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**IMPLEMENTATION OF LITERACY STRATEGIES AND THE IMPACT ON  
WORD PROBLEMS**

by

Lindsey R. Glick

A Thesis

Submitted to the  
Department of Language, Literacy, and Sociocultural Education  
College of Education  
In partial fulfillment of the requirement  
For the degree of  
Master of Arts in Reading Education  
at  
Rowan University  
May 7, 2019

Thesis Chair: Marjorie Madden, Ph.D.

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## **Dedications**

I would like to dedicate this thesis to my loving and patient husband, Greg, who I can't thank enough for supporting and encouraging me through my entire Master's program. I would also like to dedicate this thesis to my parents, Dave and Kathy, who always encouraged me and gave me the confidence to further my education.

## **Acknowledgements**

I would like to acknowledge and thank the supervisors, administration, and teachers at the study site for allowing me to conduct research and support me through my entire Master's program. I would also like to thank my students for being my reason "why" and for allowing me to learn from them. I would like to thank the professors in the MA in Reading Education program for their guidance and patience throughout this journey.

## Abstract

Lindsey R. Glick

### IMPLEMENTATION OF LITERACY STRATEGIES AND THE IMPACT ON WORD PROBLEMS

2018-2019

Marjorie Madden, Ph.D.

Master of Arts in Reading Education

The purpose of this study is to determine whether the implementation of literacy strategies in a fifth grade mathematics classroom would affect comprehension. The specific aim is to see what happens when students utilize literacy strategies when solving mathematical word problems. Three literacy topics were the focal point in this study: vocabulary, writing, and comprehension. Literacy strategies from each topic were introduced and applied during a mathematics class. Surveys, math journals, graphic organizers, classroom discussions, and interviews were analyzed. The limitations and implications for incorporating literacy instruction in a mathematics class are discussed.

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## Chapter 1

### Introduction

“Integrating reading and math instruction throughout the elementary grades can help children learn to read at the same time they read to learn.”

(Moss, 2005, p. 50)

For the longest time mathematics and literacy have been perceived as two separate content areas. Mathematics traditionally focuses on computation and procedural skills, whereas Literacy focuses on comprehension and fluency. However, since the adoption of the Common Core State Standards (CCSS) in 2010, integrating literacy skills in all content areas is required, including math. Mathematics teachers are now required to integrate writing, vocabulary, and comprehension strategies into everyday instruction. These skills according to the National Council of Teachers of Mathematics (NCTM) in 2000 are designed to prepare students for college and careers emphasizing high-level skills needed for tomorrow’s world. Therefore, implementing literacy into the mathematics classroom is a necessary change that needs to be made by current educators. When teachers integrate literacy strategies into all content areas they provide students with the ability to critically read, write, and communicate effectively. The book, *The Principal and Standards for School Mathematics*, released by National Council of Teachers of Mathematics (NCTM) in 2000 argues that, “when students are challenged to communicate the results of their thinking to others orally or in writing, they learn to be clear, convincing, and precise in their use of mathematical language” (p. 4). In today’s educational system, the mathematics teacher has a responsibility to include literacy instructional practices in order to help bridge the gap between literacy and mathematics.

## Story of the Question

The role of an elementary teacher can be very challenging. Not only are teachers responsible for providing students with the basic fundamentals of reading, writing, and arithmetic, they are also responsible for instilling character traits such as kindness, perseverance, and good manners. These life skills are important for students to attain and demonstrate at a young age so that they grow up to become well-rounded people in society. Teaching at the elementary level provides teachers with the opportunity to learn about different content areas. They are responsible for teaching each content area and implementing different curriculums. While exploring each subject, many teachers find a specific content area that they are passionate about. For me, literacy became my passion and focus while teaching at the elementary level.

When I began teaching over 10 years ago, I fell in love with literacy immediately. I enjoyed choosing novels that paired perfectly to the standards, watching students apply a new reading strategy, and creating an inviting classroom library full of picture books, novels, and content specific texts. I also enjoyed reading, learning, and implementing new literacy methods. For instance, I piloted several reading programs in my district such as reading and writing workshop, CAFE, and small group instruction. Further, into my career, I wanted to get more involved with the literacy program in my district, so I volunteered to be apart of a small committee of teachers that chose the next literacy program. Delving into each program only helped to escalate my passion for literacy and that is when I decided to apply for the Reading Masters program at Rowan University. However, in the fall of 2015, my passion for literacy was about to change.

During the end of the 2015 school year, I was asked to be apart of a new educational program in our district called the Applied Math and Science Academy (AMSA). I was honored to be given this opportunity and graciously accepted my new position as a middle school math teacher. Without having to give up my love for literacy, I needed to alter the current mathematics stigma of rote memorization, drills, and lecture to incorporate my love for literacy instruction. Currently, in my mathematics classroom, I have a classroom library that includes several genres of literacy. Students can choose from a picture book, chapter books, magazines, and of course content specific texts like mathematics. My mathematical word wall is displayed on a bulletin board, which includes examples and definition of the mathematical word or phrase. My anchor charts hang on the walls that visually display mathematical strategies. When a new mathematical unit is introduced, you can find my students engaged in a read-aloud that accurately depicts that skills and strategies they will be exploring. Even with all these literacy concepts in place in my mathematics classroom, I still feel that my students would benefit from a direct approach to literacy instruction.

One area in math that my students always struggle with is solving word problems. Even with all the skills and strategies taught, my students always seem to have a hard time extrapolating the important parts of the word problem, in order to effectively solve the problem. After reflecting on all the ways I could help my students, one particular area always seemed to surface. This area was literacy, and thus my research question was born. Curious as to how literacy could play a role in a mathematics class, I chose to focus my research on implementing a variety of literacy strategies in my 5th-grade mathematics class. This study's specific purpose is to determine whether the implementation of these

literacy strategies would affect student's comprehension when solving mathematical word problems.

### **Statement of the Research Problem and Question**

According to the results from the 2018 New Jersey PARCC assessment, only 49% of students in the 5<sup>th</sup> grade met/exceeded the expectations for the Mathematics assessment (New Jersey State Department of Education, 2018). Even though the results showed a 3% increase from the previous year, more than half of New Jersey students were not proficient in meeting the New Jersey Student Learning Standards. This data clearly shows a significant need for improvement in mathematics instruction. With the implementation of the CCSS in 2010, the math standards have become more comprehensive and challenging but the data from the PARCC assessments show that there is still a need for improvement. How can teachers provide students a better understanding of mathematical concepts? How do the assessments align with the standards? What are the instructional practices being implemented in the classroom?

In order for mathematics teachers to implement the CCSS effectively, they need to provide students with critical thinking and problem-solving skills, which will improve students' ability to communicate effectively. One way to increase critical thinking skills is to implement literacy strategies. According to the standards put forth by the NCTM in 2000 students are required to know and be able to problem solve, develop a deep meaningful understanding of mathematics by talking and writing mathematically, and learn to justify and explain their thinking. Since literacy has become an integral part of mathematics, teachers need to provide students with opportunities to use literacy skills in mathematics. Math teachers today need to expose students to strategies that can be transferred from one content area to another. When teachers weave mathematics and

literacy together, students are better able to apply the information learned from one content area to another.

With the adoption of the PARCC assessment and the implementation of the Common Core State Standards literacy instruction is a critical component in all content areas, which is why I have chosen to focus my study on the implementation of literacy instruction in a mathematics class. The question I will address is: How can literacy instructional practices when applied to a mathematics class affect the depth of student understanding? My study will focus on three areas of literacy: vocabulary, writing, and comprehension. To further investigate these three areas, several sub-questions will be addressed. The sub-questions include: How can math journals further promote student's understanding of mathematical practices? How will the implementation of text structure strategies, such as the Survey, Question, Read, Question, Compute, and Question (SQRQCQ) Model and the Know, Not, What, Strategy (KNWS) model to help students to extrapolate key ideas from word problems? How will the implementation of vocabulary instruction affect student understanding of mathematical vocabulary? A thorough investigation will be conducted by collecting data. This data will be analyzed to discover if and how literacy instruction, when applied in a 5th-grade mathematics class affects student comprehension and understanding of mathematical problems.

### **Organization of the Research**

Chapter two will provide a detailed review of the literature that focuses on mathematical literacy and the implementation of three strategies: vocabulary, writing, and comprehension. Chapter three will describe the methodology and design of the study. This chapter provides a procedural timeline of the study and gives contextual information about the district, school, and classroom. Chapter four will provide a review of the data

collected and discuss the findings. Finally, chapter five will present the conclusion of the study and any implications along with suggestions for further research regarding literacy instruction in a mathematics classroom.

## Chapter 2

### Review of the Literature

#### Introduction

Elementary teachers are faced with the task of providing students with the knowledge and strategies necessary for understanding and using mathematics. The book, *The Principal and Standards for School Mathematics*, suggests that all students need to understand math, in order to emerge and grow in our evolving world. Students today need to have a mathematical foundation in their everyday life and in the workplace. The five standards developed by the NCTM are (1) problem solving, (2) reasoning and proof, (3) connections, (4) communication, and (5) representation.

With the adoption of the Core Curriculum Content standards in 2000, New Jersey has designed standards that prepare students for college and careers emphasizing the high-level skills needed for tomorrow's world. Part of the preparation is the need for strong literacy skills in every discipline, including mathematics. According to the authors of the book, *Integrating Literacy and Mathematics: Strategies for K-6 Teachers* (2008), "To meet these and the mathematics content standards, students must develop the ability to think mathematically. Language arts provides the tools for teachers and students to read and understand problems, to write and draw their way toward understanding, and to communicate effectively" (p. 4).

Along with students developing a numerical and operational foundation in mathematics, students need to also develop the ability to communicate and share their explanations with others. The Standards for Mathematical Practices developed by NCTM advise that teachers develop students' knowledge in the fields of problem solving,

reasoning and proof, communication, representation, and connections. Mathematical Practice Standard 3: construct viable arguments and critique the reasoning of others, expresses the need for students to justify their conclusions, communicate them to others, and respond to the arguments of others. Also, Mathematical Practice Standard 6: Attend to Precision, conveys that students should be able to precisely communicate and formulate their explanations to others. As noted by NCTM (2000), students who are supported in their speaking, writing, reading, and listening in mathematics classes reap dual benefits: they communicate to learn mathematics, and they learn to communicate mathematically. Creating a classroom community that allows for thinking and mathematical conversations to occur allows students to learn from each other in a comfortable environment. The NCTM (2000) suggests that conversations in which mathematical ideas are explored from multiple perspectives help the participants sharpen their thinking and make connections.

### **The Great Debate(s)**

In the late '80s, the “reading wars” were a controversial topic that pitted two different literacy approaches against each other. Many educators were torn between instruction based on phonics or instruction based on whole language. Both methods for teaching literacy can be described as either a “bottom-up” or “top-down” approach. According to the researcher Jon Reyhner (2008), “Phonics has been described as a “bottom-up” approach, which implies that if a student is able to correctly decode a text, than they would be able to infer the meaning and the message of the text” (Phonics Versus Whole Language, para. 6). The phonics approach draws from the behaviorist learning theory established by B.F. Skinner. This theory focused on teaching reading



skills, such as phonics, through isolation. The authors Diane Tracey and Lesley Morrow (2012) have acknowledged that behaviorism changed the depiction of reading from one of perceptual processing to one of reading as a behavior composed of isolated skills, each of which could be reinforced to increase student achievement (p. 41).

In contrast, Reyhner (2008) argues that “whole language literacy is considered a “top-down” approach where the reader constructs a personal meaning for a text based on using their prior knowledge to interpret the meaning of what they are reading” (Phonics Versus Whole Language, para. 8). The whole language approach to teaching reading is derived from the constructivist learning theory developed by Lev Vygotsky, which emphasizes the importance of integrating prior knowledge with new knowledge. According to Tracy and Morrow (2012), “from a constructivist viewpoint, learning occurs when individuals integrate new knowledge with existing knowledge. In this theoretical perspective, the integration of new knowledge with existing knowledge can only occur when the learner is actively engaged in the learning process” (p. 57).

Just like the “reading wars” in the 1980s debated how to teach reading, today’s educators have been debating mathematical instruction. The term “Math Wars” has been used to argue traditional mathematics instruction and standardized-based instruction. Educators have been debating the importance of “drilling” and “rote learning” as opposed to students being taught mathematics skills by discovering the principles through a hands-on, problem-solving approach. According to the author Daniel Ansari (2016), “one side of the “math wars” advocates for greater attention to teaching students procedural knowledge for mathematics problem solving (such as explicit teaching of strategies) and encouraging them to memorize facts, while the other emphasizes the students’

construction of rich conceptual knowledge, allowing them insights into how they solve problems” (p. 5).

Educators have concluded that the basic fundamentals of mathematical operations were not enough for students and a new initiative was developed focusing on both problem-solving and mathematical application. Ansari (2016) emphasizes that, “both instructional approaches are tightly related to one another and are mutual determinants of successful math learning over time. Both conceptual and procedural knowledge are required for successful math learning” (p. 7). Just as the end of the “reading wars” created a need for a more balanced literacy approach, today’s researchers have called for a more interdisciplinary approach.

### **Literacy and Mathematics: What’s the Correlation?**

Many students and teachers feel that literacy and mathematics are two totally separate content areas, when in fact many of the skills and strategies taught in reading can be used in mathematics. Literacy is an integral part of all content areas. The incorporation of literacy in all subject areas is considered to be an essential component of curriculum standards. The book, *Do I Really Have To Teach Reading?* describes the barriers that prevent math teachers from teaching literacy skills in the classroom. According to Tovani (2007), “these barriers include the way the teachers view (or do not view) literacy as a tool for teaching math and the training the teachers have received around integrating literacy skills into mathematics (p. 7). Another barrier that students face when literacy isn’t integrated into other content areas is that ability to read and comprehend different types of texts. Tovani (2007) believes that “If language arts teachers and English teachers are the only ones teaching reading, students aren’t going to learn how to read different types of texts (p. 25). The way a math teacher read interprets a word problem is different

from the way a language arts teacher deciphers and reads poetry, so It's important for all content area teachers to incorporate literacy instruction into their daily routines in order for students to learn how to read and comprehend different texts.

When thinking about the correlation between mathematics and literacy, it's important to realize that many concepts in literacy can be infused in mathematics instruction. In *Comprehending Math: Adapting Reading Strategies to Teach Mathematics K-6* the author describes how the three guiding principles, thinking, language, and mathematics, should rely on cognition. Hyde (2006) explains that, "there are several key principles from cognitive psychology that can guide us. Therefore, I have used the term braiding to indicate that thinking, language, and mathematics can be braided together into a tightly knit entity like a rope that is stronger than the individual strands. When these three important processes are braided, the result is stronger, more durable, and more powerful than anyone could be by itself" (p. 1). Hyde believes that when students utilize the three processes together they become better problem-solvers. The authors of *Integrating Literacy and Mathematics: Strategies for K-6 Teachers* also follow Hyde's belief of "braiding" thinking, language, and mathematics together. The thinking strategies are the same cognitive strategies used for engaging with and understanding any new learning. Students rely on language, skills to read, write, talk, and represent their mathematical thinking and problem solving (Fogelberg, Skalinder, Satz, Killer, Bernstein, & Vitantonio, 2008, p. 2).

According to the standards put forth by the NCTM in 2000 students are required to know and be able to problem solve, develop a deep meaningful understanding of mathematics by talking and writing mathematically, and learn to justify and explain their

thinking. When teachers begin to realize the similarities between mathematics and literacy they begin to realize that concepts are interchangeable between subject areas. In *Building Mathematical Comprehension: Using Literacy Strategies to Make Meaning*, Laney Sammons (2011) compares the characteristics of “good readers” and “good mathematicians.” Sammons argues that just as good readers create meaning for understanding, mathematicians create meaning as they process mathematical concepts and solve problems. Since there are some many similarities between reading and mathematics, it is only logical that strategies employed to increase comprehension in one would be equally as effective at increasing comprehension in the other (p. 23).

While math and literacy share many similarities it is important to address the differences when teaching these content areas. Mathematics includes the use of numerals, symbols, and computational procedures to deconstruct meaning whereas; literacy focuses on decoding to construct meaning. Math students tend to use multiple strategies to understand and solve word problems, where literacy students focus on strategies that help them to understand and interrupt the text. In regards to fluency, math students develop numerical fluency through visualization and math manipulatives whereas; becoming a fluent reader is focused around listening and good modeling of fluency. It is important for teachers to acknowledge the differences between these two disciplines in order to provide students with the necessary skills to be successful in all situations.

### **Literacy Instruction in a Mathematics Class**

When literacy strategies are implemented in content areas, such as math, students are able to use the strategies to comprehend the material before they can use the mathematical skills to solve the problem. Sammons (2011), “understanding the

relationship between the two disciplines can provide teachers with valuable insights to help students more successfully understand the mathematics they encounter in school and in the real world” (p.23).

When thinking about literacy in regards to mathematics, it’s important to look at comprehension. In *Mosaic of Thought* (2007), Keene and Zimmermann drew from their research on proficient readers and identified seven strategies that readers use to cultivate comprehension:

1. Making Connections-using schema and building background knowledge
2. Asking questions-generating questions, before, during, and after reading to clarify understanding.
3. Visualizing-using sensory and emotional images to deepen and expand meaning
4. Making inferences-using background knowledge with new information to predict, conclude, make judgments, or interpret
5. Determining importance- deciding what information is significant
6. Synthesizing-creating new ideas or extending/revising understanding based on engagement or mathematic observations/investigations
7. Monitoring meaning- thinking about the degree of understanding and taking steps to improve understanding when necessary.

For comprehension to occur in any subject area teachers should expose students to these strategies. Students need to understand that these strategies are transferable and can be used in any content area. Sammons (2011) points out that, teachers can help their students recognize the interdisciplinary nature of the reading strategies they are already

using in reading and encourage them to use the same strategies to improve their understanding of mathematics (p. 29).

Vocabulary is another area that allows for the integration of literacy and mathematics. According to the NCTM *Principles and Standards* (2000), students should use the language of mathematics to express mathematical ideas precisely. To do so, students must have a firm grasp of that language. When students understand and use math terminology correctly they are able to provide a clear and precise explanation to their thinking. The authors of the book, *Integrating Literacy and Math: Strategies for K-6 Teachers*, suggest that mathematical vocabulary can build students understanding of mathematical concepts. Vocabulary can be especially helpful for thinking about teaching the language of mathematics because it addresses a variety of our concerns about how to support our students as they learn to communicate mathematically. Working with vocabulary is one way to bring in new knowledge and to enhance the backgrounds knowledge students already have (Fogelberg, Skalinder, Satz, Hiller, Bernstein, & Vitantonio, 2008, p. 132).

When students learn to write and think mathematically they are able to communicate and share their understanding of mathematics. According to the authors, Fogelberg, Skalinder, Satz, Hiller, Bernstein, & Vitantonio (2008), “students should be expected to write in math class for a variety of reasons: to assess their understanding, to record their thinking in order to revise their approach at a later time, to share problem-solving strategies with their peers and teacher, and to share feelings and frustrations about the mathematics they are studying” (p. 143). When teachers integrate writing components into their math class, students learn to learn skills that can be beneficial to them in other

content areas. In the book, *Math in Plain English Literacy Strategies for the Mathematics Classroom* (2013), Amy Benjamin explains how any type of writing helps with comprehension, arguing that, “the act of writing-whether that be snippets such as an annotation of a solution, a list, class notes, or fully developed sentences, paragraphs, and reports-helps students retain information” (p. 87).

## **Conclusion**

Communication is critical when integrating literacy and mathematics. Students need to learn how to read, write, speak, and think mathematically in order to be successful in today’s world. By implementing literacy strategies into mathematics classes, students are learning to use communication strategies in order to think and communicate effectively about mathematics.

When students develop their mathematical literacy they are able to think critically and use problem-solving strategies to help them fully understand the concepts. Students should be encouraged to write, communicate, and speak mathematically so that they gain a deeper understanding of the concepts. When students use mathematical terminology correctly in their everyday lives they are able to share their ideas and learn from others.

For students to be successful they need to be given the tools to succeed. Teachers should not be afraid to seek assistance from other content area teachers in order to provide students with a variety of tools that are essential for their success. When teachers incorporate strategies from other content areas, students are able to see the correlation and make the appropriate connections to the subject area. When students are able to utilize strategies in more than one content area may be able to gain a deeper understanding of the content area.

This study will further explore the integration of literacy and mathematics in order to determine how literacy strategies impact comprehension in mathematics. The next chapter of this thesis will examine the content of the study along with the design of the research based on data collection.



## Chapter 3

### Context of the Study

#### Community

The City of Vineland is located within Cumberland County in Southern New Jersey. Vineland covers a total area of 69 sq. miles. All data presented below was obtained from the 2017 American Community Survey. The survey indicates that there are a total of 60,724 people residing in the City of Vineland. Of the total population, 44.5% are white, 39.1% are Hispanic or Latino, 12% are black or African American, and the remaining 4.4% consists of other races.

In the City of Vineland, there are 21, 233 occupied housing units. Of the total number of units, 65.3% are owner-occupied. The remaining 34.7% are renter-occupied. Of the 21, 233 occupied housing units 68.3% are family households. Of those family households, 43.2% are families with married couples. 33.3% of households contain children under 18 years of age.

In the City of Vineland, the median household income is \$51,113. The per capita income is \$25,073. 12.4% of families earn income that is below the poverty level. The unemployment rate in the City of Vineland is 8.1%.

#### District

The City of Vineland is home to eight elementary schools, four middle schools, and two high schools. In 2017, 9,644 students were enrolled in the City of Vineland School District. 4,592 students are enrolled in elementary schools with a pupil/teacher ratio of 11:1. 2,185 students are enrolled in middle schools with a pupil/teacher of 9.5:1, and 2,470 students are enrolled in high school with a pupil/teacher ratio of 11:1.

## **School**

Edward R. Johnstone School is located in Vineland, NJ and is part of the Vineland Public School District. It is one of the four middle schools in Vineland, NJ. Johnstone educates over 150 students ranging from fifth-eighth grade with a staff of 20. The pupil/teacher ratio is 10:1. The racial makeup of the student population is 54.55% white, 25.32% Hispanic or Latino, 9% Black or African American, and 9% Asian. 31.82% of students are classified as economically disadvantaged. According to the 2017-2018 PARCC assessment, 95.7% of students were proficient in Language Arts and 90.6% of students were proficient in Mathematics.

## **Classroom**

Mrs. Bond's 5th-grade Mathematics class is made up of two sections for a total of 38 students. The first section consists of 20 students of which 11 are male and 9 are female. The second section consists of 18 students of which 12 are male and 6 are female. Of the 38 students, 19 are white, 11 are Hispanic or Latino, 4 are black or African American, and 4 are Asian. There are 16 students classified as economically disadvantaged out of the 38. According to the 2017-2018 PARCC assessment, 100% of the students were proficient in Language Arts and 94.3% of students were proficient in Mathematics.

## **Research Design/Methodology**

When thinking about conducting a study it is important to identify how the research will be carried out. The book, *Living the Questions: A Guide for Teacher-Researchers*, the authors define research as a process of discovering essential questions, gathering data, and analyzing it to answer questions. (Shagoury & Power, 2012). The

beginning stages of the research process focuses on developing a clearly framed question. This study explores the implementation of literacy strategies in a mathematics class and the effects these strategies have on comprehending word problems. Since this study focuses on the inquiry of a problem that will be explored and researched by a teacher educator, the qualitative research paradigm is the best approach. The following qualitative protocols will be utilized to conduct this study: surveys, interviews, student work, focus group, and teacher-research journal.

Teacher research, “is a natural extension of good teaching,” as it evolves from student observation in order “to create the best possible learning environment for students” (Shagoury & Power, 2012, p.3). When conducting teacher research it is important to focus the study on the needs of the students in your classroom. Shagoury and Power (2012) define teacher research as, “research that is initiated and carried out by teachers in their classrooms and schools” (p. 2). Conducting teacher research can be beneficial for teachers who are interested in improving their practices in their classroom. “Teacher-researchers use their inquiries to study everything from the best way to teach reading and the most useful methods for organizing their research so that it is beneficial for their students.” (Shagoury & Power, 2012, p. 2). Teacher research is designed to improve the educational practices of teachers as they discover trends and themes when they are analyzing and interpreting their data. “The primary purpose of teacher research is to help the teacher-researcher understand his or her students and improve her practice in specific, concrete ways. The significance of these studies is to inform and change teachers’ own teaching. (Shagoury & Power, 2012, p. 4). When teachers conduct research in their classroom, they are able to identify problems that are specific to their students.

In conclusion, teacher research is important for students, teachers, and other educators. It allows for teachers to share their findings with their peers and create a discussion about educational practices. It allows teachers to collaborate with others to inform and improve education. The ultimate goal for teacher research is to enhance the practices of teachers and create a better learning experience for students.

### **Procedural Timeline**

For this study, I began by conducting informal observations of the students during mathematics and recorded these observations in my teacher-journal. During the observations, I closely observed how the students tackled word problems and the strategies they implemented when they began to solve a word problem. I also observed their interaction with their peers and focused on how they communicated and described their solutions. I also documented any questions that arose from the students when they began to solve the word problems. Through these observations, I was able to create a survey for the students that focused on their knowledge of mathematics and their approach to implementing literacy strategies in mathematics. Through the informal observations and the survey, I was able to gather baseline data that allowed me to gain a better insight into how students view reading and writing in a mathematics class. The results from the survey and the informal observations indicated that all students would benefit from explicit instruction of literacy during mathematics.

The first week of the study focused on vocabulary. I began by introducing a math word wall during whole group instruction. The word wall was displayed in the classroom as a bulletin board. Instead of the words being displayed alphabetically as I have observed in literacy classrooms, the words were placed under one of the three headings:

addition, subtraction, multiplication, and division. For this week, the students were exposed to three new vocabulary words that were used frequently during a division unit. The three words were placed under the division heading on the bulletin board. To further expand their knowledge of mathematical vocabulary a Frayer Model graphic organizer was introduced. This particular model has been utilized in their literacy class, so the students had an understanding of the model. Using the Frayer Model the students defined the word, identified synonyms of the word, and provided an example and non-example of the word. The difference in using the Frayer Model in a mathematics class compared to a literacy class is that the students were able to use numbers, draw pictures, or create models to demonstrate their understanding of the word. As the students completed their Frayer Models, I logged their conversations with their peers in my teacher-research journal. I also collected their completed models as student work for further evaluation. During the week, the students and I referred back to the word wall to clarify and use proper vocabulary when speaking and writing.

The second week of the study focused on communication. I began by introducing “Math Talk” strategies during the whole group instruction. An anchor chart was displayed presenting different ways to defend or explain their answers. Phrases such as “the strategy I used” and “I disagree with your solution” were displayed on the anchor chart. The students were given different scenarios and had to use the anchor chart to justify and explain their solutions to their peers. While the students were justifying their scenarios, I used my teacher-research journal to document their conversations. I also recorded a small group discussion that occurred at the end of the week. During a small group discussion, the students solved two word problems and were encouraged to use

“math talk” to explain their answers to their peers. At this time, I was simply a facilitator and allowed the students to communicate their responses using “Math Talk”. At the end of the week, I interviewed two students that were involved in the small group discussion to gauge their reaction to integrating communication strategies in math.

The third week of the study focused on writing. For this week, I began by introducing a digital math journal during whole group instruction. A question was posted each day that related to a topic that was taught previously. The format for the math journal consisted of students explaining and/or justifying their answer in complete sentences. They also needed to incorporate mathematical vocabulary whenever possible. The students were encouraged to refer to the “Math Talk” anchor chart and math word wall to help explain their answers. At the end of the week, the math journals were collected and analyzed.

The fourth and final week of the study focused on the implementation of literacy strategies while solving word problems. During this week students were introduced to the SQRQCQ strategy and the KWNS strategy when solving mathematical word problems. Students learned how to use these two strategies in order to help them extrapolate key information in word problems and determine the precise strategy to use in order to solve the problem. At the beginning of the week, the students were exposed to a KWNS graphic organizer, which is similar to the KWL graphic organizer used in literacy as a before reading strategy. The students used this graphic organizer to identify what they know about the problem, identify the question, identify the information they need to find out, and identify the appropriate strategy to use to solve the problem. This graphic organizer helped students to organize the information given in a word problem in order to

help them correctly solve the problem. At the end of the week, the students were introduced to the SQRQCQ strategy, which stands for survey, question, read, question, compute, and question. The students used this strategy along with the KWNS graphic organizer to solve mathematical word problems. All student work from both of these strategies were collected and analyzed for this study.

### **Data Sources**

For this study, I collected several different data sources during whole class instruction and small group instruction. To begin this study I made informal observations and created a survey to get a better understanding of how students view literacy and math. To effectively collect data for this study, I used a teacher-research journal, recorded small group discussions, conducted interviews, and collected student artifacts. My teacher-research journal was an important part of the data collection process. This journal was utilized to document the students' conversations and observations, log their questions, and record my own personal thoughts and questions about the study. During small group instruction, I used audio-recordings to document how the students effectively communicated and responded to mathematical situations. I also interviewed students one-on-one to gauge their opinions and reactions to the strategies that were being implemented. Finally, student artifacts were collected to gain a better insight into how the students were applying the strategies that were introduced.

### **Data Analysis**

The data collected throughout this study was used to help make a connection between literacy and mathematics by implementing literacy strategies in a 5th-grade mathematics classroom. A survey and informal observations of students were analyzed to

determine what areas of literacy would be integrated into my mathematics class. From this initial data, I concluded that vocabulary, communication, writing, and reading strategies would be the focal points of my study. Using my teacher research journal, I was able to see how my opinions on literacy and mathematics changed from the beginning of the study to the end of the study. I was able to review my observations, document trends, and make adequate changes that helped me to draw conclusions on the effects of literacy integration in math. Audio-recordings during small group discussions were utilized to gain insight into how students were implementing the literacy strategies when solving word problems. The information collected from both my teacher-research journal and the audio-recordings allowed me to see what areas the students needed more support. The student interviews also provided feedback on how well the students were internalizing the information that was being presented in the study. The interviews were compared to the surveys that were conducted at the beginning of the study to determine if the students' mindset towards literacy and mathematics were changed. Student artifacts also played an important part in analyzing the data. Graphic organizers, math journals, and worksheets were collected and analyzed to determine how the students were using literacy strategies. Charts were used to identify trends and to track student usage of vocabulary, "math talk", and literacy strategies.

Chapter four of this thesis will discuss the results of the student surveys, interviews from students, audio recordings of discussions from a focus group, my teacher-research journal, and samples of student work.



## Chapter 4

### Data Sources

#### Introduction

Chapter four will focus on data analysis based on the findings of my study. It will also explore the question, “How can literacy instructional practices when applied to a mathematics class affect student depth of understanding?” During this study three literacy topics were implemented; they included vocabulary, writing, and comprehension. The data sources that were utilized in this study helped to identify four main themes. The four reoccurring themes include making connections and activating prior knowledge when solving mathematical word problems, the use of language when speaking and writing about mathematical concepts, writing about mathematical concepts, and communicating orally about mathematical word problems.

#### Revisiting the Study

In chapter three I described the procedural timeline of this study. This study took place over a four-week period, where I implemented literacy strategies in a 5th-grade mathematics classroom. During the first week, I surveyed students to gain insight into their opinions of math and literacy. This survey allowed me to identify the students’ abilities and feelings toward solving and processing mathematical concepts. I used this information to establish a framework for planning my study. By creating a mathematical word wall and using vocabulary graphic organizers I was able to track the students’ understanding of mathematical concepts when speaking and writing. Using and recording group discussions, I was able to learn how students process and think critically when solving mathematical word problems. By implementing a “writing block” into my

classroom I was able to collect data on how students internalize mathematical concepts when developing their own word problems. Finally, my teacher research journal allowed me to record and analyze the students' responses and behaviors through the course of the study.

### **The Importance of Making Connections and Activating Prior Knowledge**

The first major theme, activating prior knowledge, was established very early on in this study. To introduce the study to my students, I had them complete a survey. I was eager to learn about the students' opinions of math and literacy. More importantly, I wanted to see what literacy strategies they were already applying in math. During the survey, I recalled several students asking me for help. I recorded their questions in my teacher research journal. Here are a few of the questions I recorded: "What does it mean by literacy strategy?" "Is reading the problem carefully, a literacy strategy?" "I don't use literacy strategies in math, can I write 'none'?" (journal entry November 13, 2018). After reviewing the questions, I reflected in my teacher research journal, "The students do not understand what I meant by literacy strategy. If they don't understand what a literacy strategy is, how will they know if they are applying a literacy strategy? I need to establish an understanding of the word "strategy" and how strategies can be applied in all content areas" (journal entry November 13, 2018). Developing an understanding of what a "strategy" became my first priority in this study. The next day, I created a two-column anchor chart with the headings "Math Strategy" and "Literacy Strategy". The students were given two different color post-its and were asked to identify different strategies used in Math and Reading. I modeled the activity by placing a green post-it with the phrase, "GEMS" in the math strategy column and a yellow post-it with the phrase "Context

Clues” in the literacy strategy column. After the demonstration, the students began to add their post-its to the anchor chart. After several minutes, AP asked the question, “I reread in both math and literacy, where should I put my post-it note?” This question sparked a series of mini-debates in my classroom. Some students were arguing for the literacy column while others were arguing for the math column. I remained quiet and allowed the students to continue their friendly debate. Finally, AD spoke up, “Mrs. Bond, can we put it in both columns?” I then pulled out a packet of purple post-it notes and replied, “If the strategy can be used in both columns, I think we need to establish that. Let’s add reread to this purple post-it and place in it between the two columns.” The students continued to remove post-it from each side and add more purple post-its that reflected the strategy can be used in both subject areas. Later I reflected in my teacher research journal, “It was difficult to remain quiet while the students debated over each strategy. I need to remember to allow thinking and processing to occur instead of always stepping in and providing the answer. After this activity, I feel that I have established an understanding of what a strategy is and how many strategies are transferable between subject to subject” (journal entry November 14, 2018).

During the fourth week the theme, activating prior knowledge, was crucial when implementing literacy strategies while solving word problems. Since September, the students had begun each math class with a word problem. They would answer the problem in their math notebook and we would go over the answer. For this study, I wanted the students to learn new strategies when solving a word problem, so I implemented the SQRQCQ strategy and the KWNS strategy, during the fourth week of the study. Graphic organizers were utilized during this week to help the students organize

the information presented in the word problem. During one of the lessons, while introducing the KWNS strategy, I noticed a student was apprehensive about completing the assignment. I recalled a conversation I had with this student.

1. Teacher: Ok, JY, let's take a look at the problem. What information do we know?
2. JY: I have to divide.
3. Teacher: How do you know you have to divide?
4. JY: I just know.
5. Teacher: JY, have you ever been to the movies?
6. JY: Yes. I went last week.
7. Teacher: So you know that sometimes depending on the time of the movie or the age of the person, the tickets can be cheaper.
8. JY: Oh like a senior citizens discount. My pop-pop loves to use his senior citizens discount.
9. Teacher: Exactly! Or sometimes they have a discount at their parks for younger children because they can't go on all the rides that are available. So think of this problem, who do you think would receive the discounted ticket?
10. JY: Maybe the child's ticket would be cheaper because of his age?

As JY began to fill out the graphic organizer I reflected on the encounter in my teacher research journal this interaction "...JY didn't understand that a child's ticket would be a different price than an adult ticket because he couldn't relate to the situation. The information given in the word problem said discount and I made sure I reviewed the definition of discount, but I never thought that the students would not understand why they needed to apply the discount to the child's movie ticket..." (journal entry December 11, 2018). The next day, I reviewed the problem with the class and asked the students if they knew they had to apply the discount to the child's ticket. Only a couple of students raised their hands. This got me thinking that even though I front-loaded the lesson with definitions of vocabulary words the students still weren't able to solve the problem because they didn't know what ticket to give the discount too. By activating JY's prior

knowledge and using a think-aloud he was able to understand how to solve the problem and why the child's movie ticket would receive the discount.

After analyzing the students' progression over the four weeks, it became clear that even in math teachers should not assume that students have the background knowledge and life experience to solve word problems. It's important for students to ask questions, use a think-aloud, and communicate with their peers when they are unfamiliar with a situation presented in a word problem. The use of graphic organizers allows students to extrapolate the information and activate their prior knowledge in order to solve the problem. These strategies help them to organize their thought along with the information in the problem.

### **Shades of Meaning: Using Mathematical Language**

Throughout my teaching career, I have always emphasized the importance of vocabulary in all content areas. So including vocabulary strategies in my study was a very important area to cover. As I reviewed the data I collected from my study the importance of language was a theme that kept reoccurring throughout the four weeks. During the first week of my study to introduce the concept of division, I decided to use a graphic organizer to introduce new vocabulary words. The Frayer Model was utilized to help students identify the meaning of the word, provide characteristics of the word, and demonstrate examples of the word. The students were divided into groups and each given a new vocabulary to dissect. As the students worked, I reflected on their progress and recorded a few comments in my teacher research journal. "Students are struggling to identify characteristics...Students can provide examples but are having difficulty providing non-examples..." (journal entry November 19, 2018). After reviewing my

comments it was clear that the students were still struggling to identify the meaning of the vocabulary words. They could provide a definition and an example, but they couldn't internalize the importance of the word and how it applies to math. Since the Frayer Model wasn't as effective as I thought I decided to extend the lesson. The next day, I decided to examine the meaning of division with the students. Using anchor chart paper, I wrote the header "Split". I asked the students what they thought the word "split" meant. The students began to provide lots of examples describing what the word split meant. Then I wrote the word "divide" on the anchor chart and asked the students to turn and talk to their partner and describe how these two words were related. I documented some of their responses in my teacher research journal "AA: I think they are similar because they both mean to break apart. RB: Yes, like if you split the class up into groups, I guess it's the same as dividing the class up." (journal entry, November 20, 2018). As the students continued to talk with their partners, I asked them to add some of their words to the anchor chart. Some of the words they added included: were break, cut, group, and separate. I then explained to the students that these words describe the characteristics of the word divide, which is a mathematical term.

Using synonyms for the word "divide" helped the students to characterize the meaning of the word and be able to use the word accurately when communicating with their peers. As the study continued, the class created synonym anchor charts for many mathematical terms, such as multiplication, fractions, and expressions. This strategy also became very useful for students when they solved word problems.

The theme of language resurfaced again during a word problem activity. For the past week, the students were learning how to apply SQRQCQ reading strategy when

solving their daily word problem. As I monitored their progress, I came across SS and noticed that her response to the problem was different from the rest of the class.

1. Teacher: How did you come to the answer of \$55?
2. SS: Well the problem says a rebate of \$10, so I added that to her final cost and that's how I got \$55.
3. Teacher: Do you know what a rebate is?
4. SS: No, but I know re- means again, so I guessed that she needed to add that price again.

I recalled this conversation in my teacher-research journal, “While I’m so impressed that SS applied her knowledge of prefixes and suffixes while solving a math problem, this makes me question the importance of understanding what the problem is asking before being able to solve it. I wonder if other students had the same problem?” (journal entry December 13, 2018). To further this inquiry, the next day I surveyed the students and asked them if they could explain to me when it means to receive a rebate. Only a hand full of students knew the correct definition of the word. So I needed to examine the use of language further. To help the students understand the meaning of words in the problems, I gave each student a worksheet full of word problems and asked them to highlight any words that they don’t understand. I recorded GC’s list in my teacher research journal. “GC’s Word List: ascending, justify, deduct, discount, and minimum.” (journal entry, December 14, 2018). After reviewing her list of words, I realized that if students don’t understand the meaning of certain words then solving a word problem can be very difficult for them. This was the case with SS. She didn’t understand what a rebate was because she doesn’t have experience with purchasing items that may include a rebate. Many times word problems describe situations that students don’t have the prior experience. As a teacher, it’s important to provide students with mathematical

terminology so that they are able to use context clues and/or synonyms to understand how to solve the problem.

### **Writing About Math: Implementing Mathematical Journals**

In planning the procedural timeline for my study, I knew that it was important for me to emphasize the significance of writing when applied to mathematics. It's not only important for students to use appropriate vocabulary when speaking about mathematics, it's also important for them to use vocabulary when writing. It's important for students today, to be able to describe their answer and provide justification using numbers AND words. To incorporate a "writing block" into my math period, I decided to introduce math journals during the third week of the study. Each day, I would pose a mathematical question and the students would answer the question in their math journal using words and numbers. Through their math journals, I was able to see how they incorporated vocabulary and how they made sense of a mathematical concept. Below is a sample of a question and answer retrieved from AP's math journal.

**December 5, 2018**

#### **Lesson 3.8**

#### **Explain why estimation is an important skill to know when adding decimals.**

Estimation is an important skill when adding decimals because it helps us know if our answer is **reasonable**. If our estimation is sensibly close to our answer, it most likely means that our answer is correct. If our estimate and answer aren't close to each other, it probably means we added our decimals wrong or we estimated wrong. Estimating makes it much easier for us to see if our answer is correct along with double-checking. But, estimates can be used for most equations, not just when adding decimals.



Math journals were just one way I was able to incorporate writing into my math class. When introducing fractions, I needed students to understand how certain keywords provided clues for determining the appropriate mathematical operation to use when solving a word problem. Instead of providing students with examples of word problems using the keywords, I wanted to deepen their understanding of this concept. I decided to have students create their own word problem. I provided each student with a list of operational words and asked them to come up with a scenario that involved fractions. Below is an example of NR's word problem retrieved December 7, 2018:

Scott is baking a cake. The recipe requires him to use  $\frac{3}{4}$  cup of flour. If he wants to make only  $\frac{1}{2}$  of the recipe, how much flour will he need?

By writing his own word problem, I am able to assess NR's ability to understand how keywords play a role in determining the use of operations.

By having students create their own word problems I am providing them with a great opportunity to bring math and literacy skills together in a format that is complex and engaging. Learning how to solve word problems helps students think critically and become better problem solvers. Word problems provide students with the opportunity to construct meaning of difficult tasks and persevere through challenges. When students are given the opportunity to create their own word problems they are fostering a deeper understanding of mathematical concepts through writing.

### **The Power of Communication**

One major theme that presented itself throughout the study was the importance of communication. This theme was evident during the first week of the study and continued to reoccur long after the study was completed.

During the second week of the study, I introduced the concept of “Math Talk”. This strategy provided students with an opportunity to communicate and justify their thinking through classroom discussions. I wanted to create a classroom dialogue about mathematical topics that allowed students to share ideas, justify their answers, and explore new mathematical concepts in a respectful and supportive way. To implement this strategy it was important for me to change how I replied to student’s responses and include more open-ended questions. By modeling more open-ended questions I was hoping to encourage students to use the same communication strategies when communicating with their peers. I also created a “Math Talk” bulletin board in my classroom to further encourage students to use the dialogue sentence stems when talking to their peers. During a lesson on division, the students were asked to estimate the solution using compatible numbers. While helping one student, I overheard two students arguing about their estimations. I recorded their conversation in my teacher-research journal on November 28, 2018.

1. GS: I estimated 33 (divided) to 32 and 7 (divisor) to 8 because 32 is compatible with 8 and 32 divided by 8 is 4.
2. KR: Well I estimated 33 (dividend) to 30 and 7(divisor) to 10 because I know that 30 divided by 10 is 3.
3. GS: But my estimate is more accurate because it’s closer to the real answer. The real answer is 4 remainder 5. So my answer is the better estimate.

Using this situation to reinforce the strategy “Math Talk”, I had both students go to the board and explain their solutions to the class. After both students shared their compiling arguments for their answers, I asked the students to vote on the correct answer. The class was split down the middle. 10 students voted that GS’s solution was the better estimate and 10 students voted that KR’s solution was more reasonable. I then asked some of the students to explain why they voted for a particular student and recorded some

of the explanations in my teacher research journal. “I voted for GS’s answer because 32 is only one away from 33 and 8 is only one away from 7. Whereas 30 is 3 away from 33 and 10 is 3 away from 7. So GS’s numbers are closer to the actual numbers.” Another student explained, “Well when I solved the actual problem I got 4 and  $\frac{5}{7}$  and then I estimated that answer to 5. So that means KR’s answer is correct because her answer is closer to the actual answer.” (journal entry, November 28, 2018). While more and more students shared their explanations, the students were becoming more interested in the discussion and were participating in the debate. At this point, I became the facilitator and just listened to their conversations and explanations. Through this dialogue, they were learning how to justify their answers and provide examples to support their claim. They were asking the questions and building on each other’s responses. Listening to their responses allowed me to assess which students understood the concept of estimation and which students needed more support. By giving the students the opportunity to explain their thinking aloud and providing a supportive environment for learning to occur, they were able to communicate effectively with their peers.

Another strategy that had a big impact on the students was using a think-aloud to construct meaning of word problems. While revisiting the SQRQCQ strategy for solving word problems, a question arose from one of my students.

1. DR: Why do you always read the problem twice?
2. Teacher: Well, sometimes I don’t really understand what the question is asking me so I need to reread the problem again to help me understand the problem. I’m using a think aloud to help me process and construct meaning of the problem.
3. SS: I do that too. Sometimes I talk to myself when I’m doing my homework at home.

This question sparked mini-conversations amongst all the students in the class. I realized that by using a think aloud to effectively communicate my own thinking process of a problem I was modeling to students how important it is for them to talk to their peers and explain their thinking when solving word problems.

The use of a think-aloud and “Math Talk” became useful strategies when working with students in a small group setting. During the second week of the study, I began to work with a small group of students during lunch. During this time we focused on talking about mathematical concepts and the struggles they had when solving word problems. During one of our meetings, I gave the students a word problem and asked the students to explain to me how they would solve the problem. Immediately JR and HL began to solve the problem independently. After they completed the problem, I asked them to explain how they found their answers.

1. HL: Well it asks for the total, so I took 375 and 65 and added them.
2. JR: I added too because she wanted to put all the books on the shelf.
3. Teacher: Ok, this time let’s just talk about how we would solve the problem and not use our pencils.

I gave the students another word problem and asked them to read the problem once quietly to themselves and then I asked them to explain how they would solve the problem without actually doing the application part.

1. HL: Well first I think you have to find the total number of crayon boxes...
2. JR: No, you have to subtract the number of crayon boxes...
3. HL: No, you have to add the total of crayon boxes before you can find out how many crayon boxes she will be able to ship.
4. JR: Shouldn’t you subtract the number of crayon boxes that would fit in each box from the total?
5. HL: yes, but you have to find the total first, then maybe subtract...

While the students to continued to discuss the procedure for solving this word problem, I remained silent and allowed them to share their ideas and suggestions for

solving the problem. As difficult as this was for me, it was important for the students to communicate their understanding of the problem and work through each other's misconceptions of the problem. This process allowed them to vocalize their understanding of the problem and come to a reasonable solution together. During this time, the students were able to communicate effectively and provide a justification for their procedure.

### **Summary of Data Analysis**

As quoted in chapter one, “when students are challenged to communicate the results of their thinking to others orally or in writing, they learn to be clear, convincing, and precise in their use of mathematical language” (Martin, 2000, p. 4). After reviewing the data sources from my study it was clear to me that when students communicate about mathematical topics, whether it be orally or written, they are able to internalize the material and provide justification for their answers. The data suggests students were able to develop a deeper understanding of mathematical concepts by utilizing literacy strategies. They were able to activate their prior knowledge by utilizing a think-aloud and asking questions. They also began to demonstrate an understanding of language by using synonyms and graphic organizers to find characteristics of mathematical terms. Furthermore, students were able to communicate effectively about mathematical concepts when speaking and writing through the use of journaling and classroom conversations. The data suggests that when students are exposed to literacy strategies in a mathematics class they are able to justify their answers, demonstrate an understanding of language, and communicate their thoughts of mathematical concepts effectively.

Chapter five will present the conclusion and implications of this study as well as recommendations for further research.

## Chapter 5

### Conclusions

#### Summary of the Findings

Since the adoption of the Common Core State Standards in 2000, teachers have seen a need for literacy instruction in all content areas. Mathematics teachers have the added responsibility of teaching students how to read and write mathematically. As quoted in chapter 2, “To meet these and the mathematics content standards, students must develop the ability to think mathematically. Language arts provides the tools for teachers and students to read and understand problems, to write and draw their way toward understanding, and to communicate effectively (Fogelberg, Hiller, Satz, Skalinder, & Vitantonio, 2008, p. 4). Math instruction is shifting from learning how to compute and regurgitate facts to learning how to justify and explain the context of the mathematical concept in order to solve the problem. Students need to learn how to speak and write mathematically and share their results with peers. Mathematics teachers need to adapt to these challenges, by communicating effectively with literacy leaders. Research suggests that students’ ability to communicate mathematically requires the integration among language arts and mathematics (Friedland, McMillen, & Del Prado Hill, 2011, p. 58). Consequently, this study was designed to explore the question, “How can literacy instructional practices when applied to a mathematics class affect student depth of understanding?”

Over the course of four weeks, students were introduced to several strategies that focused on three areas of literacy: vocabulary, writing, and comprehension. By the end of the study, I found that students were able to demonstrate the connection between literacy

and mathematics. The additions of literacy strategies provided students with an opportunity to communicate, write, and rationalize mathematical concepts. By creating a classroom dialogue students were able to learn new strategies, collaborate with peers, and discuss solutions in a supportive environment.

After four weeks, I found that the students' knowledge of mathematical terms developed as they began to communicate in writing and orally. During small-group instruction and partner talks, I found an increase in vocabulary usage. Students used vocabulary to extend their comprehension of mathematical concepts. When communicating with their peers, students used vocabulary to help justify their answers. By the end of the study, I found that students incorporated more vocabulary words when writing about math. Math journals and word problems allowed students to provide examples to support their understanding of mathematical terms.

In addition, the students showed an increase in comprehension of mathematical concepts through writing. The students did so by justifying and explaining their solutions in math journals, assessments, and performance tasks. The students' ability to clarify their answers grew as they continued to see the connection between math and literacy. At the conclusion of the study, the students' written responses showed the complexity and a comprehensive understanding through the use of mathematical terminology, their ability to justify solutions, and the ability to identify a procedural framework to solve the problem.

Finally, the findings of my research suggest that the students were able to comprehend and analyze mathematical word problems in order to find a solution. The students showed an increase in comprehension of word problems by communicating



through a think-aloud. When solving word problems, a think-aloud helped students in identifying the difference between important information and useless information. They also provided students with the opportunity to share their solutions with peers, which increased engagement and motivation in solving word problems.

### **Conclusions of the Study**

After reviewing the data that was collected throughout this study, several conclusions can be drawn. I found that providing students with the opportunity to express their understanding of mathematical concepts allowed for learning to occur. As quoted in chapter 2, “Conversations in which mathematical ideas are explored from multiple perspectives help the participants sharpen their thinking and make connections” (NCTM, 2000). By focusing on the reasoning behind the answer and not solely on the answer itself, students were more willing to participate in the discussion. By eliminating the stigma of getting the answer incorrect, students were more willing to share their explanations and justifications behind their answers. I found that by creating a supportive environment for collaboration to occur, the students were less likely to be embarrassed when they did not get the answer correct. The emphasis on getting the answer correct shifted from them wanting to learn how other students came to find the answer. When talking with their peers, I found that the students concentrated on how they conversed with their partners and learned how to debate in a friendly manner. By practicing and using “Math Talk” strategies, I found that students were more mindful of their responses and became active listeners during the conversation.

Furthermore, math journals can provide students with an additional format for justifying and explaining mathematical concepts. As quoted in chapter 2, “students

should be expected to write in math class for a variety of reasons: to assess their understanding, to record their thinking in order to revise their approach at a later time, to share problem-solving strategies with their peers and teacher, and to share feelings and frustrations about the mathematics they are studying” (Fogelberg, Skalinder, Satz, Hiller, Bernstein, & Vitantonio, 2008, p. 143). I found that students who were more introverted had a tough time expressing mathematical concepts amongst their peers. So by incorporating a “writing block” into the daily routine, students were given an opportunity to share their knowledge of the content using a different format. I found that students used the writing block to enhance their math journals through the use of models, vocabulary words, and images. Math journals gave students the opportunity to be creative and express their understanding of mathematical concepts using words and numbers.

Lastly, when improving student comprehension of word problems, I found that the SQRQCQ and KWNS strategies were better suited for organizing information rather than increasing student performance. I found that the graphic organizers that were utilized helped students to categorize information in the word problems, but did not provide a solution for solving the word problem. During the implementation of these strategies, I found that students who were struggling to solve a word problem quickly would abort the new strategy and relied on previously taught system for solving word problems. However, I did find that students who used the strategies correctly were able to find the correct solution.

### **Limitations of the Study**

While this study was able to provide new knowledge about literacy instruction in a math class, the results also revealed some limitations. One major limitation that affected

this study was the limited timeframe that was allocated for research. This study was conducted in a 5th-grade math class during a 60-minute math block. The math block is segmented into three components: whole group instruction (20 minutes), small group instruction (30 minutes), and reflection (10 minutes). Along with conducting this study, I was also responsible for implementing the 5th-grade NJ Student Learning Standards for Mathematics. While many of the literacy strategies aligned with my math curriculum, I found it challenging to introduce a comprehension strategy along with a mathematical concept. During this study, I used my small group instruction time to revisit a mathematical concept in order to meet the needs of the study and the standards. At times, students would use their lunch period to meet and discuss mathematical concepts related to my study.

In addition to time, I found it challenging to motivate students who disliked math. Even with the emphasis on writing and communication, I still had students who lacked the motivation to participate and add to the conversation. At times, some students would disregard a strategy that was being introduced and simply solve the problem.

### **Implications of the Findings**

This study was conducted in a 5th-grade classroom; some of the findings represented may not reflect other grade levels. Future studies should be conducted across different grade levels. Analyzing the use of literacy strategies across different grade levels would allow for teacher researchers to see how students apply the strategies at all ages. Teacher-researchers would also be able to see what strategies students are retaining from year to year and what strategies need to be revisited.

In addition to grade level, this study was conducted in a mathematics classroom. As stated in chapter 2, the Common Core State Standards initiative allocates more literacy instruction in all content areas. Further teacher research should be conducted in other content areas to see how students are transferring the skills from one subject to another. This would also allow for a more in-depth look at how literacy instruction affects performance in different content areas. Teacher-researchers can look for patterns amongst the implementation of literacy strategies in different subjects to help support content area teachers.

In summary, the use of literacy strategies in mathematics can help students to create a classroom dialogue, justify and provide mathematical reasoning, enhance their use of mathematical terminology, and communicate effectively about mathematical topics. This study suggests that teachers expose students to a variety of skills and strategies that help to increase their understanding of complex tasks. Literacy instruction provides students with the tools they need to dissect word problems, communicate their findings, and explain their thought process through many different formats.

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