Grade 3

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>The student earns 4 points. The response contains no incorrect work.</td>
</tr>
<tr>
<td>3</td>
<td>The student earns 3 points.</td>
</tr>
<tr>
<td>2</td>
<td>The student earns 2 points.</td>
</tr>
<tr>
<td>1</td>
<td>The student earns 1 point, or minimal understanding is shown. Ex: The five correct subtotals (4, 14, 8, 10, 11) are given as the answer in Part 1.</td>
</tr>
<tr>
<td>0</td>
<td>The student earns 0 points. No understanding is shown.</td>
</tr>
<tr>
<td>B</td>
<td>Blank—No Response. A score of “B” will be reported as “NA.” (No attempt to answer the item. Score of “0” is assigned for the item.)</td>
</tr>
</tbody>
</table>
### Solution and Scoring

<table>
<thead>
<tr>
<th>Part</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2 points possible</td>
</tr>
<tr>
<td></td>
<td>1 point: Correct answer: 47 (trees) <strong>AND</strong></td>
</tr>
</tbody>
</table>
|      | 1 point: Correct (and complete) procedure shown and/or explained of how the answer was determined. Work may contain a calculation error, copy error, or counting (+/− 1 whole tree leaf) error for any street.  
Give credit for one of the following or equivalent:  
- $4 + 14 + 8 + 10 + 11 = $  
- $23 \times 2 = 46; 46 + 1 = $  
- $23 \frac{1}{2} \times 2 = $  
- $2$ added $23$ times $+ 1 = $  
- $10 + 10 + 10 + 10 + 7 = $ (any grouping that includes one odd number is acceptable)  
- $4 + 12 + 8 + 10 + 11 = # $ (counting error − 1 whole leaf)  
- A graphic depiction clearly showing the number of trees adding up to 47, with the conversion of the half-unit into a whole unit (e.g., bar graphs or grid boxes checked)  
- "I counted by 2's until I got to the half symbol which would be + 1 to get my total." |
| 2    | 2 points possible |
|      | 1 point: Correct answer: 3 ½ (leaves, which may be drawn) **AND** |
|      | 1 point: Correct (and complete) procedure shown and/or explained of how the answer was determined. Work may be based on an incorrect answer in Part I and/or contain a calculation or copy error.  
Give credit for one of the following or equivalent:  
- $14 + 4 = $  
- $7 + 3 = $  
- $4 + 1 + 4 + 2 = 14 $  
- $4, 8, 12, 14$ (skip counting)  
- A graphic depiction clearly showing 7 leaves converted to 3 ½ leaves.  
- "I counted the pairs of leaves and there were 3 pairs and 1 leaf by itself." |
Kelly drew the line segments shown.

1. Name 2 line segments in Kelly's figure that appear to be parallel to each other.
2. Name 2 line segments in Kelly's figure that appear to be intersecting each other.
3. Copy Kelly's figure in your Student Answer Document. Draw and label a new line segment that intersects line segment CD. Use words, numbers, and/or pictures to explain why the line segment you drew is intersecting line segment CD.

BE SURE TO LABEL YOUR RESPONSES 1, 2, AND 3.
### Mathematics Item C Scoring Rubric—2011 Grade 3

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>The student earns 4 points. The response contains no incorrect work. Kelly's figure is correctly copied in Part 3.</td>
</tr>
<tr>
<td>3</td>
<td>The student earns 3 points.</td>
</tr>
<tr>
<td>2</td>
<td>The student earns 2 points.</td>
</tr>
<tr>
<td>1</td>
<td>The student earns 1 point, or minimal understanding is shown. Ex.: Response includes a verbal description and/or graphic depiction of parallel and/or intersecting lines in any part of the response that clearly demonstrates the meaning of one or both.</td>
</tr>
<tr>
<td>0</td>
<td>The student earns 0 points. No understanding is shown.</td>
</tr>
<tr>
<td>B</td>
<td>Blank—No Response. A score of &quot;B&quot; will be reported as &quot;NA.&quot; (No attempt to answer the item. Score of &quot;0&quot; is assigned for the item.)</td>
</tr>
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</table>
## Solution and Scoring

<table>
<thead>
<tr>
<th>Part</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 point possible&lt;br/&gt;1 point: Correctly names 2 line segments that are parallel to each other. Give credit for any of the following pairs (or equivalent):&lt;br/&gt;- Line segments AE and BF&lt;br/&gt;- AC and BD&lt;br/&gt;- CE and DF&lt;br/&gt;- AE and BD&lt;br/&gt;- AE and DF&lt;br/&gt;- AC and BF&lt;br/&gt;- CE and BF&lt;br/&gt;- AC and DF&lt;br/&gt;- CE and BD</td>
</tr>
<tr>
<td>2</td>
<td>1 point possible&lt;br/&gt;1 point: Correctly names 2 line segments that are intersecting each other. Give credit for any of the following pairs (or equivalent):&lt;br/&gt;- Line segments A2 and CD&lt;br/&gt;- BF and CD&lt;br/&gt;- AC and CD&lt;br/&gt;- BD and CD&lt;br/&gt;- CE and CD&lt;br/&gt;- DF and CD&lt;br/&gt;- AC and CE&lt;br/&gt;- BD and FD</td>
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</table>
### PART II  Released Mathematics Items—2011 Augmented Benchmark Grade 3

<table>
<thead>
<tr>
<th>Part</th>
<th>Points</th>
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<tbody>
<tr>
<td>3</td>
<td>2 points possible</td>
</tr>
<tr>
<td></td>
<td>2 points: Correct and complete diagram with support:</td>
</tr>
<tr>
<td></td>
<td>Response contains the following:</td>
</tr>
<tr>
<td></td>
<td>• Diagram is drawn showing a new, correctly labeled line segment intersecting $CD$.</td>
</tr>
<tr>
<td></td>
<td>Note: Letters A-F cannot be used to designate a new point.</td>
</tr>
<tr>
<td></td>
<td>Note: Kelly's figure does not need to be copied in its entirety, except at the &quot;4&quot; level.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Diagram" /></td>
</tr>
<tr>
<td></td>
<td>• Support explains and/or shows an understanding of intersection using words and/or pictures:</td>
</tr>
<tr>
<td></td>
<td>Ex: &quot;Any line segment that crosses line segment CD is intersecting.&quot;</td>
</tr>
<tr>
<td></td>
<td>Ex: &quot;One line crosses (goes across) another line.&quot;</td>
</tr>
<tr>
<td></td>
<td>Ex: &quot;One line segment goes through another line segment.&quot;</td>
</tr>
<tr>
<td></td>
<td>Ex: &quot;One line meets another line.&quot;</td>
</tr>
<tr>
<td></td>
<td>Ex: &quot;My line touches the other line.&quot;</td>
</tr>
<tr>
<td></td>
<td>Ex: &quot;The segment connects with another segment.&quot;</td>
</tr>
<tr>
<td></td>
<td>Note: Do not deduct if the student uses the term &quot;line&quot; instead of &quot;line segment&quot;, even at the &quot;4&quot; level.</td>
</tr>
<tr>
<td>OR 1 point:</td>
<td>Give credit for the following.</td>
</tr>
<tr>
<td></td>
<td>• Diagram is drawn showing a new, incorrectly labeled line segment intersecting $CD$, with or without a supporting explanation.</td>
</tr>
<tr>
<td></td>
<td>or</td>
</tr>
<tr>
<td></td>
<td>• Diagram is drawn showing a new, incorrectly labeled line segment intersecting another labeled line segment, with a supporting explanation as defined above.</td>
</tr>
</tbody>
</table>
Mathematics Reading Test

1. Hank uses 6 ounces of water to make 1 mug of hot chocolate. Hank wants to make 12 mugs of hot chocolate. What number sentence can be written to model the number of ounces of water Hank will need to make 12 mugs?
   This story is about:
   a. How to make hot chocolate.
   b. Showing work and explaining the answers.
   c. Deciding how many ounces are divided among 12 mugs of hot chocolate.
   d. Hank deciding to make hot chocolate.

2. Julian and Olivia play a game with a numbered spinner. Julian gets 1 point if the spinner lands on an even number. Olivia gets 1 point if she lands on an odd number. What would a spinner look like to make the game fair for Julian and Olivia?
   This story is about:
   a. How to make a spinner.
   b. Odd and even numbers
   c. Julian and Olivia learning how to play a game with a spinner.
   d. A spinner has an equal amount of odd and even numbers on it.

3. Joshua has 8 pencils, 4 crayons, and 2 markers in a bag. If he pulls one writing utensil from the bag without looking, what is the probability he will pull out a crayon?
   This story is about:
   a. How to pull a crayon out of the bag without looking
   b. What probability is
   c. Deciding how to make a fraction that tells what the probability of pulling out a crayon is.
   d. Showing how to make an equal amount of pencils, crayons and markers in a bag.

4. Mrs. Edmonds has 3 boxes of pencils. Each box has the same number of pencils in it. Mrs. Edmonds has a total of 24 pencils. What is a number sentence that can be used to determine the number of pencils in each box?
   This story is about:
   a. Showing work and explaining answers.
   b. Figuring out how to make a number sentence that will multiply 3 by a number to get the answer 24.
   c. What a number sentence is and how to use it.
   d. How to equally distribute pencils.
5. Robert, Sally, Toni and William each have 17 stickers. How many total stickers do they all have? Allie has 12 stickers. She puts her stickers with the total number of stickers that Robert, Sally, Toni and William have. The 5 friends decide to share all the stickers equally. How many stickers does each friend receive?

This story is about:

a. A contest to see who has the most stickers.
b. Sharing is important to friendship.
c. Deciding how many stickers if they are divided equally among a group of friends.
d. Showing work and explaining answers.

6. Jimmy made a pictograph of the types of trees on Blossom Lane. His pictograph has a key of 1 leaf represents 4 trees. How many leaves did Jimmy draw to represent the elm trees on Blossom Lane?

This story is about:

a. How to make a pictograph.
b. Deciding how many trees by multiplying by 4’s.
c. How to draw leaves.
d. Showing work and explaining answers.
Appendix G1

Mathematics Test

1. $60 + 40 = $

2. $8 + 4 + 2 = $

3. $17 \times 4 = $

4. $51 + 12 = $

5. $63 \div 5 = $

6. $68 + 12 = $

7. $4 + 14 + 8 + 10 + 11 = $

8. $14 \div 4 = $
9. 4 + 4 + 4 + 2 =

10. 800 + 100 =

11. 3 \times 4 =
Appendix H

**Analytic Scoring Scale**

**Understanding the Problem**
- 0: Complete misunderstanding of the problem
- 1: Part of the problem misunderstood or misinterpreted
- 2: Complete understanding of the problem

**Planning a Solution**
- 0: No attempt, or totally inappropriate plan
- 1: Partially correct plan based on part of the problem being interpreted correctly
- 2: Plan could have led to a correct solution if implemented properly

**Getting an Answer**
- 0: No answer, or wrong answer based on an inappropriate plan
- 1: Copying error, computational error, partial answer for a problem with multiple answers
- 2: Correct answer and correct label for the answer

6/6 = 100%
5/6 = 83%
4/6 = 66%
3/6 = 50%
2/6 = 33%
1/6 = 16%
0/6 = 0%
Appendix I

<table>
<thead>
<tr>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
<th>Week 6</th>
<th>Week 7</th>
<th>Week 8</th>
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<tr>
<td><strong>Math focus:</strong></td>
<td><strong>Math focus:</strong></td>
<td><strong>Math Focus:</strong></td>
<td><strong>Math Focus:</strong></td>
<td><strong>Math Focus:</strong></td>
<td><strong>Math Focus:</strong></td>
<td><strong>Math Focus:</strong></td>
<td><strong>Math Focus:</strong></td>
</tr>
<tr>
<td>Regrouping, Subtracting two-digit numbers, subtracting three-digit numbers.</td>
<td>Subtracting across zero, Determining whether it is an exact answer or estimate, adding and subtracting money.</td>
<td>Choosing a computation method, equalities and inequalities, Telling time to the half hour and quarter of an hour.</td>
<td>Telling time to the minute, elapsed time.</td>
<td>Calendar, introduce data, line plots, pictographs, and bar graphs.</td>
<td>Reading line graphs, data problems, multiplication as repeated addition, arrays and multiplication.</td>
<td>Multiplication stories, Making a table for multiplication problems, 2 as a factor, 3 as a factor.</td>
<td></td>
</tr>
</tbody>
</table>

**Reading Concept:** Find the main idea. Find supporting details. Planning the solution and explaining. Putting all strategies together.

**Reading Concept:** Finding key words. (vocabulary) Making predictions. Drawing inferences. **Reading Concept:** Visualization. Sequencing information. Putting all strategies together. **Reading Concept:** Drawing conclusion. Summarizing. Putting all strategies together. **Reading Concept:** Drawing a picture to find main idea. Using graphic organizers. Find main idea and supporting details. Analyze and use best strategy.

**Problem types:** Identifying main idea word problems. Deciphering what are important supporting details word problems. Subtraction word problems. **Problem types:** Missing information. Estimation word problems. Money word problems with missing information. **Problem types:** Missing information. Too much irrelevant information. **Problem types:** Word problem without pictures representing clocks. Word problems with a series of events. Elapsed time word problems. **Problem types:** Data word problems. Long and lengthy information with data. **Problem types:** Data word problems. **Problem types:** Multiplication word problems. Too many supporting details and irrelevant information. **Problem types:** Multiplication word problems involving tables. Multiplication word problems with irrelevant information.
Monday 1-9-12

I. Math—Understanding the main idea of a word problem

II. 3rd grade

III. TLW know what the main idea of a problem is.

TLW understand that in order to solve a mathematical word problem that they must look for the main idea of the problem. The main idea is identifying the gist of what the problem is asking to do and can be identified by trying to find the big idea.

TLW be able to identify the main idea of a mathematical regrouping word problem.

Frameworks:

NO.1.3.1: Recognize equivalent representations for the same whole number and generate them by composing and decomposing numbers.

Common Core Standards: 3.NBT.1. Use place value understanding to round whole numbers to the nearest 10 or 100.

IV. Materials: Promethean Board, Mathematical regrouping problem, butcher paper for anchor chart,

V. Schema: Ask the students if they have ever read a math word problem and not known at all what the problem was asking them to do? TTW explain to the students that if they read it and don’t understand what it is asking they do not understand the main idea or the purpose of the problem and that understanding the main idea is essential to knowing how to solve the problem.

Review: Review reading numbers using place value blocks.

Purpose: Learn to use strategy of finding the main idea of a regrouping problem in order to understand what the problem is asking to do.

Method: Display a mathematical regrouping word problem on the promethean board. Read the problem as a class. After reading the problem as a class underline or highlight the main question the problem is asking. Inform the students that this main question is the main idea or the gist of the problem. TTW then use a piece of butcher paper to begin an anchor chart on the reading strategies that are used in order to solve mathematical word problems, and will write find the main idea, and provide some explanation of what the main idea is.

G.P.: TTW provide the students with a few different problems in which they are to underline or highlight the main idea of those problems as the teacher guides them through the problems.

I.P.: TLW identify the main idea of 3 mathematical regrouping word problems, and write a sentence describing what the author is asking or what the gist of the problem is.

VI. Evaluation: TTW evaluate TL’s understanding of finding the main idea by checking the problems for correct identification of the main idea by using the understanding the problem portion of the Analytic Scoring Scale.
Math Word Problems

Regrouping and Finding the Main Idea

Directions: For each of these problems underline the main idea of the problem and write a sentence down below of what the problem is telling, or asking you to do.

1. There are 309 cars on Interstate 30 in Arkadelphia. How many tens is the same as the hundreds in this number?

   The problem is asking me to find out how many tens is the
   hundreds in this number.

2. There are 365 days in one year. How would you regroup 1 hundred as 10 tens in this number?

   This problem is asking me to find out how you could regroup
   1 hundred as 10 tens.

3. Billy has 4 dimes and 3 pennies. Kara has the same amount of money as Billy but a different number of dimes and pennies. What coins does Kara have?

   The problem is asking me to find out what coins
   Kara has.

4. After regrouping 1 hundred as 10 tens, Andrew has 2 hundreds, 14 tens, and 6 ones. Which number did he regroup?

   This problem is asking me to find out what number
   Andrew regrouped.

   + 2
Tuesday 1-10-12
I. Math - Finding supporting details of mathematical word problems
II. 3rd grade
III. TLW know what supporting details are.
TLW understand that supporting details are the rest of the information that is needed to solve the problem. Supporting details aid the main idea because it helps the reader identify what details or numbers are needed to solve for what the problem is asking.
TLW be able to identify the supporting details of a two-digit number subtraction word problem.
Frameworks: NO.3.3.4: Solve simple problems using one operation involving subtraction
Common Core Standards: 3.NBT.2: Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.
IV. Materials: Promethean board, Anchor chart, Two-digit subtraction word problems,
V. Schema: TTW display a sentence on the board that is very vague and has no supporting details. She will then ask the students to think-pair-share about what can be done to make this sentence have more details or add information so the reader would know what the sentence was about.
Review: TTW review with the students what regrouping is, and how you can regroup 1 hundred as 10 tens and 1 ten as 10 ones. TTW explain that regrouping is important to being able to subtract. TTW also review how to find the main idea of a problem, and why this is important to solving mathematical word problems.
Purpose: Learn to use strategy of finding supporting details or numbers that they will use to solve a problem and help to contribute to the main idea of a problem.
Method: TTW display a word problem that has to do with subtracting two digit numbers on the board. TTW conduct a think aloud on how to find the main idea of the problem, and what else would be important to solving these mathematical problems, as a class they will highlight or underline the main idea of the problem. TTW explain to the students that supporting details are the numbers or any other information that is used to aid in the main idea and these will help them solve the problem. As a class they will circle the supporting details that are found in this problem. TTW then use the butcher paper anchor chart and add that supporting details are essential to understanding the purpose of the problem, and knowing what number or other important information is needed in order to solve the problem.
G.P.: TTW work through several word problems that have to do with subtracting two digit numbers. TTW guide and model on how to find the main idea and the supporting details of these problems. TTW also guide and model the students on how to solve three-digit subtraction problems.
I.P.: TLW identify the main idea and the supporting details and important information that is needed to solve mathematical word problems.
VI: Evaluation: TTW check the problems for accuracy using the Analytic Scoring Scale to check for accurate identification of supporting details and how they aid in the main idea.
Finding the Supporting Details

Subtracting Two-Digit Numbers

Directions: Find and circle the supporting details of each problem, and underline the main idea of the sentence. Write a sentence about the main idea and the supporting details.

1. There are 85 apple blossoms on Anna's apple tree. She picked 36 flowers to make a bouquet. How many flowers are left on the tree?

   The main idea is how many flowers are left on the tree. By using subtraction, the supporting details are 49.

2. Anna invited the entire third grade to her party. There are 48 students altogether, 23 of the students are boys and 25 are girls. 9 students will not be able to go to the party. How many students will be there?

   The main idea is how many students will be at the party. By using subtraction, the supporting details are 39.

3. The distance from Fayetteville to Jonesboro is 88 miles. Mr. Adams drove 29 miles from Fayetteville towards Jonesboro. How many miles does he have left to drive to get to Jonesboro?

   The main idea is how many miles Mr. Adams have to drive. By using subtraction, the supporting details are 59.

4. The zookeeper has 68 fish to feed the penguins. 19 penguins have already gotten a fish. The zoo has 36 penguins. How many more penguins need to get a fish?

   The main idea is how many more penguins need to get a fish. By using subtraction, the supporting details are 59.

5. Casey has read 58 pages of a book. The book has a total of 92 pages. How many more pages does she still have to read?

   The main idea is how many more pages does Casey have to read. By using subtraction, the supporting details are 34.
Appendix N

Wednesday 1-11-12
I. Math– Explaining how to get the solution and planning it for a math word problem.
II. 3rd grade
III. TLW know what planning a solution is and how to explain how to get the solution.
TLW understand that planning a solution will involve restating the problem in your own words, trying to connect it to a past problem that could be similar or related, to make sure you have used all of the data, and to solve the parts you know how to first and then work from there. Explaining the solution will involve describing what steps are needed to solve the problem and what strategies were used in order to solve it.
TLW be able to plan a solution and explain how to get it for a three-digit subtraction word problem.
TTW check the problems for accuracy using the Analytic Scoring Scale to make sure they grasp the concept of supporting details and how they aid in the main idea.
Frameworks: NO.3.3.1: Develop computational fluency in multi-digit subtraction using contextual problems and strategies for subtracting numbers.
Common Core Standards: 9.3OA. Identify arithmetic patterns (including patterns in the addition table or multiplication table), and explain them using properties of operations. For example, observe that 4 times a number is always even, and explain why 4 times a number can be decomposed into two equal addends.
IV. Materials:
Promethean Board, anchor chart, mathematical three-digit subtraction word problems
V. Schema:
TTW model a difficult math word problem on the board, and show them the answer. TTW ask the students if they understood how I planned my solution, or if there were any explanations of how to plan the solution? TTW explain that without an explanation of planning the solution then others would not understand how they arrived at their plan or why they chose to do it this way.
Review:
TTW review how to find the supporting details and the main idea of a mathematical word problem. TTW also review subtracting two-digit numbers and regrouping.
Purpose:
Learn to plan a solution and explain how to get the solution to mathematical word problems.
Method:
TTW display a math word problem on the board. TTW conduct a think aloud on how to identify what the main idea and supporting details are, and finally what type of strategy can be used in order to solve the problem. TTW describe that in order to find the answer she must plan a solution by figuring out which strategy can be used to solve the problem. TTW rewrite the important information of the problem into a sentence that asks the question of how to solve the problem. TTW also conduct a think aloud on the different types of problems that they have seen in the past that are related and can be connected to this particular problem, and how this will help to solve the problem. She will also double check to make sure that she has used all of the data necessary to rewrite and plan a solution. TTW also conduct a think aloud that will describe how to explain how to get the solution to a problem. TTW then write this step on the anchor chart and as a class they will describe how to plan a solution and to explain how to get a solution and important details that are needed to plan a solution and explain how it was planned.
G.P. TTW walk the students through several subtraction word problems. TTW guide and model how to plan a solution and then how to explain how to get the solution.
I.P. TLW complete the subtraction word problems independently and be able to find a solution and explain how to get that solution. TLW write an explanation of how they planned and explained what the solution is.
Evaluation:
TTW check the problems for accuracy using the Analytic Scoring Scale by checking for correct plan for the solution and accurate explanation of the plan.
Thursday 1-12-12
I. Math—Carry out the plan and find the solution (Putting it all together)
II. 3rd
III. TLW know how to put all the steps together to solve a mathematical word problem.
TLW understand that they must find the main idea, supporting details, plan a solution and explain how to find that solution, and then finally solve the problem by using the numbers to compute it and arrive at a solution.
TLW be able to put all the steps together and find a solution to a mathematical subtraction word problem.
Frameworks: NO.3.3.1: Solve simple problems using one operation involving subtraction.
Common Core Standards: 3.0A.8. Solve two-step word problems using the four operations. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.
IV. Materials: Promethean board, anchor chart, K-N-W-S chart,
V. Schema: TTW display a KWL chart on the board and ask the students to describe what a KWL chart is. TTW then ask the students if they believe that for a math problem that they could use a similar chart in order to help put all their ideas together and begin planning a solution.
Review: TTW review finding the main idea, supporting details, and planning and explaining how to find a solution. TTW also review 3 and 2 digit subtraction problems with and without regrouping.
Purpose: To learn how to put all the steps together in order to arrive at a solution to a subtraction math word problem.
Method: TTW use a K-N-W-S chart. TTW describe the K is what facts that they know (main idea), the N is to note what information is not relevant, the W is what the problem wants them to find out, and the S is what strategy can be used to solve the problem. TTW conduct a think aloud based on a problem in which she describes how to use the chart and note all the information onto the chart. TTW explain that the chart helps them find the main idea, supporting details, what strategies can be used in order to plan a solution, and then finally how to plan and compute the solution to the problem. TTW add the last step to the anchor chart describing how to put it all together and explain how to find the solution. TTW also remind the students that it is important to label answers in order for the reader to easily find how they arrived at the solution that they did.
G.P. TTW guide the students through several subtraction word problems showing them how to put all of the steps together in order to arrive at a solution to the problem.
I.P. TLW complete a subtraction word problem independently and then take a 10 question quiz based on the entire week of lessons. The quiz will have them define the main idea, define supporting details, plan and explain a solution, and finally solve mathematical subtraction word problems.
Evaluation: TTW check TL’s understanding by checking the math problem for correct plan and correct solution process.
Word Problems

1. Galileo collected 97 animal stickers. Carolina collected 18 fewer stickers than Belle. How many stickers did Carolina collect?
   The main idea of what this problem is about is:
   a. Collecting stickers with friends
   b. To figure out how many stickers were collected by using subtraction
   c. Showing work and explaining answers
   d. To figure out how to divide stickers between two friends.

2. Leonel had 33 marbles in his pocket. He was playing with 3 girls and 4 boys outside. After Leonel came back inside he noticed that he had lost some when he went outside to play. Now he only has 18 marbles. How many marbles did Peter lose?
   Underline the main idea in this statement and circle the supporting details in this word problem.

3. Abby and Jennifer played miniature golf. Jennifer score was 62. Abby’s score was 14 points lower than Jennifer’s score. What was Abby’s score?
   Solve this problem, and write a sentence that explains your solution.

4. There are 524 books in the children’s section of the library. There are 600 children in the school that are able to check out books. 146 were checked out over the weekend. How many books were left?
   The supporting details of this problem are:
   a. 524
   b. 146
   c. 600
   d. Both A and B
5. The library has 215 books about sports. There are also 157 books about science. How many more books are there about sports?
   The main idea of what this problem is about is:
   a. Showing work and explaining answers
   b. How to pick out a book from the library
   c. Figure out how many more books there are about sports by using subtraction
   d. Figuring out how many books there are about science and sports.

6. Teri and Anna are building a giant tower. Teri used 237 building pieces. Anna used 325 building pieces. How many more pieces did Anna use?
   Underline the main idea and circle the supporting details.

7. 862 people ran in the marathon this year. 591 people crossed the finish line. How many people did not finish the marathon?
   The supporting details of this problem are:
   a. People ran the marathon
   b. How many people did not finish the marathon
   c. There were people that did not finish the race

8. The supermarket had 538 boxes of cereal on the shelf. They sold a lot of cereal on Friday. Now they only have 255 boxes left. How many boxes of cereal did they sell?
   Underline the main idea and circle the supporting details.

9. What is the main idea in a mathematical word problem?
   a. The numbers or the extra details
   b. The big picture, and what the problem is asking you to do
   c. The solution to the word problem
   d. The plan to how to solve a mathematical word problem

10. There are 642 students at T.G. Smith Elementary School. 295 students have pets. How many students do not have pets?
    Solve this problem and write a sentence that explains your solution.
Appendix Q

Mathematics Problem Solving Pre-Test Scores

<table>
<thead>
<tr>
<th>Student</th>
<th>Pre-test Percentage Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>17</td>
</tr>
<tr>
<td>B</td>
<td>41</td>
</tr>
<tr>
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Mathematical Problem Solving Post-Test Scores

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Analytic Reading Skills Post-Test Results

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Appendix Y

Individual Mathematical Problem Solving Gender Results

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### Appendix Z

**Gender Mathematical Problem Solving t-test Results**

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## Individual ELL and Non-ELL Results

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### Appendix BB

**ELL and Non-ELL Mathematical Problem Solving t-test Results**

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### Appendix CC

#### Anecdotal Record Table

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<th>Used strategies in other content areas</th>
<th>1-26-2012: Student O used the summarizing strategy during reading instruction for <em>Charlotte’s Web.</em></th>
<th>2-1-2012: Student G used the visualizing strategy to describe another students writing.</th>
<th>2-9-2012: Student K “I know how to read this passage in my book and find the main idea.”</th>
<th>3-6-2012: Student H said, “I know how to sequence <em>Charlotte’s Web</em> because of your math lesson.”</th>
<th>3-15-2012: Student U said, “I know how to read my narrative writing and analyze it in order to find the main idea.”</th>
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<tbody>
<tr>
<td>Used strategies without direct instruction</td>
<td>1-18-2012: Student J was using the program, SuccessMaker and said, “I could answer the main idea from the reading because I remembered what you taught us in math.”</td>
<td>2-2-12 Student E said, “We can analyze the problem and figure out a strategy without you telling us what to do.”</td>
<td>2-7-2012: Student P said “Today when I was doing SuccessMaker I knew how to summarize the text and find the main idea because of your math lessons.”</td>
<td>2-1-2012: Student R stated, “we can use our mathematics notebook that has resources in it to help us understand how to solve the word problems.”</td>
<td>2-7-2012: Student J said, “I know I need to analyze the problem, which means to look and read it closely, and figure out the best strategy to use to solve it.”</td>
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<tr>
<td>Mathematics concepts difficulties</td>
<td>1-12-2012: Student K displayed frustrations with the assignment and began crying during the independent practice.</td>
<td>1-25-2012: Student C said, “I don’t understand how to do the math for these problems.”</td>
<td>2-21-12: Student Q said, “I don’t understand how to apply the reading strategies to the pictograph word problems.”</td>
<td>2-8-2012: Student L said, “I am confused on what the point of line plots are.”</td>
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<td>Reading Strategy difficulties</td>
<td>1-13-2012: Student A struggled with reading strategies that were presented.</td>
<td>1-23-12: Student D said, “I still don’t understand how to draw inferences.”</td>
<td>1-25-2012: Student N said, “I think the hardest reading strategy is drawing inferences.”</td>
<td>2-9-2012: Student M said, “I think summarizing for pictographs is hard.”</td>
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