The Effects of the Inclusion of Mathematical Problem-Solving Instruction

on

5th Grade Students Who Are Reading Below Grade Level

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Table of Contents

List of Tables

List of Figures

Abstract

The purpose of this study was to determine if teaching mathematical problem-solving strategies to students who show difficulty interpreting what a question is asking, due to limited reading comprehension skills, increase mathematical problem-solving skill. Pre-and post- assessment data was analyzed to determine the effect that the reading strategies had on 5th grade student achievement as measured by post-assessment data. Data was collected using a Baltimore County (Maryland) Public Schools Unit Assessment. Each unit is composed of a pre-assessment with computation and problem-solving components as well as a post-assessment with similar components. Data was compared to determine growth in student performance for those exposed to the strategies compared to those not exposed to the strategies. The data collected showed that there was no statistical difference between the two groups, but all students made progress in both areas of the post-assessment.

CHAPTER I

INTRODUCTION

Overview

This research focused on mathematical problem-solving strategies and the effect they have on students who show difficulty interpreting what a question is asking using mathematic problem-solving skills. With the new Common Core State Standards mandated in many states in 2009, student required rigor has increased and thus methods of best practices must also be increased in rigor. There has been a push to guide teachers to assure they plan cross-curricular activities and to assure they use reading skills in content areas. One major gap includes students who are struggling readers who have to read in order to comprehend and interpret mathematics real world problems in math class.

Many students have shown a greater increase in difficulty deciphering real world problems with the introduction of Common Core. Teachers have a greater need to teach students specific problem-solving strategies, and in many cases, reading intervention strategies that help students read, comprehend, and interpret mathematics problems. For students who already struggle in reading, math is often an escape from that struggle. This is no longer the case. Common Core has a heavy focus on real-world problem-solving in which students must read, interpret, and comprehend complex story problems before they can do the math. In turn, struggling readers now have more difficulty in math. Strategies to help guide struggling readers are the focus of this research study.

Statement of Problem

The purpose of this study is to determine the effects of the inclusion of direct teaching of mathematical problem-solving instruction on 5^{th} grade students who are reading below grade level.

Hypothesis

The null hypothesis is that the achievement level of 5^{th} grade students, reading below grade level, who are instructed using mathematical problem-solving strategy interventions is not significantly different than the mathematics achievement level of 5^{th} grade students receiving regular instruction.

Operational Definitions

Content-area Literacy

Content- area literacy is the use of literacy components such as reading, writing, and speaking within a content area such as science. Students use their literacy skills to interact with a text in the discipline. "Content-area literacy includes many opportunities for students to read, write, and talk about the discipline in which they are studying" (Cater, 2006, p. 127).

Mathematical Reading

Mathematical reading is the complex use of reading skills to interpret meaning and comprehension in math story problems. "Mathematical reading involves using word recognition and linguistic comprehension skills of the simple view of reading as well as knowledge of the 'language of mathematics'… Students bust be able to decode and comprehend word problems and textbooks in addition to making sense of specialized mathematical vocabulary in order to communicate and think mathematically" (Cater, 2006, p. 128).

Achievement

Achievement is the measurement of student growth from a pre-assessment to a post-assessment. Achievement measures the amount of growth as a result of instruction on a skill. Low achievement in reading was measured in this study using MAP scores.

Measurement of Academic Progress

The Measurement of Academic Progress assessment is a standardized assessment, developed by the Nothwest Evaluation Associaton, to measure student growth from one period to the next. MAP is a responsive online assessment given to students in the fall, winter, and spring to measure reading comprehension and mathematical computations.

Problem-Solving Strategies

Problem-solving strategies are skills explicitly taught to students to improve their interpretation of mathematical story problems. In this study the strategies used are: UPS (Underline, Plan, Solve), RIDGES (Read, Identify, Draw, Group Discussion, Equation, and Solve), and the local county school system's mathematics problem-solving process- (retell, visualize, represent, solve, check and justify).

CHAPTER II

REVIEW OF THE LITERATURE

Overview

"Mathematics is a remarkable, intriguing, fun, complex, frustrating, frightening, enlightening, and mysterious discipline…" to many students (Fuentes, 1998, p. 81). The concept of reading comprehension in mathematics has been a topic of discussion for many years. Most recently the focus of attention has been on reading comprehension in mathematics due in large part to the introduction of the Common Core State Standards for public school instruction. Students have always been asked to solve story problems. With Common Core, there is no exception.

The rigor of story problems has grown increasing difficult over the years. The need for deciphering real world complex multi-step problems is becoming increasing prominent in real life; that is life outside the classroom. It is the role of the teacher to guide students to mastery for problem-solving in grades as early as pre-kindergarten. In research by Ozdemir (2009) it was noted "Mathematics educators agree with the idea that students' abilities to solve problems need[s] to be improved" (p. 88) and this is still a problem today because "it is not possible for someone to solve a problem they do not understand" (p. 88). Thus, educators must teach comprehension strategies in mathematics to support problem-solving proficiency.

The following research pertaining to the area of study is organized as follows. Section I presents research pertaining to the clarification of Content-Area Literacy as compared to Disciplinary Literacy. Section II presents literature as it pertains to literacy strategies used in the mathematics class to enhance problem-solving. Section III contains literature that pertains to an analysis of mathematics problem-solving. In section IV the research presented pertains to STEM and STREAM education initiatives.

Content-Area Literacy or Disciplinary Literacy

Reading instruction in the content areas is becoming increasingly important. Vacca, Vacca, and Mraz (2011) stated "Content-Area Literacy is the ability to use listening, speaking, reading, writing, and viewing to gain information within a specific discipline" (as cited in Ming, 2012, p. 214). "These five modes help students think critically as they receive, process, and produce information" (Ming, 2012, p. 214).

In elementary school reading in the content areas can be especially difficult. Primary school teachers, those in grades pre-kindergarten to second grade, frequently teach phonics and reading comprehension. However this is often lost in the rigor of later grades, especially in secondary schools, despite many students not having mastered learning to read. Without learning to read, reading to learn is increasingly frustrating for students. Content- area literacy is more than reading a book or textbook in science a designated way as disciplinary literacy suggest. Carter and Dean (2006) state "Content-Area Literacy includes many opportunities for students to read, write, and talk about the discipline they are studying" (p. 127). Furthermore, Content-Area Literacy requires teachers to incorporate "effective reading strategies into their discipline-specific instruction" (p. 127).

The language of mathematics is understood using the same two fundamental components of reading- word recognition or decoding and linguistic comprehension. Adams (2003) argued that the language of mathematics consists of "words, numbers, and symbols" (as cited in Carter & Dean, 2006, p. 128). Common Core rigor requires teachers to incorporate effective reading strategies into their content area disciplines to assure students are successful in each course. This is true for mathematics class as well. “Integration of content-area literacy has been shown to increase reading comprehension, build conceptual knowledge, and foster problem-solving skills” (Ming, 2012, p. 214).

“Does Disciplinary Literacy have a place in the Elementary School classroom?” -a valid question often pondered by those in education. Disciplinary literacy refers to the idea that students should be taught various ways to attack text depending on the content they are studying. For example, in a science classroom the information gained from a text is the same as in the reading classroom with non-fiction text. Disciplinary literacy simply brings attention to these connections for teachers and students. With Common Core being rapidly introduced throughout the country, many secondary teachers are no strangers to this concept of integrating literacy strategies into the content areas.

What is the role then of the Elementary School teachers? Shanahan and Shanahan (2014) explain that the role of teaching in the elementary level schools is to assure students have the literacy skills not only for reading class but also for content areas and to assure they know the difference and can apply it. Students should read a non-fiction science text in reading in the same manor they would read it in science class and it is the role of the elementary school teacher to assure students master this skill. It is also their role as outlined in the Common Core State Standards to assure there is a wide range of informational text used. “Disciplinary Literacy matters because general reading skills can only take students so far” (Shanahan & Shanahan, 2014, p. 637).

Shanahan and Shanahan (2014) outline many approaches that elementary school teachers use from the standards outlined in Common Core to promote disciplinary literacy. First it is important to note that the Common Core standards are outlined beginning with anchor standards.

This is a general standard that applies to all grade levels. From there, each grade level is a variation of that skill that continues to increase in difficulty throughout each grade level. Shanahan and Shanahan describe three Reading Informational (RI) text standards for second grade; RI 2.5, RI 2.7, and RI 2.9. Each of these standards works within the informational text genre to assure students learn to master the skills such as: text features (RI 2.5), using images to clarify (RI 2.7), and comparing and contrasting text on the same topic (RI 2.9). Using these standards in reading class and then connecting to the discipline to which they connect allows students to begin mastering disciplinary literacy. Once students learn to navigate different forms of text effectively their performance in various disciplines should in turn be impacted.

Reading Literacy in the Mathematics Classroom

With the increased rigor of real world application in mathematics class, it is no secret that students who are struggling readers are facing extra challenges in mathematics class. Students struggle with word problems for various reasons beyond procedural or calculation challenges. As a result, students require support in reading and language development in addition to math" (Kong & Orosco, 2016, p. 172). Though some minority students tend to need more support, all students who show a need for intervention in reading can also benefit from intervention support in mathematical problem-solving. Students are expected to read, comprehend, analyze, and then solve story problems on a frequent basis as early as primary school. The easiest modification for students who struggle to read is simply to read the question to them. But this only bridges one of many gaps between the mathematics classroom and a literacy classroom. Though the student has access to the text by hearing the words and not needing to decode them oneself. As in reading class, students need to also be able to use specific strategies to tackle the problem independently and accurately. "Students must be able to decode and comprehend word problems and textbooks in addition to making sense of specialized mathematical vocabulary in order to communicate and think mathematically" (Carter & Dean, 2006, p. 128). Many students lack this strategy as most instructional mathematics is limited to vocabulary and computations. It is assumed the students are able to read, comprehend and interpret mathematical story problems.

Support for literacy instruction throughout content areas, specifically in math, can be found in the Common Core State Standards which are mandated by most states and require students to use their reading and writing skills in order to be successful in mathematics with real world application. Additionally, Friedland, McMillen, and Hill (2011) note that the International Reading Association and the National Council for Teachers of Mathematics support the following recommendations for content area literacy: "(a) Provide explicit vocabulary instruction; (b) provide direct and explicit comprehension strategy instruction; (c) provide opportunities for extended discussion of text meaning and interpretation; and (d) increase motivation and engagement in literacy learning" (p. 57).

Aside from reading fluency and comprehension, another major component of reading literacy that poses challenges in the mathematics class is content specific vocabulary and using this vocabulary to accurately demonstrate mathematical problem-solving competency. Additionally, (Friedland et al., 2011) add that one reason literacy in math is particularly challenging is due to the specific vocabulary used. Mathematics vocabulary is often only used in the mathematics classroom. The few words that are used outside a mathematics classroom are words that have a different meaning in the mathematics classroom than outside it "such as power or radical" (p. 57). "Activation of prior knowledge is essential for comprehending any text… Activating prior knowledge is especially important in mathematics" (Carter & Dean, 2006,

p. 128). Prior knowledge instructional strategies from reading such as word webs, brainstorming, think-pair-share conversations, drawings, etc. can be used in mathematics class to help students recall prior learned vocabulary and skills. It is critical to a student's comprehension for them to connect the concepts and vocabulary to build a deep understanding. In 1982 Schell noted that it has also been found that "mathematics textbooks contain more concepts per sentence and paragraph than any other content areas; thus making mathematics more difficult to read" (as cited in Carter & Dean, 2006, p. 129).

Basic reading strategies need to be taught in mathematics classes. Halladay and Neumann (2012) outline a few basic reading strategies and how they can be used in the mathematics classroom to help problem-solving. "In both reading and mathematics, we want students to make predictions, monitor understanding, determine importance, and make connections" (p. 471). In reading, teachers ask students frequently to make predictions, justify prediction, and revisit prediction throughout various text. Likewise in mathematics class, teachers need to assure students are thinking about the context of the numbers and make predictions using skills like estimating or inferring whether a value should increase or decrease as a result of the computations. Students can then participate in peer conversations allowing them to justify their thinking demonstrating comprehension of the problem.

In addition to making predictions, students can use monitoring comprehension, determining importance, making connections, and vocabulary usage strategies of reading to promote mathematical comprehension in problem-solving situations. Students can monitor comprehension in mathematics by considering reasonability of their steps or answer. They can also compare to another example and check for errors in outlined steps making corrections as needed. Likewise in reading, teachers ask students "does that make sense" when they misread a word in context. The same applies in math. For example, if you are buying something, then the reasonable thinking would be that the amount of money you have decreases. Students who can explain the reasonableness or lack thereof show a deeper comprehension of mathematical problem-solving. When determining the purpose in reading, the focus is often on the facts or important details that guide a story along. In mathematics, students need to think critically of the information presented in problems to assure they only use the values that are important to answer the question asked. Also, they must interpret what to do with said values using the context of the problem. Making connections in reading and mathematics are equally similar. Students need to connect their prior knowledge to their new learning. When students can make connections to themselves or the world around them; as desired in the Common Core standards; they are able to comprehend the skill better. Halladay and Neumann (2012) also stress the importance of a universal language in mathematics class. Students are able to master vocabulary and contextualize it better when the vocabulary used is precise and consistent.

Ming (2012) includes the use of visualization in mathematic when considering Content-Area Literacy. The majority of students in classrooms are visual learners. The 21st century learner is constantly exposed to visual stimuli and it is the role of educators to foster and guide these visuals into new learning. Visualization is defined as "the ability [of students to]…use their imagination to create mental images, putting themselves into specific situations…" (Ming, 2012, p. 218). Once students are able to visualize their problem and make connections by using their imagination to put themselves into the problem, they are able to begin to interpret the context of the problem and then begin to make predictions such as estimations.

Mathematics Problem Solving Analysis

Carter and Dean (2006) state "the first step for solving a [mathematics] problem is to understand it" (p. 133). Understanding of mathematics story problems involves three major literacy strategies. Students must be able to decode, understand the meaning of content specific vocabulary, and then comprehend. Students use this information to construct meaning from the problem and plan for solving. These researchers offer an explanation of Decoding, Comprehension, and Vocabulary as presented below: (p. 133)

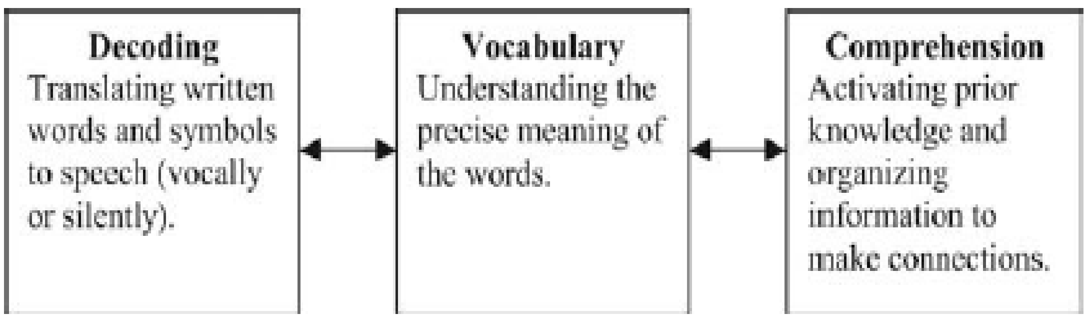

FIGURE 1 Understanding the problem.

Decoding is a familiar term for primary school teachers. Students will use decoding to blend letter sounds into words at various paces depending on the level of the student. Students also need to be able to decode mathematical symbols and understand the meaning and application of each. Once students have decoded the unfamiliar words, students must then make connections to the word in order to interpret the vocabulary. The goal, through explicit instruction, is for full comprehension of the problem. Demonstrating comprehension in mathematics involves not only mathematical computations but also the discussion of mathematical content and written expression of reasoning and application.

STEM to STREAM

The focus on Science, Technology, Engineering, and Math (STEM) in education continues to grow. The most recent growth has been a push for literacy strategies to be included in the STEM teaching process to assure student growth and success. Some studies show STEM with literacy skills integrated while others have renamed the philosophy to STREAM (Science, Technology, Reading and Writing, Engineering, Art, and Math). The research reviewed for either method, emphasizes the importance of literacy in all subject areas. Jones (2014) gives several examples of integrating literacy strategies in STEM classes. For teachers, this is included in some county's curriculum but other ideas Jones presents are unique. She challenges teachers to begin by changing "the lens of how you view teaching practices" (p. 37). From there she explains how simple activities that get students engaged and moving can easily integrate into the STEM components.

In the ever-changing 21st Century of learning, students must not only be literate but also be technologically literate. Literacy has moved beyond the book and pencil and into a whole new digital world. In this new world, students need to be taught how to be literate with technology. Jones (2016) explains that students in the young learner stage from Pre- Kindergarten to Second Grade need to be taught digital literacy strategies and how to develop those strategies and use them in higher levels of technological skills. Elementary school age students, as she defines them, are grades three to five. These students should focus on understanding the resources they are using. Like a science book in a Biology classroom, a website needs to be understood structurally and encountered effectively to assure learning takes place. Jones states "We [educators] can broaden students' concepts of technology and enhance cross-curricular learning while building collaboration and problem-solving skills" (p. 24). Through adjusting the mindset of teachers and with proper training, students and teachers can effectively blur the lines between disciplines and assure students have the tools, both digital and not to be successful.

CHAPTER III

METHODS

Design

This study used a quasi-experimental research model to determine the effect that reading strategies had on 5th grade student mathematics achievement as measured by pre and post-assessment data. The independent variable is the inclusion of problem-solving strategies which will be explicitly taught to an intervention group while the control group received standard mathematics instruction. The dependent variable is the achievement measured on the post-assessment. A null hypothosis guided this study's inquiry.

Participants

The two groups involved in this study were enrolled in a fifth grade class of 15 (12 of which were involved in this study). Six students from this group received the intervention strategy instruction and were compared to a second small group of six students who did not receive the intervention strategy instruction. Both groups were composed of students who were considered struggling readers based on the Measurement of Academic Performance (MAP) assessment in the spring of the previous school year (2015- 2016). To be considered a struggling reader and included in this study, students had to score in the low to low-avg categories on the ELA/ reading MAP assessment. All 12 students are students who have not been retained and all received additional reading intervention instruction daily.

Instrument

A Maryland county curriculum assessment aligned with and embedded in the curriculum, served as the post-assessment instrument. These assessments are created by curriculum writers and tested using a BETA year in which specific schools or mixed demographical areas implement the BETA curriculum and assessments. Based on achievement and feedback, the assessments were edited then finalized for the remainder of the county schools to implement. The pre-assessment as well as the post-assessment included ten computation problems to assess only the mathematical computation proficiency of students and then eight story problems requiring problem-solving skills.

The current mathematics curriculum is composed of six mathematics units. Each unit has a pre-assessment and post-assessment. Each assessment is composed of multiple choice computation questions and problem-solving based story problems. For this study, unit 5 of the 5th grade curriculum was used. Prior to this unit, students received daily small group intervention instruction on four units spanning a nine-month period. The assessment for this study measured student performance with fractions. Students were expected to demonstrate mastery of adding, subtracting, multiplying, and dividing fractions. Additionally, they were expected to interpret complex real-world based story problems that applied any or a mix of these skills forming multistep problems.

Procedure

In the spring of their fourth grade year, each student participated in MAP testing for reading and mathematics. These scores determined the placement of students for their fifth grade classrooms. Students who struggle in reading, receive additional interventions, and placed in class together. Students took the pre and post assessments in the classroom under similar parameters such as having posters or anchor charts visible that enable task completion. Students also had unlimited time to complete each assessment. In the control group, students received small group instruction daily only on computation skills. The control group worked on story problems but were not given daily intervention instruction on strategies. In the intervention group, students received small group instruction daily on computation skills as well as problem-solving strategies.

In the intervention group, students were taught one strategy at a time and allowed time to practice and master the strategy in small groups with teacher instruction and then again in a reteach small group with additional practice problems and peer support. Students then were encouraged to determine the strategy they felt most successful and applied that strategy for the remainder of the unit. Students were given opportunities to reflect on the strategies they learned and determine what worked for them and what did not to determine their best strategy. Students were also able to use these strategies in combination to assure their success. Each day, they were required to identify the strategy used, how they used it, and what helped them to determine their response.

CHAPTER IV

RESULTS

The purpose of this study was to determine the effects of explicit problem-solving strategy instruction with students who were below grade level in reading. The study compared two small groups of students over one unit of instruction in a fifth grade mathematics class. The first group of six students (control group) received daily small group instruction with computation practice only. The second group of six (intervention group) included computation as well as direct instruction on and applying the problem-solving strategies learned in the small group instruction.

Students worked for a total of 36 days to master the units' content and problem-solving skills. Students demonstrated no prior knowledge of the computation skills needed for the unit on the pre-assessment and thus were also unable to show any prior knowledge on the problem-solving portion of the pre-assessment. Both groups' showed a mean of 0%. Thus, there was no pre-existing difference between the control group and the intervention group prior to beginning this unit of instructional content. All students showed growth from the pre-assessment to the post-assessment with a mean of 60.75% on the post assessment. Table 1 shows the overall data collected from the pre-assessment and the post-assessment.

In order to determine the impact of explicit problem-solving strategy instruction, a series of independent samples *t*-test analyses were conducted. The first analysis compared the overall student performance on the post assessment including both sections examining the differences between the intervention and control groups as shown in Table 4 below. Shown in Table 5 is the second analysis comparing student performance in the area of problem-solving. The third analysis; shown in Table 6, illustrates the comparison between groups in the area of computation. The significance level for all the noted analyses was set at p<.05.

Table 1
Cumulative Overall Test Scores

Student	Pre-Assessment %/100%	Post-Assessment %/100%
1	0%	43%
2	0%	61%
3	0%	37%
4	0%	52%
5	0%	42%
6	0%	95%
7*	0%	54%
8*	0%	60%
9*	0%	83%
10*	0%	67%
11*	0%	49%
12*	0%	86%

**indicates student who received intervention instruction in small group*

Table 2 includes the student scores broken down by student. Included are individual scores on the pre-assessment and post-assessment for both the computation and problem-solving sections of the unit assessment.

Table 2
Cumulative Test Scores Breakdown by Section

Student	Pre-Assessment %/100% Computation	Post-Assessment %/100% Computation	Pre-Assessment %/100% Problem Solving	Post-Assessment %/100% Problem Solving
1	0%	38%	0%	48%
2	0%	61%	0%	60%
3	0%	38%	0%	36%
4	0%	55%	0%	48%
5	0%	55%	0%	28%
6	0%	94%	0%	96%
7*	0%	44%	0%	64%
8*	0%	44%	0%	76%
9*	0%	77%	0%	88%
10*	0%	66%	0%	68%
11*	0%	38%	0%	60%
12*	0%	88%	0%	84%

**indicates student who received intervention instruction in small group*

As shown in Table 3, group sizes for the intervention and control group were 6 and 6, respectively. The intervention group (M= 59.5) outperformed the control group (M= 56.83) on the computation section of the post-assessment. The intervention group (M =73.33) also outperformed the control group (M =52.67) in the problem-solving section of the post-assessment. As such, combined performance on unit post-assessment revealed that the intervention group (M=66.50) scored higher than did the control group (M= 55).

Table 3
Post-Assessment Mean Scores: Intervention and Control Groups

Group Name	Group Size (N)	Computation Mean Score	Problem Solving Mean Score	Overall Mean Score
Control	6	56.83	52.67	55
Intervention	6	59.5	73.33	66.50

As presented in Table 4, an independent *t*-test was conducted to compare the differences between overall student test scores including both the computation and problem-solving sections. The analysis revealed no significant differences between the intervention group (M= 66.5, SD= 15.22) and the control group; (M= 55.0, SD= 21.36); t (10)= -1.074, p = 0.308. As such, there was not enough evidence to reject the null hypothesis.

Table 4
Independent *t*-Test Analysis of Post-Assessment Overall Mean Scores: Intervention vs. Control Groups

Group Name	N	Overall Mean Score	SD	t	Df	p
Control	6	55	21.36	-1.074	10	.308

As shown in Table 5, an independent t-test was conducted to compare the differences between the intervention and control group in the area of problem-solving. The analysis revealed no significant differences between the intervention group (M= 73.33, SD= 11.22) and the control group; (M= 52.67, SD= 23.92); t (10)= -1.916, p = 0.084. As such, there was not enough evidence to reject the null hypothesis.

Table 5:
Independent *t*-Test Analysis of Post-Assessment Problem Solving Mean Scores: Intervention vs. Control Groups

Group Name	N	Problem Solving Score	SD	t	df	p
Control	6	52.67	23.92	-1.916	10	0.084
Intervention	6	73.33	11.22			

The final independent t-test was conducted to compare the differences between the intervention and in the area of computation; outlined in Table 6. The analysis revealed no significant differences between the intervention group (M= 59.50, SD= 20.57) and the control group (M= 56.83, SD= 20.51); t (10)= -.225, p = 0.827. As such, there was not enough evidence to reject the null hypothesis.

Table 6
Independent t-Test Analysis of Post-assessment Computation Mean Scores: Intervention vs. Control Groups

Group Name	N	Computation Score	SD	t	df	p
Control	6	56.83	20.57	-.225	10	0.827
Intervention	6	59.50	20.51			

The information presented in Chapter IV provided the basis for the analyses of student data and subsequent determination of the effectiveness of the intervention strategies. Each of the three analyses yielded *p*-values greater than the significance level of $p < .05$. As such, in each case, there was a failure to reject the null hypothesis. A more detailed discussion of these findings and their implications is presented in Chapter V.

CHAPTER V

DISCUSSION

The results of this study failed to reject the null hypothesis stating that the achievement level of 5th grade students who are instructed using mathematical problem-solving strategies as an intervention in mathematics is not significantly different than the achievement level of 5th grade students receiving regular instruction in the general education classroom during small group instruction time. Student progress was monitored daily with formative assessments in both groups and ultimately a culminating unit assessment at the completion of the instructional unit. Though there was not a statistical difference in performance between the control and intervention groups, there was evidence of higher performance for the intervention groups on all three post assessments.

The small group instruction for the test group included many problem-solving strategies geared towards helping students who also struggle with reading comprehension. Students learned the various strategies, when to apply them, and how to apply them in various mathematical story problems. Students expressed their appreciation for the skills and were able to explain, in detail, which strategies they used and found the most helpful to them. They expressed a desire to share their new strategies with other students in the class after the unit was completed. The inclusion of this explicit instruction was time consuming. Each small group lesson was used to aid students in computation as well as problem-solving skills, thus administrators should plan accordingly.

It was also helpful that in this classroom, there was an instructional aid during math rotation time. Her role was to work on computation skills and guide students to practice the problem-solving skills they had (control group) or were learning (intervention group) throughout the unit. Her role was simply to guide practice with no new instruction in her rotation with the students. Both teacher and aid met during the scheduled planning time to discuss the skills and assure mastery of the computation was met. They also discussed student growth and planned accordingly. The aid was present the entire school year and had a consistent role thought the mathematic block daily.

Implications of Results

The results of this study suggest that small group instruction on problem-solving strategies did not prove to be statistically significant in improving student performance on the unit post assessment. In each analysis of this study the p-value was greater than the set value. The data collected failed to reject the stated null hypothesis where the stated value of $p<.05$; as such there was a failure to reject the null hypothesis. While the evidence was statistically significant, findings did show the intervention had positive effects in all three analyses; this is worth mentioning since there were no differences between the groups initially but then the intervention group did better across the board. It is worth highlighting and discussing. There is no statistical evidence to support the interventions being used. Threats to the validity below explain possible reasons why these intervention strategies were not statistically successful.

Theoretical Implications

It is important to note the environment of the classroom this study was conducted in due to the theoretical implications that may have aided in student success. The *Ecological Systems Theory* described by Bronfenbrenner describes the many complex systems that work together to aid in the development of humans beginning in the earliest stages of life. The school falls in to Bronfenbrenner’s second level called the Mesosystem. In this layer the influences from the child’s environment and how they work together help with development socially, behaviorally, and academically (Berk, 2014). The classroom this study was conducted in spends 15-20 minutes a day in a "Morning Meeting" where students learn social skills, coping strategies, and build bonds with the teacher and one another. The culture of the classroom was one of nurturing and students were encouraged constantly from the teacher, aid, peers, and also themselves. Consequently, students in general felt a desire and willingness to explore and apply new strategies. With both the control group and the intervention group being in the same classroom (mesosystem), they both demonstrated a desire to try new strategies and were willing to try something new to help them. The intervention group was taught these strategies whereas the control group was not, thus the intervention group showed more growth.

Threats to the Validity

The environment of the classroom this study was conducted in was described previously. This environment is a threat to the validity because students in the class have more willingness to try and fail knowing that the environment they are in supports them throughout their journey to mastery. Another threat to validity was the lack of instructional time due to spring break. Spring break was 10 days long in the middle of the unit; in consequence, students may have forgotten information in the time between the pre-assessment and the post-assessment.

Additionally, the inclusion of both computation and problem-solving skills on the test made it difficult to interpret the growth. All students demonstrated significant growth from the pre-assessment to the post-assessment. However, mastery of computation was needed in order to be successful on the problem-solving section. The assessment scores showed students were still struggling with the mastery of the content creating a threat to validity.

The final threat to validity is the classroom organization. The students who were in the control group could have easily overheard the intervention instruction being conducted within the same classroom. The small groups were pulled within the classroom to a small table for instruction. During instruction, anchor charts were made to support the visual learners and could have been seen by all students. It was expressed to the whole class that their time to learn these skills would be in the next unit to encourage them to focus on their task and not the small group's intervention instruction. Students were also reminded of the "Fair vs Equal" lesson taught at the start of the year to remind them that not everyone needs the same support at the same time, again to encourage them to focus on their task.

Connections to Previous Research

Prior studies have indicated that reading ability can impact a student's ability to complete story problem task. Carter and Dean (2006) stated the need for students to be able to decode and comprehend story problems in order to complete the problem-solving task. Elementary school teachers are responsible for more than just the content they teach. Shanahan and Shanahan (2014) explain that the teacher plays a role in assuring the students have the skills for literacy proficiency but are also able to apply those skills in all subject areas. They are responsible for teaching students how to access the material with various strategies. Students need to learn to master all aspects of math including the computation as well as the problem-solving as Ming (2012) explains when discussing content-area literacy. The strategies used in this study aimed to help students apply the literacy strategies mastered in reading class to the story problems they encounter in mathematics class.

Additionally, vocabulary is important in mathematics instruction. Because mathematics vocabulary is mostly specific to the mathematics discipline, it can be difficult for students to make connections and understand the new terms in addition to the new skills needed for computation. Friedland, et al. (2011) provided detailed research on vocabulary interventions that were included in the problem-solving intervention group used in this study. Halladay and

Neumann (2012) further discussed the reading skills needed in a mathematics room in order for students to be successful when solving complex story problems. Making predictions, determining importance, and making connections are a few of the specific skills used in this study to aid the intervention group in developing the reading skills needed to be successful in mathematics problem-solving.

Various previous studies have been conducted describing the implications and applications of each of the strategies used in this study; with the exception of the Baltimore County Public Schools Story Problem Visuals. In each study the researcher tested the strategies and presented one's finding similar to this study. This study differs in that it included many different strategies from different studies to allow student choice in the strategy that worked best for them.

Implications of Future Research

Future studies could examine the effects of each set of strategies on student performance to determine if one strategy is more effective than another. Students could then focus on one new set of strategies instead of many in one unit. Another study that could be conducted would include all the strategies but each taught in isolation over the course of a school year and could compare the beginning of the school year pre-assessment data to the end of the school year post-assessment data. This study would however have many variables to consider.

Future research could also address the limitations of this study. A larger more diverse sample population would add validity to the results. The study could also be conducted over an uninterrupted time period or a longer span of instruction. However, for future more precise data, one may consider teaching the problem-solving skills with an area of computation that has already been mastered to assure scores reflect mostly problem-solving skills as compared to this study which required computation and problem-solving.

Conclusion

The results of this study rejected the null hypothesis stating that the achievement level of 5th grade students who are instructed using mathematical problem- solving strategies intervention in mathematics is not significantly different than the achievement level of 5th grade students receiving regular instruction in the general education classroom during small group instruction time. The students demonstrated and expressed a desire to use the strategies learned and applied them on the post- assessment making notable growth. However, all students made notable growth despite receiving or not receiving intervention instruction. The researcher felt the limitations and threats to validity of the study led to more research needed and additional time spent with study. Time spent on instruction of strategies was worth the researcher’s time, but may have been better spent instructing all students in smaller chunks.

REFERENCES

Berk, L. (2014). Development Through the Lifespan. *6th Edition*. Boston, MA: Allyn, & Bacon.

Carter, T., & Dean, E. (2006). Mathematics intervention for grades 511: Teaching mathematics, reading, or both? *Reading Psychology*, *27*(2), 127-146. doi:10.1080/02702710600640248

Friedland, E., McMillen, S. E., & Hill, P.. (2011). Collaborating to cross the mathematics-literacy divide: An annotated bibliography of literacy strategies for mathematics classrooms. *Journal of Adolescent & Adult Literacy*, *55*(1), 57-66. doi:10.1598/JAAL.55.1.6

Fuentes, P. (1998). Reading comprehension in mathematics. *Clearing House*, *72*(2), 81-88.

Halladay, J., & Neumann, M. (2012). Connecting reading and mathematical strategies. *Reading Teacher*, *65*(7), 471-476. doi:10.1002/TRTR.01070

Jones, V. (2014). Teaching STEM integrative curriculum. *Children's Technology & Engineering*, *18*(3), 37-39.

Jones, V. R. (2016). Unraveling technological literacy! *Children's Technology & Engineering*, *21*(1), 22-24.

Kong, J. E., & Orosco, M. J. (2016). Word-problem-solving strategy for minority students at risk for math difficulties. *Learning Disability Quarterly*, *39*(3), 171-181. doi:10.1177/0731948715607347

Ming, K. (2012). Ten content-area literacy strategies for art, mathematics, music, and physical education. *Clearing House*, *85*(6), 213-220. doi:10.1080/00098655.2012.691568

Ozdemir, A. S. (2009). The effect of reading comprehension abilities primary school students over their problem-solving achievement. *Reading Improvement*, *46*(2), 88-98.

Shanahan, C., & Shanahan, T. (2014). Does disciplinary literacy have a place in elementary school? *Reading Teacher*, *67*(8), 636-639. doi:10.1002/trtr.1257