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Integrating Reading into Math Instruction to Increase Academic Achievement of English Language Learners

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Integrating Reading into Math Instruction to Increase Academic Achievement of English Language Learners

by
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Approval Page

This applied dissertation was submitted by Camelia A. Courtright under the direction of the persons listed below. It was submitted to the Abraham S. Fischler College of Education and approved in partial fulfillment of the requirements for the degree of Doctor of Education at Nova Southeastern University.

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Statement of Original Work

I declare the following:

I have read the Code of Student Conduct and Academic Responsibility as described in the *Student Handbook* of Nova Southeastern University. This applied dissertation represents my original work, except where I have acknowledged the ideas, words, or material of other authors.

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Name

June 11, 2016

Date

Acknowledgments

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Abstract

Integrating Reading into Math Instruction to Increase Academic Achievement of English Language Leaners. Camelia A. Courtright, 2016: Applied Dissertation, Nova Southeastern University, Abraham S. Fischler College of Education. ERIC Descriptors: Second Language Learning, Metacognition, Vocabulary Development, Interdisciplinary Approach, Language Proficiency

The majority of the school population at the research site struggles in reading and mathematics, particularly the English language learner (ELL) students. ELL students typically score lower than non-ELL students and perform at various levels of English language proficiency in reading and math. The purpose of the study was to identify and implement effective research-based strategies during math instruction to support and increase ELL students' academic performance.

This experimental research was composed of a between-subjects approach with a pre- and posttest control group design with a simple random sample selection. The objective was to measure the effectiveness of integrating guided reading instructional strategies in ELL students' third grade math class. Students received instruction inclusively in the form of word problems. The study consisted of an experimental and control group, a total of 36 participants. The period of implementation for the experimental group occurred over a 2-week period, 5 days a week, for 60 minutes each day.

Data analysis consisted of an independent samples *t* test on pre- and posttest scores and a Mann Whitney *U* test on end of semester grade level progress reading scores to detect two groups are significantly different. Analysis of Covariance (ANCOVA) revealed the mean scores for the two groups. The objective was to evaluate the impact of teaching literacy in the content of math to increase ELL students' academic achievement.

Table of Contents

Appendices

Tables

Chapter 1: Introduction

Statement of the Problem

English language learner (ELL) students are among the lowest-scoring groups in national and state assessments (Martiniello, 2008). However, the results of a test score are not a true reflection of their academic achievement (Grant, Gottardo, & Geva, 2011). Students, from non-English speaking backgrounds struggle mastering content or understanding questions due to limited English proficiency. Researchers report that development of vocabulary knowledge is crucial to ELL students' understanding of content. Swanson and Howerton (2007) found that vocabulary acquisition and comprehension skills, components of guided reading, are keys to the academic achievement of non-native speakers of English.

The topic. ELL students are not meeting adequate yearly progress (AYP) in math. Kieffer, Lesaux, Rivera, and Francis (2009) and Wolf and Leon (2009) revealed that ELL students perform poorly on content area exams, such as math, due to their insufficiency in academic vocabulary and English literacy. The quest for this study was to identify and implement effective research-based guided reading strategies to successfully support ELL students during math instruction with an objective to promote literacy and increase student achievement across the discipline.

The research problem. At the research site, the majority of the school population struggles in the areas of reading and math, particularly the ELL students. To compound this inadequate situation, each year, state officials' annual measured objective for schools to make AYP increases by at least 10 points. ELL students typically score lower than non-ELL students and perform at various levels of English language proficiency in reading and math. Therefore, it is imperative to determine the reason for the lack of understanding of a particular concept among ELL students.

Background and justification. Nationwide, only 12% of ELL students scored at or above proficiency in mathematics in fourth grade on the 2009 National Assessment of Educational Progress, compared with 42% of non-ELL students ("Education Week," 2011). Additionally, schools are required to report ELL students' math and English language art scores in the states accountability system, one of the mandates by the No Child Left Behind Act of 2001 (NCLB). With a history of low performance, reporting scores for this subgroup of students greatly impacts schools' accountability.

The administrative staff of the research site reported 28.7% of the schools' population did not meet the criterion-referenced competency test (CRCT) standards for the 2010-11 school year. Among the ELL students, 21.8% did not meet the CRCT standards (Georgia Department of Education, 2011). The CRCT is the statewide assessment in Georgia utilized to assess academic achievement of students in the areas of reading, math, English language arts, science, and social studies (Georgia Department of Education, 2011). The following table shows the overall rating on the CRCT for 2011-2012 in comparison to schools within the district and schools across the state of Georgia.

Table 1

Percent of Students at or Above Proficiency on 2011-2012 CRCT

Subject	Research Site	District	State
English Lang. Arts	79.8	90.2	88.1
Math	66.7	85.5	88.9
Reading	80.5	92.8	90.0
Science	57.9	81.5	79.0
Social Studies	54.4	79.5	74.7

AYP is a mandate by NCLB, which serves as a statewide accountability system to measure the performance and academic progress of schools and districts. Students are categorized according to subgroups of ethnicity, English proficiency, income level, and special education (Cobb, 2004). In order to conform to NCLB, school administrators must ensure the students are proficient in reading and math by the end of the school year (Yell, Katsiyannas, & Shiner, 2006).

In 2012, members of the state Department of Education granted Georgia a waiver from NCLB provisions and replaced the federal AYP system with the College and Career Readiness Performance Index (CCRPI) to gauge schools' academic progress. Analysts for the 2012 school year discovered 18.8% of ELL students did not meet standards in English language arts, 16.9% did not in reading, and 26.5% did not in mathematics (Georgia Department of Education, CCRPI, 2012). In 2013, analysts stated that 22.9% of ELL students did not meet standards in English language arts, with 18.9% in reading and 27.6% in mathematics (Georgia Department of Education, CCRPI, 2013).

As part of the waiver, members of the Georgia Department of Education (2012) classified schools as priority schools, focus schools, and reward schools. Officials of the department used achievement data from all core content areas and graduation rates to determine the classifications. A more detailed evaluation of subgroup performance identified alert schools. Alert schools are schools whose subgroup graduation rate, subgroup performance, and subject area performance on any statewide assessment falls three standard deviations or more below the statewide average (Georgia Department of Education, CCRPI, 2013).

In the areas of reading, English language arts, math, science, and social studies, Table 2 shows the overall rating the research site administrators reported on the Milestones End of Grade Assessment for 2014-2015. Data only apply to students in the third, fourth, and fifth grades. Compared to other schools in the state of Georgia, the average proficiency level was much lower for the research site.

Table 2

Percent Proficiency on 2014-2015 Georgia Milestone

Subject	Research Site	District	State
Eng. Lang. Arts	17.2	48.6	37.3
Math	10.4	44.3	38.6
Reading Lexile	Low 54.5	Low 27.0	Low 35.3
	Medium 34.7	Medium 37.6	Medium 37.6
	High 10.7	High 34.6	High 27.3
Science	8.9	38.6	34.6
Social Studies	7.4	32.6	31.0

CCRPI is a comprehensive school improvement, accountability, and communication platform that enables members of the Department of Education to score schools based on student achievement and the academic progress of all Georgia public school students. The design of the index is to close the achievement gap for specific subgroups and ensure students graduate from high school with both rigorous solvent content and the ability to apply that knowledge (Georgia Department of Education, Georgia CCRPI, 2013). To meet this objective, it is essential for students to improve their performance in reading and math in accordance with Georgia's Common Core State Standards.

Deficiencies in the evidence. ELL students in grades K-12 are learners from diverse educational, cultural, and linguistic backgrounds; English is not their first language (Calderon, Slavin, & Sanchez, 2011). The demographics of America indicate that there are immigrant children from Mexico, Central America, South America, and the Caribbean, in addition to numerous countries around the globe. Other ELL students are refugees from around the world and children of professionals who have come to the United States to work or study. Additionally, a significant number of ELL students are born in the United States and spoke English since the day of their birth, so they are namely, native-born speakers of English; however, they are considered ELL because their home is bilingual (Capps et al., 2005). ELL students enter a classroom at different levels of literacy in their first language. Further research could be used to expand knowledge on how to teach academic content to diverse learners (Janzen, 2009).

Audience. Strategies developed in the study support all teachers' efforts to increase academic achievement in reading and mathematics, to motivate students to develop literacy skills, and to establish a foundation and knowledge of skills necessary for high-stake testing in all academic areas. Curriculum specialists could gain a deeper understanding of the relationship between literacy and academic content. Teachers and administrators can plan for staff development training centered on literacy and learning across the curriculum more precisely and efficiently using research-based findings.

Setting of the Study

The research was conducted at a Title I Focus elementary school in the western part of Georgia. The administrators at the school reported that the population consisted of 1,238 students from low economic households with a transiency rate of 42.5%. ELL comprised 46.2% of the student body, equating to 572 students. The staff further stated that Spanish was the largest language representation at 45.6%. The study involved 36 students in ELL math classes.

Researcher's Role

The researcher's role as an English to speakers of other languages (ESOL) teacher was to conduct and analyze research in ELL students' math class. Additionally, it was the goal of the researcher to integrate reading and math in order to increase the academic achievement of the students. The strategies may have helped educators establish a classroom relationship whereby students felt safe in taking risks and sharing mathematical ideas during collaborative group discussions.

Purpose of the Study

The purpose of this study was to determine how inclusive math teaching (with word problems) and utilizing guided reading instructional strategies affect the academic achievements of ELL students. The relevance for this research was to identify and implement effective research-based guided reading instructional strategies to support ELL students during math instruction in order to increase their academic achievement. Integrating reading and math provided students with foundational experiences that allowed them to develop skills and concepts, build academic vocabulary, and understand that reading has a purpose and a structure, while venturing into the world of mathematics (Huerta & Jackson, 2010).

Definition of Terms

Adequate yearly progress (AYP). This term refers to the assessment of schools' yearly academic progress supported by student performance on state mandated exams (NCLB, 2002).

Alert schools. Alert schools are comprised of three categories: (a) graduation alert in which the graduation rate is below 3 standard deviations from the mean of the state's subgroups' graduation, (b) subgroup alert in which the achievement rate is below 3 standard deviations from the mean of the state's subgroups' meets and exceeds rate, and (c) subject alert in which the subject achievement is below 3 standard deviations from the mean of the state's meets and exceeds rate for each subject. (Georgia Department of Education, Georgia CCRPI, 2013).

College and Career Readiness Performance Index (CCRPI). CCRPI is an accountability system used by state administrators to measure the AYP of schools and school districts on a 100-point scale. Schools receive a score of 0-100 points in the same way students score points on assessments in their classes. Overall scores are comprised of three major areas: (a) achievement (70 possible points), (b) progress (15 possible points), and (c) achievement gap (15 possible points). Schools that have a significant number of economically disadvantaged students, ELL, and students with disabilities also receive up to 10 "challenge points" added to their score. If these students exceed expectations and participate in college and career readiness programs, the schools receive additional points for exceeding the CCRPI targets (Georgia Department of Education, CCRPI, 2013).

English language learners (ELL). Linguistically and culturally diverse students who have a primary language other than English and demonstrate limited English proficiency in listening, speaking, reading, and writing are identified as being ELL (Echevarria, Vogt, & Short, 2004).

Focus school. A focus school is a Title 1 participating high school with a graduation rate less than 60% during a 2-year period or a Title 1 school that has the largest within-school gaps between the highest-achieving subgroup or subgroups and the lowest-achieving subgroup or subgroups, or at the high school level has the largest within-school gaps in graduation rates (Georgia Department of Education, Georgia CCRPI, 2013).

No Child Left Behind Act (NCLB). NCLB is a federal government act requiring each individual state to develop and implement standards holding schools accountable for students' academic progress. Government officials placed special focus on the performance of ELL, students in special education, and poor and minority children (NCLB, 2002).

Performing school. This term refers to a Tier 1 or Tier 11 school under the School Improvement Grants program that uses the funds to implement a school intervention model, a Title I participating high school with a graduation rate less than 60% for 2 years, or a Title 1 school in the state based on the lowest achievement of the "All Students" group on the statewide assessments. Schools in this category show a lack of progress on these assessments for a period of 3 years in the "All Students" group (Georgia Department of Education, Georgia CCRPI, 2013).

Reward schools. Schools commended by the state for high academic achievement or high levels of student progress over a number of years are noted as being reward schools. Criteria for highest performing include 5% of Title 1 schools, highest performance for the "All Students" group (n size $\geq$ 30) over 3 years, high schools with the highest graduation rates, schools must have made AYP in 2011, and schools may not be identified as a priority school, focus school, or alert school. Highest progress contains 10 % of the Title 1 schools, highest progress in performance for the "All Students" group (n size $\geq$ 30) over 3 years, and may not have been identified as a priority school, focus school, or alert school (Georgia Department of Education, Georgia CCRPI, 2013).

Chapter 2: Literature Review

Introduction

The number of ELL students is increasing in public schools at a more rapid rate than the overall school-age population across the nation (Halladay & Moses, 2013). The fastest growing group is low-income Hispanics (Rapporteur, 2011). Researchers reported that approximately 5.3 million ELL students were enrolled in preK-12 schools in 2008-2009. This statistic accounts for 10.6% of public school students, of which 75% are Spanish speakers (National Center for Education Statistics, 2009; National Clearinghouse for English Language Instruction Education Progress, 2011). The national enrollment of ELL students is nearly six times the growth rate in the mainstream student population, including special education students with disabilities (Flannery, 2009).

Immigrant children in schools and local school districts respectively are increasing due to settlement in residential areas in large cities (Rangvid, 2010). Another contributing factor is the response of native children's parents transferring them to private schools with a fewer concentration of immigrant children (Rangvid, 2010). Strickland and Alvermann (2004) concluded there was an achievement gap in all subject areas between ELL students and the overall student population, especially the academic language needed to read content-area textbooks. Therefore, it is imperative to find effective means to help this diverse population achieve the same level of fluency as their native English-speaking peers; it is imperative to close the achievement gap (Calderon et al., 2011).

Immigrant students in urban schools perform lower academically than their native counterparts for several reasons: barriers inside and outside of schools, lack of instructional coherence, socioeconomic background, and language skills (Jensen & Rasmussen, 2011; Waldfogel, 2012). Waldfogel (2012) further asserted that limited economic, educational, and social resources influenced reading skills. Such influence lead to literacy gaps in children prior to entering school. Because parents are unable to participate actively in reading to their children, the children's language acquisition, early reading performance, social development, and success in later school years are diminished (Waldfogel, 2012). Key influences for ELL students are the language spoken at home, parental proficiency, and whether the learners participated in preschool. Differences in parenting and socioeconomic status are possible explanations for the gap in school readiness in literacy and other academic outcomes (Rouse, Brooks-Gunn, & McLanahan, 2005). Members of the American Psychological Association, Presidential Task Force on Educational Disparities (2012) concurred that minority students consistently demonstrate higher incidences of low academic performance than their Caucasian and Asian counterparts.

Academic Trend

In an issue brief, theorists of the National Center for Education Statistics (2012) analyzed tracking of an early childhood longitudinal study regarding the kindergarten class of 1998-1999 educational experiences. This class was a nationally representative sample of first-time kindergarteners. Twelve percent of the students represented language-minority students. Within this group, 5% were English proficient when they entered kindergarten, 2% were proficient by the spring of kindergarten, 5% of the students did not demonstrate proficiency by the end of kindergarten, and 88% were students from homes whose primary language was English. Extending previous kindergarten investigation, analysts examined achievement in reading, mathematics, and science for language minorities in the kindergarten cohort with a particular focus on students' scores on standardized assessments at the end of grade 8. The researchers considered characteristics of students' race and ethnicity, poverty status, and mother's education, and categorized the students according to language background and English language proficiency (National Center for Education Statistics, 2012).

The authors of the kindergarten study also reported that students who were proficient in English when they started kindergarten, regardless of the language spoken at home, scored higher on the eighth grade reading, math, and science assessments than language minority students who became proficient in English after starting kindergarten. Language minority refers to students that speak a language at home other than English (National Center for Education Statistics, 2012). English proficient non-Hispanic language minority students and non-poor language minority students, when entering or completing kindergarten, scored higher in reading, math, and science than their Hispanic peers. Non-Hispanic and non-poor students performed better on the reading assessment than ELL Hispanic and poor students not proficient by spring of kindergarten. The authors further indicated that regardless of home language or English proficiency, students who had mothers of higher education scored higher and students with mothers of least education generally produced lower scores (National Center for Education Statistics, 2012).

Among the students who spoke English in American classrooms, approximately 30% completed reading assignments without understanding what they read, while the percentage for ELL students not comprehending text was much higher (Biancarosa &

Snow, 2006; Lesaux, Kieffer, Faller & Kelley, 2010). This statistic indicates it may be beneficial to integrate reading instructional strategies across content areas to support struggling students in content-area reading. In order for students to improve their mathematics skills, it is essential for students to demonstrate improvement in reading (Jitendra & Star, 2011).

ELL students, whose primary language is not English, may take 5 to 9 years to develop academic language (Cummins, 2000). They have limited English proficiency and understand, speak, read, and write little or no English. Some of these students enter the school system academically delayed in their native language, with fewer life experiences and less exposure to print resources. Due to a wide range of language proficiencies in both English and their native language, ELL students face a unique challenge in learning content in a second language (Echevarria et al., 2004). These students have educationally diverse backgrounds, expectations of school, socioeconomic status, and personal experiences. Additionally, they came to the United States at varying ages with exceptional language, cognitive, and cultural needs (Unrau, 2008).

As Echevarria et al. (2004) and Unrau (2008) explained, at one end of the spectrum, some immigrant students enter American schools with strong academic backgrounds and some students have above equivalent grade levels in math and science. These students tend to be literate in their native language and require only English language development as they become proficient in acquiring conversational or academic English. The knowledge in their native language then begins to transfer to the English language. These students have the ability to transfer knowledge, skills, and capacities learned in their primary language to learning and understanding in content area discourse taught in a second language (Echevarria et al., 2004; Unrau, 2008). Cobb and Kallus (2011) claimed the use of the native language is best because critical thinking skills and cognitive structuring are conditioned by linguistic and cultural knowledge and experiences obtained at home and brought to school.

At the other end of the spectrum, some immigrant students have very limited formal schooling, possibly due to war in their native countries or the remote location of their homes. These students are not literate in their native language and cannot read or write. Due to significant gaps in their educational backgrounds and lack of knowledge in specific subject areas, they need time to become accustomed to school routines and expectations as they simultaneously learn English and keep abreast in their content area classrooms (Echevarria et al., 2004; Unrau, 2008). Jensen and Rasmussen (2011) maintained that students in schools with high immigrant concentrations score lower on reading and math test scores. Family background is posited to play a major role in the outcomes of all disadvantage children; the background is the main reason for test scores being lower for these children than for their native English counterparts (Jensen & Rasmussen, 2011).

Of students born in the United States who speak a language other than English at home, some are literate in their home language (such as Japanese or Spanish) and only need English added to their knowledge base in school. However, there are those students who are not literate and have not mastered English or the home language. Such illiteracy impacts the competence of students in instructional language (Echevarria et al., 2004; Unrau, 2008). Balatova (2007) articulated that many ELL students are not adequately proficient English speakers in spite of receiving their education exclusively in the United

States. Mastering instructional and academic language are great barriers for immigrant students. Cobb and Kallus (2011) supported the premise that the extent to which a child is literate in the home language determines the extent to which he or she will have a positive experience in a second language. Cobb and Kallus as well as Cubukcu (2008) reported as to the effectiveness of implementing meta-cognitive strategies to increase student's vocabulary, reading comprehension, and academic achievement.

Critical Thinkers

Metacognitive strategies enable learners to plan what steps they will take to accomplish a specific learning task, thus, learners are aware of their thought processes while thinking (Bursuck & Damer, 2011). Cognition is referred to in terms of knowing, thinking, reasoning, and judging (Cobb & Kallus, 2011). Thinking and reading are closely intertwined as thinking includes recall, retention, problem solving, and imagery, which Cobb and Kallus (2011) believed to be the most important aspect of cognition. Thinking impacts reading because of its influence on comprehension (Cobb & Kallus, 2011). However, the act of recalling past knowledge and experiences could also directly relate to comprehension (Busuck & Damer, 2011). In this global society, the conclusion is that reading instruction cannot be separated from the critical, higher-level cognitive processes necessary for survival (Cobb & Kallus, 2011).

When students use metacognitive strategies to check their understanding, they evaluate and monitor their thinking before, during, and after reading (Ku & Ho, 2010). Utilizing metacognitive strategies in this manner is a key to comprehension and critical thinking development (Ku & Ho, 2010). Predicting, self-questioning, clarifying, and summarizing are strategies that actively engage proficient readers (Boulware-Gooden, Carreker, Thornhill, & Joshi, 2007). Thinking while reading causes students to summarize, question, clarify, and predict what comes next in a text (Unrau, 2008). Metacognitive strategies promote higher-level thinking, build upon background knowledge, and serve as a tool to help students develop scientific vocabulary (Boulware-Gooden etal., 2007; Bursuck & Damer, 2011).

For learners to comprehend text adequately, it is vital to go beyond awareness of the print, phonological and phonemic awareness, phonics, fluency, and asking literal type questions when having students summarize reading (Unrau, 2008). In addition to decoding skills, students need skills to monitor their understanding; therefore, reflection and assessments should utilize narrative and expository text to check comprehension (Bursuck & Damer, 2011). McCormick and Zutell (2011) reported findings of a case study in a reading tutor clinic of a third grader, Freddy (not his real name). Freddy displayed excellent performance in phonic and structural analysis, read books above grade level, and satisfactorily answered literal questions. For this reason, the tutor felt that he was mistakenly placed in the program and agreed with his reading teacher that he was a proficient reader. However, the tutor, following her supervisor's recommendations, decided to investigate a little deeper and assess Freddy's higher-level understanding (McCormick & Zutell, 2011).

Over the next sessions, Freddy was asked to complete four tasks (McCormick & Zutell, 2011). The first task was to read silently and complete the comprehension portion of a standardized test. The second task was to read a story orally for a Reading Miscue Inventory in which he retold and responded to probing questions to assess higher-order comprehension. The third task involved reading from authentic narrative texts after which he answered questions about details, but also made inferences and drew conclusions. The final task was to read two well-written informational articles (McCormick & Zutell, 2011).

The conclusion was that Freddy produced the same errors that cause problems for poor readers (McCormick & Zutell, 2011). His score on the comprehension questions of standardized tests was lower than his oral word recognition abilities. As he retold and orally read a story for the Reading Miscue Inventory, his views of the story plot were irrelevant to major points in the story. Responses to teacher probe higher-order comprehension questions included some literal recall of information. Questions without direct answers in the text indicated that he was confused. Freddy misinterpreted and lacked understanding of the inference questions as well as the strategies necessary to help him determine the correct response. His performance after reading narrative texts was similar to the Reading Miscue Inventory. Results from reading informational articles indicated that Freddy relied heavily on textual information. He could not integrate textual cues with background knowledge to draw appropriate conclusions and failed to link causes to events; he gave literal responses without drawing inferences. McCormick and Zutell estimated that 70% of questions asked by teachers are literal and little to no consideration is given regarding asking higher-level thinking questions.

Poor readers are at a greater disadvantage in learning and need special reading instruction that facilitates comprehensive strategies that reflect higher-level reasoning and integration of text information with prior knowledge to construct meaning (McCormick & Zutell, 2011). From the view of a constructivist, it is essential for ELL students to have appropriate interactions in English to develop cognitive processes in order to understand linguistic input and obtain contextual information (Rybold, 2010). Comprehension is a critical element in reading for both native English speakers and ELL students to actively process text (Bursuck & Damer, 2011; Cromley, Snyder-Hogan, & Luciw-Dubas, 2010; Kim, Schatschneider, & Foorman, 2010). Intervention strategies that support and develop comprehension skills and learning activities before, during, and after reading a text help ELL students conquer their reading deficiencies (McIntye, Hulan, & Layne, 2011; Ruddell, 2009). Additionally, these strategies help learners remember what they have previously read.

Vasquez (2004), a teacher and researcher, argued that a critical literacy curriculum should be incorporated into the daily lives of children to help them understand the social and political issues around them. Vasquez advocated developing classroom discussions confronting issues in the immediate environment of students in order to increase comprehension skills. Literature is a vehicle whereby students learn not only how to read words on the page, but also learn more and make connections about their world. Associations and connections of print to reality lead to increased reading, highly developed literacy skills, and eventually high test scores (Vasquez, 2004).

Members of the National Research Council asserted effective teaching connects to students' cultural and social backgrounds (Rapporteur, 2011). Such connections are particularly true and important with ELL students. Providing research instructional strategies give students the ability to communicate successfully and appropriately in social and academic environments. Activating students' prior or existing knowledge elicits cultural and social experiences when internalizing new information (Bandura, 1968; Vygotsky, 1978).

Guided Reading

Guided reading is a teaching approach that requires students to gather and organize information around important concepts with the objective to help students learn to interpret information accurately and construct meaning using problem solving strategies to decipher unfamiliar words (Iaquinta, 2006; Vacca & Vacca, 2008). Fountas and Pinnell (1996), Iaquinta (2006), and Vacca and Vacca (2008) posited that guided reading helps students learn how to gain meaning from text before, during, and after, while in small group settings with peers on the same reading level. Within the small group setting, students actively engage in talking about what they read, ask questions, and build their expectations of the text in a social environment through the process of reading, writing, speaking, and listening; such engagement with the teacher and peers accelerates learning for ELL students (Avalos, Plasencia, Chavez, & Rascon, 2007). Fountas and Pinnell supported the concept of providing opportunities for students to receive explicit instruction in the learning skills and comprehension strategies needed to facilitate reading proficiency. Additionally, this framework provides teachers a systematic means to evaluate and monitor students' individual needs and strengths.

Reading is a transaction between a reader and the text (Cobb & Kallus, 2011). Rosenblatt (1938) proposed that there are two types of readers: efferent and aesthetic. An efferent reader concentrates on ideas and concepts and takes knowledge from the text, while an aesthetic reader focuses his or her attention on feelings, emotions, and images in a "lived-through" experience rather than from solely gathering information. This transactional view of reading considers the nature of readers and what they bring to the text along with the different lenses through which they view the text (Rosenblatt, 1938).

Cobb and Kallus (2011) declared that meaning happens during the transaction based on or linked to the experiences of the reader, including physical, personal, social, and cultural factors. The objective is to guide students to understand what they read and to respond to it in a personal and critical manner (Biggam & Itterly, 2009). The guided reading approach allows students to become aware of their own thinking and demonstrate self-regulated behaviors and this heightened awareness leads to a deeper understanding of what the students read and allows them to develop necessary communication skills (Iaquinta, 2006; McIntyre, Hulan, & Layne, 2011).

Before reading, students need to form predictions, activating background and prior knowledge that will enable them to make connections to the text and to real-world experiences (Vacca & Vacca, 2008). In guided reading groups, readers interpret the meaning of text by sharing their personal experiences and current mindset (Lynch-Brown, Tomlinson, & Short, 2011). Building and activating background knowledge in a culturally diverse classroom motivates and builds students' interests. Stimulating background knowledge prior to reading promotes comprehension and gives a sense of purpose (Cobb & Kallus, 2011). Cobb and Kallus (2011) believed academic instruction was more effective when integrated with student's specific culture and relevant prior knowledge. Reading strategies mostly centering on questioning strategies build student's self-questioning abilities. When students clarify the main idea and supporting details, they foster an awareness of what to think about while reading (Cobb & Kallus, 2011). Lastly, summarizing allows readers to organize, review, and capture the essence of the reading, a key skill in the process of reading comprehension (Boulware-Gooden et al., 2007). In guided reading, comprehension has several components: knowing the vocabulary and being able to follow the text's structure, visualizing, making predictions, summarizing text meaning, getting the main ideas, making inferences, interpreting, arguing with the text, and monitoring one's comprehension of the reading (Temple, Ogle, Crawford, & Freppon, 2011).

Strategies (e.g., graphic organizers; see Appendix A) support students in reading and comprehending text by identifying important information, which serves as a tool to activate prior knowledge and link to new concepts (Salend, 2008). Incorporating graphic organizers during instruction enable students to label aspects of the text, use language from the texts, and visually illustrate the connections among characters, events, and ideas (Herrell & Jordan, 2006). Organizers, such as T-charts, KWL (knows, want to learn, learned) charts, and Word maps, also help students build on their prior knowledge, generate questions, expand vocabulary, and make connections among words and concepts (Pearse & Walton, 2011).

In 2006, the National Literacy Panel (NLP) reported that ELL students significantly benefitted from explicit teaching in phonemic awareness, phonics, vocabulary, comprehension, and spelling when learning to read. Embedding words in meaningful context, coupled with opportunities for repetition and use, contributes to increased learning for ELL students. To increase reading comprehension of ELL students, the NLP made four recommendations: (a) use cooperative learning to complete learning goals, (b) encourage students to read in English, (c) make provisions for students to master criterion prior to moving to new learning, and (d) engage students in instructional conversations in which ideas are explored rather than answers to test questions. As ELL students reach third grade, language limitations begin to impede their progress as vocabulary acquisition and academic content knowledge are increasingly difficult (NLP, 2006). The NLP believes it is critical to provide instructional strategies for ELL students to develop their content knowledge and oral English (with specific emphasis on vocabulary) from the first time they enter the school system. Lastly, the NLP stated it was essential that teachers modify instruction by speaking slowly, giving clear vocabulary and directions, using pictures and objects, moving slowly to illustrate content, and providing wait time.

Vocabulary

To ensure the success of ELL students, it is important for them to develop good reading comprehension skills, balance vocabulary, determine meaning of unfamiliar words using context clues, and engage in higher-level thinking (Huerta & Jackson, 2010; Swanson & Howerton, 2007). Vocabulary knowledge increases and enhances students' understanding of what they read during class discussions and supports the ability to connect to current knowledge. Students are then able to learn unfamiliar words and answer open-ended questions with confidence (Sobolak, 2011). For example, without support from class discussions or peer dialogue, a French reader would likely link the word "le pain" with the concept of bread and yet an English reader would connect the phrase with the concept of bodily or mental suffering (Cobb & Kallus, 2011). Investigators reported that vocabulary deficiencies are strongly linked to the academic failure of disadvantaged students in grades 3 through 12. (Greenwood, 2010; Herrell & Jordan, 2006). Therefore, it is imperative to provide instruction to increase vocabulary in conversational and academic language (Graves, 2006).

Vocabulary is a key mechanism and an important metacognitive effect in reading comprehension (Lesaux et al., 2010). Students who know more words have more abstract language at their disposal and such knowledge allows them to be strategic readers. Additionally, students with a developed understanding of language, including strategies to manipulate language, will learn words more successfully. Lesaux et al. (2010) believed because struggling learners read less than their typically achieving peers, they encounter fewer words, suffer from less developed metacognitive strategies for word learning, and are less equipped to use surrounding words and grammatical clues to glean the meaning of unfamiliar words. Since the ratio between known and unknown words is too high, those struggling to learn cannot rely on known words. To bridge this gap in vocabulary knowledge, Lesaux et al. advocated for effective instructional practices to promote vocabulary development as it relates to comprehending and analyzing texts through the incorporation of systematic and explicit vocabulary instruction into the curriculum.

Lesaux et al. (2010) shared four instructional principles in their quasi-experimental, mixed method research study that were claimed to be successful in seven urban middle schools. The student population in each school represented a large percentage of students of color ranging from 43.5 % to 96.4%. Students from low-income backgrounds ranged from 24.4% to 100%. Centering on the primary objective, the investigators evaluated the implementation and effectiveness of an academic vocabulary program to promote the reading comprehension skills of learners in low-performing urban middle school classrooms with high numbers of language minority learners. To meet the second goal, they investigated the programs' implementation from the perspective of the teachers (Lesaux et al., 2010).

In terms of findings, Lesaux et al. (2010) indicated several results. First, vocabulary instruction promotes a deep understanding of a relatively small number of words, their elements, and semantically and morphologically related words in rich contexts. Also, word selection centers on general purpose academic words as opposed to the low-frequency and unimportant words teachers sometimes select for instruction. The third principle for effective vocabulary instruction was to balance direct teaching with cultivating word-learning strategies to equip students with cognitive tools to learn more independently. Several features of the program included lessons and activities that promoted student knowledge: frequent encounters with words across context, the use of definitional and contextual information to learn and determine word meanings, a balance of direct instruction in word meanings and cognitive strategies for word learning, and the development of lessons to promote active processing of target word meanings by integrating the skills of listening, speaking, reading, and writing. Finally, the researchers incorporated the use of collaborative learning activities for the benefits of peer interaction for language and metacognitive development (Lesaux et al., 2010).

Lesaux et al. (2010) posited that text-based academic vocabulary teaching was a promising approach for improving early adolescents' vocabulary and comprehension over a period of time. The authors concluded that starting with key academic words to teach deep vocabulary knowledge is an approach that has not been sufficiently tested with older students from diverse backgrounds, but appears to be the correct technique for a large number of struggling readers. The majority of the teachers in the study cited the benefits of beginning with high-quality text to design their vocabulary instruction relative to students' lives (Lesaux et al., 2010).

Relative to ease of implementation, Lesaux et al. (2010) reported the materials were the primary strength of the program. Additionally, the teachers in the study differentiated the levels of support for the students. The authors observed that struggling readers, language minority learners, and native English speakers had generally good foundational skills for word reading, but did not understand deeply what they read. Academic vocabulary was a particular source of difficulty for students who struggled with comprehension (Lesaux et al., 2010).

Building academic vocabulary acquisition has a significant meaning on ELL students' language and reading success (Wasik, 2006). Across all domains of academic literacy, a well-developed vocabulary closely correlates with reading comprehension and reading achievement (Beck, Perfetti, & McKeown, 1982; Stahl & Nagy, 2006). Tran (2006) and Witherall (2007) contended the best way for ELL students to acquire vocabulary is through combining words with extensive reading and interactive instruction in meaningful ways.

Integrating Technology

One form of interactive instruction is the integration of computer technologies to increase students' success in reading and math. Students who use computer assisted technology have a greater chance of closing the achievement gap by meeting NCLB requirements, and earning higher scores in reading and math (Keengwe & Hussein, 2014). Hawley, Fletcher, and Piele (1986) observed that third and fifth grade students who used technology had higher math scores than their peers who did not use computers. Computer-assisted instruction is noted to improve mathematics achievement of middle school students in regular education and special education (Traynor, 2003).

Interactive whiteboards (IWB), such as smart board technology, support a more cross-curricular approach to literacy and strongly benefit students due to interactive hands-on learning. IWB are beneficial in assisting all types of leaners, and learners show better engagement and enjoyment during lessons (Bahadur, & Oogarah, 2013; Lacina, 2009; Shenton & Pagett, 2007; Yanez & Coyle, 2011). Students who receive instruction via interactive multimedia demonstrate a greater improvement in reading skills and comprehension than leaners taught through the traditional approach (Keengwe & Hussein, 2014). Additionally, IWB meet the needs of visual learners by engaging them and providing effective interactive whole-class lessons (Wall, Higgins, & Smith, 2005). For ELL students, computer assisted programs enhance learning, encourage teamwork, foster motivation, offer practice time using simulated interactive thinking, and increase authentic resources that students can study (Feengwe & Hussein, 2014).

Bruce, McPherson, Sabeti, and Flynn (2011) conducted a study identifying when and how the IWB functions as a productive tool that impacts student learning in mathematics. The authors reported interconnected findings. First, the IWB supported the creation of a collaborative learning environment where students viewed multiple solutions and strategies on a large screen. The findings revealed that for visual learners the IWB helped to clarify understanding and support construction of mathematics ideas. Secondly, while working at the IWB, students were comfortable in taking risks in their mathematical thinking and persisted in solving and exploring multiple solutions to problems due to the efficiency of the IWB (Bruce et al., 2011). Furthermore, Bruce et al. (2011) and Shenton and Pagett (2007) found that the IWB was a key pedagogical consideration in mathematics as IWBs could have a prevailing positive impact on student learning and student communication of mathematics reasoning.

The faculty and staff at Richardson Primary School in Canberra, Australia received one of the Federal Government's National Awards for Quality Schooling for Outstanding School Improvement and credited the achievement to using interactive whiteboards (Kent, 2006). Kent (2006) described how the school took advantage of this technology with particular reference to mathematics at the whole-school level. To support their instruction, the teachers moved easily between using virtual graphics calculators, spreadsheet programs, learning objects, and mathematics-based software applications with an IWB. Various forms of learning objects and flipchart software permitted class interaction; such interaction allowed the teachers to promote higher-order thinking where students gained a deep understanding of concepts, lead substantive discussions, and posed in-depth questions (Kent, 2006).

In one of the junior primary mathematics classroom, Kent (2006) observed an activity utilizing the IWB, wherein the students explored perceptional number skills. The activity had the students dragging numbers onto the body of a caterpillar that was shaped by circles labeled with numbers in numerical order. The program had varying starting positions to promote quality and the students needed to count forward, backwards, skip count, and then provided the opportunity to discuss with peers their mathematical reasoning in completing the task. Another illustration involved taking digital photos of classroom objects and displaying them on the IWB to identify symmetry. In addition to exploring concepts and presenting knowledge as problematic with IWBs, the teachers connected learning to the world outside the classroom, engaged students in learning related to their everyday life, and ensured curriculum focus on real world situations (Kent, 2006). At the touch of a pen, the IWBs could transform a schools' entire educational program.

Many early childhood teachers incorporate IWB in their mathematics instruction by displaying manipulative instructional content, such as math word problems, pictures, graphics, or an excerpt from a story (Linder, 2012). Linder (2012) shared how IWBs could help to develop children's conceptual understanding and improve the quality of learning in mathematics. In a first grade classroom during the course of a few weeks, students investigated money. As an extension, at the top of the IWB was a picture of a quarter labeled 25 cents. Pictures of pennies, nickels, and dimes appeared below the quarter. The students were able to duplicate and move the coins around the IWB (Linder, 2012). Collaboratively, the children made 25 cents in a variety of ways using the coins. Similarly, integrating IWBs in an elementary school science curriculum was observed to increase collaboration and communication among students (Murcia, 2010). In a study of kindergartners utilizing an IWB during math lessons on fractions, a more complex understanding of fractions was gained by the children who used the technology than those who did not (Goodwin, 2008).

Yanez and Coyle (2011) investigated learning with an IWB from the perspective of children in an English language immersion class in a British primary school in Spain. The school consisted of Spanish children and children whose primary language was English. Twelve children, comprised of eight non-native speakers and four native speakers at 8 years of age, participated in focus group interviews. The 12 students were divided into three groups according to their native language. Two groups were Spanish speakers and one group was English speakers. The groups compared each other's comments and answers to the interviewer's questions in a small group setting. Only two native speaking students had previous experience using the IWB (Yanez & Coyle, 2011).

After using the IWB for less than a year daily in all areas of the curriculum, the Spanish speakers answered all 11 interview questions and the group of English speakers answered eight (Yanez & Coyle, 2011). The questions centered on how the teacher and students used the IWB in the classroom. Additionally, their opinions of the IWB concerning technical issues were offered. Three of the questions related to the Spanish groups regarding their second language competence and how the IWB impacted their learning of the curricular content (Yanez & Coyle, 2011).

Yanez and Coyle (2011) concluded from the interviews that IWBs have a positive impact on motivation and is a powerful instrument to facilitate language comprehension; it makes lessons interesting, fun, and enjoyable. The children's interaction and views of the IWBs showed an appreciation of the wide range of activities as well as the visual and audio properties this technology offers. The interviewers believed the multimodality of IWBs supported individual learning styles as it integrates sound, video, text, and animation. Specifically, the children liked the idea of having math questions at the bottom of the screen and receiving instructions via a loud speaker; they expressed how the images remained in their minds and helped them remember and understand the lessons. Additionally, learning in English helped their comprehension significantly. However, Yanez and Coyle (2011) acknowledged the risk of non-native speakers becoming overly dependent on visual imagery to support comprehension. The authors also related that achieving a balance between physical response with the IWB and teacher input in immersion settings was difficult.

Regarding technological problems during lessons, Yanez and Coyle (2011) indicated that all the children mentioned problematic aspects, such as internet connectivity, capability of moving the elements on the board, recalibrating, and frequent incidents of sunlight shining on the surface of the IWB. These problems seemed to be frustrating and irritating for the children and teachers. Shenton and Pagett (2007) encouraged teachers to be technically and pedagogically confident in the use of IWBs so as to be able to deal with technological problems during lessons. Teachers are recommended to make interactive use of a tool like the IWB that impacts teaching and learning of literacy, and significantly raises the level of student engagement to increase academic achievement (Shenton & Pagett, 2007).

Vasquez, Sneider, and Comer (2013) illustrated an interdisciplinary approach to educating students promoting science, technology, engineering, and mathematics education. This learning approach supports schools and school district administrators' ability to identify and apply concepts and content from science, technology, engineering, and mathematics into real world, rigorous and relevant learning experiences rather than having educators teach the subjects separately via traditional methods. The researchers explained that students might use mathematical knowledge to measure distances, calculate speed, and plot data on a graph then they might interpret the graph using scientific concepts to describe motion in terms of distance, time, and speed. Hence, students learn that an object increases its speed as it rolls downhill. To accomplish this task, students become familiar with lab technology and vocabulary, such as stopwatch, marble, ramp, and measuring tape. Lastly, learners would be able to apply principles of engineering to create a roller coaster (Vasquez et al., 2013).

Within an interdisciplinary learning environment, students can work collaboratively and participate in class discourse (Vasquez et al., 2013). The environment can also lead to students learning to apply computational thinking and focus on real world applications of problem solving as well as demonstrate their understanding in a variety of different ways (Vasquez et al., 2013). Students in elementary education who are exposed to an integrated content approach perform better in mathematics and science than students who are not exposed to an integrated approach (Rapporteur, 2011; Vasquez et al., 2013).

Common Core and Students With Learning Difficulties

In the areas of English language arts and mathematics, the adoption of the Common Core State Standards (CCSS) conveys rigorous expectations across grade levels for all students (National Center for Education Statistics, 2013). To be successful in college and careers, the developers of the standards identified the knowledge and skills students need to improve access to rigorous academic content. For students with learning difficulties, learning within this framework requires multiple means of instruction and opportunities to demonstrate knowledge of the general education curricular knowledge (Kiuhara & Witzel, 2014).

Analysts of the National Center for Education Statistics (2013) reported students in the United States perform at or below basic levels in math relative to computational reasoning and scores at the lowest level on the Program for International Student Assessment 2013. Literacy in mathematics is beyond manipulating symbols and rules, but encompasses the ability for students to elaborate and reconstruct problems, evaluate proposed solutions, modify approaches, apply current and prior knowledge in novel contexts, reflect on processes, and explain their thinking (Ojose, 2011; Steen, 2007). To meet the challenge of common core, it is important to provide research-supported instructional approaches that engage learners so they are able to make conceptual connections and to facilitate contextual learning of mathematical content and math reasoning (CCSS, 2016, "Standards for Mathematical Practice"; Molina, 2012).

Molina (2012) examined three major attributes of conceptual understanding in mathematics: (a) deep and thorough definitions of key terms and concepts, (b) connections among key topics that deepen understanding, and (c) interpretation and translation of the language and symbols of mathematics. Providing simple, deep definitions of words, such as round and slope, builds students' understanding of fundamental mathematic concepts. Such concepts interrelate and build on each other as with multiplication and division. Finally, Molina explained, in order to understand definitions and make connections among linguistic concepts, it is essential for students to interpret the meanings and contexts of the language and symbols. For example, in order to solve problems using the commutative property of addition, it is necessary for students to interpret and translate the symbols and abstract mathematical terms.

Students who struggle with math also exhibit difficulty in reading, and have a limited range of vocabulary knowledge; such limitations create a challenging situation for learners to apply the necessary mathematical reasoning to solve word problems (Jitendra & Star, 2011). With the implementation of common core for mathematics, it is crucial for math teachers to develop lessons that engage students in dynamic dialogues, discussions, debates, and thought about how they conceive the mathematical task. Students must be able to read with full comprehension, to question, visualize, make connections, and have time to think about their concepts in mathematics texts and story problems (Jitendra &

Star, 2011; Pearse & Walton, 2011). The CCSS (2016, "Standards for Mathematical Practice") explicitly defines text complexity and places equal attention on students' reading skills and the type of texts that students read; this focus requires ELL students to become proficient in reading and comprehending complex literary and informational texts for different genres and grade levels (Abadiano, Turner, & Valerie, 2014; Halladay & Moses, 2013).

Halladay and Moses (2013) reported the CCSS for English learners presents challenges and opportunities for educators to support students' language and literacy development. Recommendations included schools providing instructional supports to make grade-level course work comprehensible, modified assessments allowing students to demonstrate their content knowledge, extended time to complete tasks and assessments, instructional practices facilitating listening and speaking classroom interactions that develop concepts and academic language in the disciplines, opportunities for interaction with proficient English speakers, and opportunities for ELL students to build on their strengths, prior experiences, and background knowledge (CCSS, 2016, "Standards for Mathematical Practice").

English learners constitute a demographic representing a wide range of cultural and linguistic backgrounds with varying levels of English proficiency. Individual and environmental factors impact second language acquisition, exposure, and experience in the English language and educational background (World-Class Instructional Design and Assessment, 2014). Wolf, Wang, Huang, and Blood (2014) stated the most challenging feat is to implement the CCSS as ELL students develop English skills and access academic content simultaneously.

Relative to language demands contained in the CCSS for English language arts and implications for the instruction of ELL students, Wolf et al. (2014) emphasized the importance of giving students opportunities to engage in tasks that involve higher-order academic language functions. Secondly, members of CCSS expect teachers and ELL students to spend time and effort building foundational skills, while engaging in higher-order tasks (Wolf et al., 2014). Acquiring these essential skills requires moving ELL instruction toward emphasis of simultaneous development of phonetic, lexical, and syntactic knowledge while engaging in grade-level language-based tasks as defined in the CCSS (Wolf et al., 2014).

Mathematics and Non-Native Speakers of English

In addition to vocabulary development to maximize ELL students' math achievement, there are scores of rules in the English language, including multiple exceptions, a large amount of idiomatic expressions, numerous homonyms, words with multiple meanings, and spellings different from pronunciation (Bursuck & Damer, 2011; Molina 2012). Conversational and academic mathematic word usage, particularly abstract mathematical concepts, can be confusing for students. As language is the vehicle to convey mathematical knowledge, comprehension depends on academic and instructional communication. To face the challenge of addressing language-based problems, integration of literacy instruction into all content areas so mathematics and language are cohesively intertwined is a necessary step (Molina, 2012).

Pourdavood, Carignan, King, Webb, and Glover (2005) conducted a study at an urban primary school in Eastern Cape Province to explore mathematical discourse and teaching methods in Grade 6 and Grade 7. The particular focus of the study was on language as a medium for teaching and learning. The school's student population changed from predominately Caucasian English/Afrikaans-speaking learners prior to 1994 to predominately African Xhosa-speaking learners by 2004. The mandate for learners to speak solely English was a challenge for educators as most of them could not speak or understand Xhosa (Pourdavood et al., 2005).

Members of the education system in South Africa urged problem-based learning, critical thinking, and written and verbal reasoning relative to mathematical discourse (Pourdawood et al., 2005). The teachers resorted to a math curriculum where they focused on mastery of computational skills rather than a conceptual understanding of mathematical procedures. The reason for this shift in focus was due to the challenge of finding teaching strategies to help all students understand math computation and academic language. The authors of the study suggested that working with peers in Xhosa might contribute to facilitating learners' skills and developing and understanding of mathematical concepts. They further thought that peer interaction would illustrate how language plays a pivotal role in classroom discourse. Mandating verbal discourse in the English language limits students' success in demonstrating mathematical reasoning (Pourdawood et al., 2005).

Martiniello (2008) reported on the linguistic complexity of math word problems that exhibit differential item functioning for ELL students and non-ELL students on the fourth grade Massachusetts Comprehensive Assessment System (MCAS) math test. The differential item functioning procedure focuses on discrepancies in difficulty of an item on a test construct for members of two groups with equivalent proficiency. The investigator discovered that the more the linguistic complexity increases, such as complex vocabulary and sentence structure, the more difficulty ELL students have in comprehending text as compared to non-ELL students of equivalent math proficiency. Items with the greatest complexity contain grammatical structures essential for understanding the task, and mostly low-frequency, nonmathematical vocabulary terms central to comprehending the item requires the ability to use context clues (Martiniello, 2008).

ELL students' difficulty with solving word problems is beyond mathematical procedures or calculation challenges; they need reading and linguistic support (Orosco, Swanson, O'Connor, & Lussier, 2012). From a high-poverty school in Southern California, English as-a-second language elementary classroom, six native Spanish speakers at risk for math failure participated in a study; all of the students demonstrated low math and reading scores (Orosco et al., 2012).

In the study by Orosco et al. (2012), the effectiveness of a math comprehension strategy, Dynamic Strategic Math (DSM), was used for word problem solving for Latino ELL students. When DSM was used, the students' reading and language comprehension levels increased. Operationally, DSM referred to systematically modifying vocabulary to each student's understanding level of the word problems. Then providing strategy instruction with probes to assess students' ability to solve problems. Opportunities for students to learn and practice the academic language of mathematics by teaching them how to use their English skills and contextual experiences to solve world problems was central (Orosco et al., 2012).

As a result of implementing DSM, the students' reading comprehension and vocabulary domains improved through the application of positively affecting students' understanding of word problems, instructing students to be aware of their comprehension through probes, teaching students to understand word problem structure as they read, guiding the students to find the question in the word problem, finding important vocabulary and numbers, setting up the problem to solve, and finally, checking the answer for accuracy (Orosco et al., 2012). ELL students need multiple strategies and approaches to further develop their mathematical thinking, therefore, it is important for teachers to first focus on instruction that enhances math comprehension strategies, giving the students the opportunities to develop necessary language skills to solve word problems in English (Orosco et. al., 2012).

Abdullah, Halim, and Zakaria (2014) examined the impact of strategic thinking and a visual representation approach in increasing students' achievement, conceptual knowledge, metacognitive awareness, awareness of problem solving strategies, and attitudes toward mathematical word problem solving among primary school students in Malaysia. In a classroom-oriented setting, students simultaneously mastered a repertoire of thinking skills with particular emphasize on gaining metacognitive knowledge and subjective elements, while developing habits and tendencies to give meaning to and interpret problems through visual representations. The strategic thinking and visual representation approach positively impacted students' achievement, conceptual knowledge, metacognitive awareness, consciousness of problem-solving strategies, and attitudes toward mathematical word problem solving (Abdullah et al., 2014).

Using a quasi-experimental pre and posttest nonequivalent control group design, the pre and posttests were utilized to measure the impact of the five dependent variables during a period of 10 weeks (Abdullah et al., 2014). Participants consisted of 96 students in the experimental group and 97 in the control group. The mean achievement test scores showed 36.93 for the experimental group, 37.56 for the control group. In terms of conceptual knowledge, 17.35 and 18.03 were the means for the experimental and control group respectively. Metacognitive awareness means were 1.77 for the experimental group and 1.80 for the control group, awareness of problem solving means were 2.16 for the experimental group and 2.17 for the control group, and for the variable of attitude towards mathematical problem solving, 1.47 for the experimental group and 1.45 for the control group were the mean values (Abdullah et al., 2014).

Descriptive findings indicated the mean score and standard deviation for all the variables were similar (Abdullah et al., 2014). Furthermore, the results of the study yielded no differences in the mean scores of the five variables between the experimental and control groups for the pretest analysis. The findings indicated that at the beginning of the study, all the variables were equal. The posttest analysis indicated the visual representation and strategic thinking approach significantly impacted achievement test scores, conceptual knowledge, metacognitive awareness, awareness of problem solving strategies, and attitudes toward problem solving among students. Abdullah et al. (2014) concluded that mathematical problem solving requires critical thinking skills to strengthen students' conceptual understanding, procedural fluency, strategic competence, productive disposition, and adaptive reasoning abilities.

With the increasing population of ELL students, Abdullah et al. (2014) suggested ongoing research to determine the effectiveness of metacognitive strategies empowering ELL students to gain control over their thinking, providing them with skills and vocabulary to talk about their learning, improving test taking skills, and increasing students' ability to summarize or reflect on what they read or heard. ELL students of various proficiencies are in classrooms across the nation and reliable research instructional strategies will aid in closing the language gap (Rapporteur, 2011; Swanson & Howerton, 2007). Further research would help these students develop techniques to increase academic competence. All teachers must understand the factors that affect ELL students' language, reading, content development, and minimal background knowledge in mastering complex course content (Calderon et al., 2011). Research in creating a responsive standards-based instructional program regarding integrating literacy strategies across the disciplines will help ELL students become better readers, writers, and learners (Vacca & Vacca, 2008).

Vocabulary development is a key indicator of the verbal ability to communicate successfully and appropriately in social and academic environments (Calderon et al., 2011). Greenwood (2010) concluded that a deficiency in readers' vocabulary impacts their linguistic and cognitive comprehension across the curriculum. The development of math vocabulary and comprehension strategies contributes to the generation of math discourse expressed in writing and speaking (Unrau, 2008). In order to create a responsive, standards-based instructional program that integrates literacy strategies to help students become better readers, writers, and learners, it is time to integrate literacy instruction across content (Molina, 2012). Math literacy involves educators teaching vocabulary when reading the math text, facilitating reading with comprehension strategies, and making an effort to understand learner thinking by encouraging metacognition during reading and problem solving (Cobb & Kallus, 2011; Fuentes, 1998; Unrau, 2008).

In mathematics education, technology influences what is taught, promotes student learning, and is essential in teaching mathematics (National Council of Teachers of Mathematics, 2000; Vasquez et al., 2013). The more exposure there is to technology in the learning environment, the more students generate a positive attitude in taking control of their learning and attacking more complex solutions to problems (Hopson, Simms, & Knezck, 2002; Vasquez et al., 2013). Continued exploration of integrating technology with ELL students builds upon existing research and enhances and reinforces visual interactive learning for students in all subject areas (Liu, Moore, Graham, & Lee, 2002; Vasquez et al., 2013).

ELL students process the discipline of mathematics differently; presenting math in the form of sentences requires comprehending the language of the text prior to solving the mathematical problem. Therefore, it is crucial to identify and implement educational programs and research-based practices that promote disciplinary language across the content for ELL students (Hill & Miller, 2013). Providing rich and integrated learning experiences will support ELL students in establishing foundations of knowledge and skills necessary for higher grades and high-stakes testing in all academic areas (Fuentes, 1998; Huerta & Jackson, 2010). The researcher of this dissertation sought ways to provide students of all proficiency levels comprehension skills to demonstrate cognitive behaviors in the process of improving mathematics skills and decreasing mathematics anxiety. Additionally, the writer implemented strategies designed to address the achievement gap of ELL students and affect the AYP rate for schools.

Research Questions

1. How do benchmark mathematics scores for students who receive guided

reading instructions in mathematics compare to students who do not receive guided reading instruction in mathematics as measured by pre- and posttest scores?

2. How do benchmark reading scores for students who receive guided reading instruction in mathematics compare to students who do not receive guided reading instruction in mathematics as measured by end of semester grade level progress reading scores?

Chapter 3: Methodology

Introduction

The purpose of this quantitative research was to identify and implement effective research-based strategies during math instruction in an effort to increase ELL students' academic performance. The majority of the students at the research site struggled in reading and mathematics, particularly the ELL students. This subgroup of students typically scored lower than non-ELL students and performed at various levels of English language proficiency in reading and math. In this study, literacy was integrated in math content.

Participants

The researcher targeted students at a Title 1 Focus elementary school in the western part of Georgia. Students were in grades 2 through 5. The school served a population of 1,238 students who were economically disadvantaged. Of all the languages spoken, Spanish was the predominant language among the ELL students. English speakers represented 572 students (45.6%) of the school population.

The sample for this study included 36 ELL students in third grade; the administrative staff at the school randomly selected the participants. The objective was to ensure each individual had an equal opportunity to be included in the sample. Participants were composed of 18 individuals each for the experimental group and control group. The researcher facilitated math instruction inclusively using word problems in a third grade math classroom.

The researcher employed guiding reading that focused on vocabulary and comprehension strategies which served as a tool to help students acquire a higher level of understanding in mathematics problem solving. Supported by the literature review, investigators expounded upon 30 years of research that could be utilized to validate explicit literacy instruction in helping students to learn and engage in higher level thinking. A language approach during math instruction provided opportunities for ELL students to clarify mathematical concepts and receive immediate feedback. This direct advice helped learners address any issues that impeded their success (Molina, 2012). The researcher taught English literacy with this instrument to measure acquisition of learning and students' abilities, monitor comprehension, and facilitate explicit instruction (Fountas & Pinnell, 1966; McIntyre et al., 2011). Comprised of scientifically based methods, guided reading is a reliable technique of leading both proficient and struggling readers through the reading process (Iaquinta, 2006; Peregoy & Owen, 2005; Unrau, 2008). The researcher integrated guiding reading and math in efforts to influence ELL students' performances and to increase their reading and mathematics achievements.

Instruments

The pre- and posttest (see Appendix B) benchmarks used in this study were developed and designed by McGraw-Hill Education as a math assessment that compliments the student's My Math text. Benchmark items matched skills targeted in instruction and were aligned with and measured CCSS achievements (McGraw-Hill Education, 2013). Benchmark assessments offered rapid access to student data. The data revealed trends and patterns in student performance.

The second instrument used, the Development Reading Assessment (DRA2), was developed and designed by Pearson Education to document students' growth as readers over time. The assessment was field-tested in collaboration with classroom teachers and administrators across the United States and parts of Canada (Pearson Education Incorporated, 2009). The multiple field-tests and feedback by educators created an effective, reliable, informative, and practical reading assessment appropriate at each reading level (Pearson Education Incorporated, 2009).

Procedures

Design. This experimental design involved utilization of a between-subjects approach with a pre- and posttest control group design to determine causation between variables. Students were randomly assigned to groups: 18 students selected for the control group and 18 for the experimental group. The intervention occurred over a 2-week period for 60 minutes a day, 5 days a week. ELL students in the control group participated only in the pre- and post-benchmark testing, but ELL students in the experimental group participated in the intervention in addition to the pre- and post-benchmark testing. To control or minimize instrumentation threats, the same pre- and posttests were used during the study.

Data collection procedures. After receiving consent from parents and students, the researcher administered a pre-test to the experimental and control groups within the school setting. The experimental group engaged with common core multiplication word problems generated from McGraw-Hill's third grade math text for the duration of the study. Students represented and solved multiplication word problems within 100 various items that involved equal groups, arrays, and measurement quantities. For example, students used drawings and equations with a symbol for an unknown number to represent the problem. Each lesson started with a 5-minute introduction of the word problem, followed by direct instruction for 10 minutes, small and whole group discussion for 20 minutes, independent practice and peer interaction for 20 minutes, and a closure activity for the final 5 minutes.

Each day, students read each problem aloud prior to working on it to ensure understanding and pronunciation of any unfamiliar words. As they worked in collaborative groups, the researcher monitored their comprehension of language specifically used in the word problems, evaluated and monitored their individual needs and strengths, and provided immediate feedback and clarification. During independent practice and peer interaction, learners used academic vocabulary orally and in writing. As the lessons proceeded, the problems increased in complexity.

At the end of the intervention, all students in the control and experimental groups completed the post test. Data from both groups were compared to determine whether the guided reading intervention affected students' mathematics achievement. Due to the district's time-frame for targeted content and unexpected delays in implementation, 2-weeks was insufficient to generate effective reading data utilizing pre- and posttest for data analysis. End of the semester progress scores were used to determine significant differences in reading achievement by way of a Mann Whitney *U* test.

Week 1 Objectives

Students focused on understanding the relationship between multiplication and addition using equal groups and arrays, made a table to solve problems, and used multiplication to find the total number of combinations made when given two groups of objects.

Day 1. Students took the word-problem pretest consisting of 10 questions. The experimental group completed the test in the classroom. Immediately afterwards, the control group was administered the test in the Media Center. Prior to testing, students received a brief explanation pertaining to the purpose and objective for the 2 week sessions. Testing time was approximately 45 minutes for completion.

Day 2. The students (as a class) started with an introduction of a KWL graphic organizer. The graphic organizer facilitated transfer of information in the word problem, visualization, comprehension, summarization, and a means to decode or break apart the problem into smaller pieces. The segmented organizer consisted of the word problem, a space for students to provide pertinent information retrieved from the problem, a calculation section that included an illustration, and finally a section where students summarized their thought processes. Participants expressed what specific information was known or given in the word problem. They acknowledged the question, provided an illustration, and proceeded to calculate using concepts learned from modeling and previous learning experiences. Lastly, students explained how they arrived at their answer; they provided steps and strategies they utilized to solve the problem.

The researcher read, modeled, and asked questions for 10 minutes about the word problem for discussion. Here is the word problem: Shawn helped his mom bake cookies. He served 8 cookies on each plate. There are 2 plates. How many cookies did he serve? The phrase “Shawn served 8 cookies on each plate” and the question, were written in the appropriate section on the organizer as students articulated how many plates and how many cookies were on each plate. The number 8 appeared under each plate in the calculation section. The students counted each cookie aloud, totaling 16. Two number sentences indicated 2 x 8 = 16, signifying two equal groups of 8. The equation 8 + 8 = 16 for repeated addition was used to show the relationship between addition and multiplication and to build on previous knowledge.

Lastly, the researcher modeled the summary section aloud as the explanation was written on the graphic organizer. The researcher modeled aloud the following text: First, I drew two plates. Then put 8 cookies in each plate. I know 2 equal groups of 8 = 16 and repeated addition 8 + 8 = 16. So Shawn served 16 cookies. The product after multiplying the factors 2 x 8 equals 16.

Throughout the research, vocabulary words specific to each lesson (such as product, multiply, factors, repeated addition, and equal groups) were introduced, used, and discussed in context during direct instruction. The researcher encouraged students to use academic vocabulary words in small and whole group dialogues, peer-related activities, and particularly in their summaries.

After modeling, in three groups of six for 20 minutes, students solved the following problem collectively and shared their results with the entire class. The problem: Alicia read in a brochure that the Atlanta zoo has 10 tanks in the snake exhibit. There are 2 snakes in each tank. How many total snakes does the zoo have?

Finally, for approximately 20 minutes, students independently solved the following word problem and shared their answer with a partner: How many buttons does Maria have altogether if she has 6 bags of buttons and each bag has 10 buttons? As with the small group, the researcher monitored discussion and provided immediate feedback as needed. During the last 5 minutes of class, the students placed the graphic organizers containing problems for the day in their math folders for a point of reference. Any questions and concerns were also addressed during this time of closure for the day.

Day 3. The third day started with distribution of folders and a 5-minute review of vocabulary words introduced in Day Two. Additionally, there was a review in which the researcher reiterated that the multiplication symbol refers to “groups of.” Following the discussion, modeling occurred for 10 minutes using a different word problem coupled with verbalizing the terms “array,” “columns,” “rows,” and “commutative property” to explore multiplication. The following problem was used as an example: Alondra has 6 sheets of stickers. Each sheet has 7 stickers on it. Writing a multiplication and addition sentence, how many stickers does she have in all? The researcher used two arrays for this demonstration with specific inference on vocabulary during guided practice. One array depicted 6 rows and 7 columns, and the other showed 7 rows and 6 columns. The arrays served as a visual guide to explain how changing the order of numbers, characteristic to the commutative property, does not change the product. The arrays also served as a means for students to gain a deeper understanding of the relationship of repeated addition and multiplication.

For 20 minutes, using the graphic organizers containing the problem for the small group, students gathered into their groups for collaborative work. Afterwards, they shared their results with the whole class. The students solved the following problem: Raphael currently has 20 can goods for the school food drive. He collected 4 more cans from each of his 6 neighbors. How many can goods does Raphael have for the food drive?

Students independently practiced the subsequent problem and shared results with a partner: Laura’s necklace is 8 inches long. Joan’s necklace is 3 times as long as Laura’s necklace. How many inches long is Joan’s necklace? The researcher monitored and provided immediate feedback during peer discussions. In the last 5 minutes of class, students placed their organizers in their folders, and asked questions and raised concerns for the day.

Day 4. The first 5 minutes of class began with the distribution of folders, followed by the reading and introduction of the modeled word problem. Guided practice focused on utilizing a table to solve problems. (The words guided practice and modeling are used interchangeably in this research). The researcher modeled the following problem: Daniel can choose one type of bread (wheat or white) and one type of meat (chicken or turkey) for a sandwich. How many different sandwiches can Daniel make? The students observed a table that consisted of two rows and two columns. The researcher labeled the outside of each row with a different type of bread and the outside of each column with a different type of meat. Students answered specific questions about the problem, such as what type of bread and meat could a person choose. Discussion generated around the words "one type of bread and one type of meat," indicating that Daniel had two choices. Students understood the facts, what was needed, and how to organize the information in a table of columns and rows to solve the problem. In this case, the details reflected the breads, meats, and the two choices of different sandwiches Daniel could make. Inside the table, each cell had different combinations of bread and meat, totaling four different possibilities.

Then, in groups for 20 minutes, students collaboratively solved the problem that appeared on their graphic organizers and shared their results with whole group. The problem was as follows: Micah has 3 shirts to wear to school. They are red, blue, and green. He also has 3 pairs of pants to choose from. They are tan, black, and brown. How many different combinations can he wear?

As on previous days, students worked independently and shared their results with a partner for 20 minutes. The students independently practiced the following problem: Jane's new bike can have hand brakes or foot brakes. The bike can be silver, blue, black, or purple. How many possible bikes are there? Finally, for the last 5 minutes, students gathered their organizers and placed them in their math folders. Any questions and concerns were also addressed during this time of closure for the day.

Day 5. The objective for day five centered upon students using multiplication to find the total number of combinations made when given two groups of objects. They used multiplication in real-life situations involving combinations. For the first 5 minutes, the researcher distributed the folders and reviewed vocabulary related to combinations. Afterwards, direct instruction and modeling, took place for 10 minutes.

Using a table to organize the information, the researcher utilized counters and connection cubes to model making combinations with one item from the counters and one item from the second group. The counters were red and yellow. The connection cubes were blue, green, and purple. On top of a sheet of paper, the counters laid in a row across and the cubes were placed in a column on the left side of the paper. Horizontal and vertical lines were drawn to form a table with each object in a cell. The demonstration included showing students how to record each combination by taking one item from each group and matching them together. In this case, the combinations were blue and red, blue and yellow, green and red, green and yellow, purple and red, and lastly, purple and yellow; six combinations were made in all. The researcher further explained that when using two objects, you could also use the factors 2 x 3 = 6 to find the total number of combinations.

The students proceeded to solve a problem collaboratively in small groups and shared their thought processes and calculation of the assigned problem with the whole class. This activity lasted 20 minutes. The word problem stated that a sports team could only wear orange and black shorts with jersey colors of green, red, and yellow. The question asked students to find jersey and short combinations for the team.

The independent practice and peer interaction problem, which took 20 minutes to complete, read as follows: Regina's teacher asked her to list all of the 2 digit numbers that can be made with 3 or 4 as the tens digit and 1, 6, 7, 8, or 9 as the ones digit. How many combinations are possible? Write a multiplication sentence. For the last 5 minutes, students placed their organizers in their folders and asked for clarification of any misconceptions they had.

Week 2 Objectives

Students used equation and multiplication properties to solve problems and understand the relationship between multiplication and division.

Day 1. The first 5 minutes began with distribution of folders and an introduction of the vocabulary words (such as equation, expression, operation, parentheses, and the associative property of multiplication). The researcher defined the academic vocabulary words used throughout the explanation of the guided practice problem. The goal was to ensure that the students understood the difference between the terms equation and expression. Specifically, an expression does not have an equal sign whereas an equation always has an equal sign.

By the end of guided instruction, students had a clear understanding of the difference and that an expression is a number or a combination of numbers and operations. The examples used were as follows: 8 – 5 and 6 + 3 - 2. The students remembered (from previous lessons) that the term operation referred to addition, subtraction, multiplication, and division. The researcher explained to students when there are no parentheses, they must first multiply or divide from left to right. Then, they must add or subtract from left to right.

The researcher molded the following problem: Chris and Katie each received 4 smiley stickers a week for 3 weeks. How many smiley stickers did they earn altogether? Students participated in the discussion and acknowledged what was known and reiterated the question presented in the word problem. The equation for this problem, (2 x 4) x 3 = 2 x (4 x 3), was written on the white board as the students stated the number of people, number of stickers, and the number of weeks taken to obtain the stickers. Then, the researcher expressed to students that the parenthesis can be used to group two factors when multiplying 3 numbers.

The researcher explained that the first step in solving a problem using the associative property is to perform the operation inside the parentheses. Students observed and understood how changing the order of the numbers did not change the product. The equation on both sides of the equal sign generates a product of 24.

For 20 minutes after guided instruction, the students proceeded to solve the following collaborative small group problem: Molly earns $10 each week for babysitting. She spends $3 of that each week and saves the rest. How much money does she save after 8 weeks? Write an equation and solve. Students shared with the whole group their equation and strategies used to find the product. As previous days, the researcher observed students' conversation and encouraged learners to use academic vocabulary during their dialogues. Immediate feedback was provided as needed.

After the collaborative group work, independent problem solving and peer interaction occurred for 20 minutes. The students solved the following problem: It rained 6 inches each month for the last 6 months. How much will it need to rain this month for the total rainfall to be 43 inches? Lastly, students placed organizers in their folders and asked for clarification of any misconceptions they had. Then they commented and explained why it was important to perform the operations in an equation in a certain order.

Day 2. The first 5 minutes began with distribution of folders and reviewing vocabulary words presented in the previous lesson. Students continued to solve two-step word problems. The researcher proceeded to introduce the guided practice problem: Anthony bought three boxes of breakfast bars. Each box contained 6 bars. If he gave away five bars, how many does he have left? The researcher drew three boxes on the board and placed the number six in each box. Students readily knew to multiply the equation 3 x 6 – 5 = 13 and were able to articulate it. They were then asked to explain what words in the problem indicated to multiply and subtract.

The students received their organizer with the small group collaborative problem for the day: Carla made four chocolate cakes. Each cake used three eggs. She used another two eggs to make a pan of brownies. How many eggs did she use altogether? Students wrote an equation, solved the problem, and shared their results with whole group.

Students solved their independent problem and shared their answer with a peer for 20 minutes. The problem read: Maria bought 3 loaves of bread that have 20 slices each. Then she used 2 slices to make a sandwich. How many slices are left? Learners were to write an equation and solve. Lastly, they clarified any misconceptions and placed the graphic organizers in their folders.

Day 3. The first 5 minutes began with distribution of folders and an introduction of the vocabulary words dividend, divisor, inverse operations, and quotient. The researcher reviewed and discussed these vocabulary words during guided instruction. The problem stated: Pasco set each picnic table with 6 dinner plates. He used 24 plates to set the table. How many tables did he set? The students answered questions pertaining to the dividend, divisor, quotient, and the meaning of the term inverse. The researcher demonstrated how 24 divided by 6 is the inverse (or opposite) of the multiplication fact 4 x 6. The students connected this demonstration to addition being the opposite of subtraction.

The learners proceeded to solve their collaborative small group problem and shared their answers with whole group. The small group problem was as follows: Sarah has 32 crackers. She eats 2 and throws away 2 that she dropped. Sarah puts the rest of the crackers into 4 equal groups. How many crackers are in each group? The researcher observed the students and provided immediate feedback as needed.

Afterwards, the learners independently solved a problem and shared their answers with a peer. The independent problem read as follows: On Monday, Yasmin's math teacher gave the class 45 problems to finish by Friday. She will do the same number of problems each day. How many problems will Yasmin do on Friday? The researcher observed and encouraged students to include academic vocabulary during their dialogue. During this time, the researcher provided immediate feedback. At the end of the day, students prepared for dismissal and placed their graphic organizers in their folders.

Day 4. The day started with distribution of folders. Students continued to use related multiplication facts to find quotients. For 10 minutes the researcher engaged in modeling and demonstrating the following guided practice problem: Fifteen scouts equally shared 3 tents. How many scouts are in each tent? As in previous lessons, after establishing what is known, and reiterating the question, the researcher drew three triangles on the white board to represent 3 tents. After placing one tally mark at a time into each tent while simultaneously counting up to 15, the researcher commented that each tent shared 5 scouts. Fifteen divided by 3 is the inverse of 5 x 3.

Students worked and solved the following small group collaborative problem and shared their results with the entire class: It costs $40 for 4 friends to ride go-carts for 1 hour. How much does it cost 1 person to ride for 2 hours? The researcher observed and provided immediate feedback as needed.

Lastly, students independently solved the following problem and shared their results with a peer: A bus has 32 pieces of luggage. If each person brought 4 pieces of luggage, how many people are on the trip? During discussion time, the researcher provided immediate feedback and observed students' usage of academic vocabulary. Then learners placed the graphic organizers in their folders for the day followed by the researcher answering questions and clarifying any misconceptions.

Day 5. Students took the posttest, which consisted of the same 10 questions administered in the pre- test. The experimental group completed the test in the classroom. Immediately afterwards, the control group took the test in the Media Center. The test lasted approximately 45 to 50 minutes for each group.

Data analysis. In order to answer Research Question 1, students' benchmark mathematics scores were measured using an independent samples *t* test on pre- and posttest scores. In order to answer Research Question 2, a Mann Whitney *U* test was used to analyze data on the end of semester grade level reading progress scores. The researcher used an Analysis of Covariance (ANCOVA) to examine the mean scores for the two groups.

Limitations

Several limitations were generated from the experimental research.

- The length of time for the intervention was not sufficient to assess the clear impact of guiding reading strategies on math and reading achievement.
- The administrative staff of the school only provided a list of the randomly selected participants and the method by which the participants were selected was not indicated.
- Random selection only partly addressed the threat of selecting native English speaking students reaching proficiency level.
- Another threat to internal validity was mortality. One of the students in the control group was absent on the day of the posttest, which impacted conclusions that the researcher drew from the scores.
- In terms of external validity, the experiment did not involve all individuals in the school population relative to ethnic origin.
- The study does not reflect the entire ELL population of the district.
- Results of the experiment conducted during the first semester of the school year may be different if the study had been done during the second semester.

Chapter 4: Results

Introduction

This quantitative experimental research involved measurement of the effectiveness of integrating guided reading instructional strategies in the content of math to increase third-grade ELL students' reading and mathematics discourse. The ultimate goal was to develop vocabulary acquisition and reading comprehension skills in efforts to promote literacy and augment student achievement across the discipline. The researcher utilized a between subjects' approach with a pre and post control group design. Randomly selected by the school's administrative staff, 36 third grade ELL students participated in the study. The method used for random selection was not indicated on the list provided for the randomly selected participants.

Eighteen individuals comprised the experimental group and 18 individuals for the control group. Remediation occurred over 2-week period for 60 minutes a day, 5 days a week. The experimental group was in attendance throughout the research study. To balance or minimize instrumentation threats, the same math pre- and posttest were administered before and after the intervention. ELL students in the control group participated only in the pre- and post-benchmark testing, while the students in the experimental group experienced the intervention in addition to the benchmark testing. One of the students in the control group was absent on the day of the posttest; a mortality that impacted drawing conclusions from scores.

An independent sample *t* test was conducted to analyze statistical significance on math achievement to answer research question one. ANCOVA was utilized to examine the mean scores for the two groups. A Mann Whitney *U* test was implemented to analyze the data on the end of semester grade level progress reading scores to detect whether the two groups were significantly different in order to answer research question two.

Data Analysis

Research Question 1. How do benchmark mathematics scores for students who receive guided reading instructions in mathematics compare to students who do not receive guided reading instruction in mathematics as measured by pre- and posttest scores? The null hypothesis indicated that the benchmark mathematics scores for students who receive guided reading instructions in mathematics (i.e., the experimental group) will not differ from the benchmark mathematics scores for students who do not receive guided reading instruction in mathematics (i.e., the control group). The alternate hypothesis was that the benchmark mathematics scores for students who receive guided reading instructions in mathematics (i.e., the experimental group) will be higher than the benchmark mathematics scores for students who do not receive guided reading instruction in mathematics (i.e., the control group). In order to answer Research Question 1, an independent samples *t* test was conducted using group (control vs. experimental) as the independent variable and changes in the math scores (i.e., math posttest scores minus math pretest scores) as the dependent variable. Results of the independent samples *t* test revealed that although the experimental group ($M = 4.44$, $SD = 38.23$) performed better than the control group ($M = 0.00$, $SD = 26.83$), the results were not significant, $t(32) = -.39$, $p = .35$. Consequently, there was a failure to reject the null hypothesis.

In further examining the control and experimental groups, an independent samples *t* test revealed the experimental group ($M = 54.44$, $SD = 25.72$) performed significantly higher on the pretest than the control group ($M = 37.22$, $SD = 20.24$; $t(34) =$

-2.23, p = .03). Consequently, ANCOVA was conducted to control for the math pretest scores. Results of the ANCOVA revealed the experimental group had a significantly greater change in math scores than the control group when controlling for pretest scores, $F(1, 31) = 5.91$, $p = .01$, partial $\eta^2 = .16$. Consequently, the null hypothesis was rejected when controlling for pretest scores.

Research Question 2. How do benchmark reading scores for students who receive guided reading instruction in mathematics compare to students who do not receive guided reading instruction in mathematics as measured by end of semester grade level progress reading scores? The null hypothesis indicated that the benchmark reading scores for students who receive guided reading instruction in mathematics will not differ from the benchmark reading scores for students who do not receive guided reading instruction in mathematics. The alternate hypothesis was that the benchmark reading scores for students who receive guided reading instruction in mathematics will be higher than the benchmark reading scores for students who do not receive guided reading instruction in mathematics. In order to answer Research Question 2, a Mann Whitney *U* test was conducted using group as the independent variable and the end of semester grade level progress scores as the dependent variable. Results of the Mann Whitney *U* test revealed that the mean rank scores for the control group (*M* rank = 21.92, n = 18) were significantly higher than the mean rank scores for the experimental group (*M* rank = 15.08, n = 18), $U = 100.50$, $p = .04$). Consequently, the researcher failed to reject the null hypothesis since the control group outperformed the experimental group, which was not the direction predicted by the researcher.

Chapter 5: Discussion

Overview of Dissertation

The purpose of this experimental study was to integrate reading into math instruction to increase ELL students' academic performance. The participants consisted of 36 randomly selected third graders with various leaning needs and language proficiencies. Students were assigned to two groups: 18 students for the experimental group and 18 for the control group. The study occurred over a 2-week period and included a pre- and posttest design. ELL students in the control group participated only in the pre- and post-benchmark testing, while the students in the experimental group experienced the intervention as well as the testing.

The objective was to measure the effectiveness of integrating guided reading instructional strategies in ELL students' math class that was taught inclusively using word problems. To increase students' reading comprehension and vocabulary acquisition, strategies included question and answer session, decoding with guidance of a graphic organizer, small groups, teacher-student and peer dialogue, modeling, activating prior knowledge, critical thinking, visualization using drawings and diagrams, and summarization.

The researcher found that as the students applied before, during, and after reading strategies, they were able to ascertain the main idea and identify the relevant details and numbers essential to answering the question in the problems. Respectively, students' drawings and the graphic organizers helped them to visualize the context of the problem, break it apart, and extract appropriate information leading to a solution. Dialogues and peer interaction extended their thinking and knowledge, and provided the opportunity to encompass experiences and perspectives of others. As the students asked questions to better understand and internalize the meaning of the mathematical text, they became self-directed learners. Integrating reading in math instruction contributed to the participants understanding how to read in mathematical contexts and apply reading strategies for solving word problems.

Interpretation of Findings

Research question one was concentrated on comparing the benchmark mathematics scores of students who received guided reading instructions in mathematics (i.e., the experimental group) to students who did not receive guided reading instructions (i.e., the control group) in mathematics. An independent samples *t* test showed that the experimental group scored higher than the control group when subtracting math pretest scores from math posttest scores. This experimental group of participants demonstrated a mean of 4.44, and the control group a mean of 0.00, a difference of 4.44 points between the two groups. However, the results were not significantly different as the *p* value was greater than .05. The *t*-test analysis revealed $t = -39$, resulting in a *p* value of .35.

Looking deeper into this discrepancy, an independent samples *t* test revealed the experimental group performed significantly higher on the pretest. The mean pretest score of the control group was 37.22, whereas the mean pretest score of the experimental group was 54.44. The difference in scores were 17.22 points, indicating that the experimental group was more knowledgeable in math than the control group. Results of the ANCOVA supports this view, as evidenced in a *p* value of .01.

The second research question was focused on the benchmark reading scores of the students (experimental group) who received guided reading instructions in mathematics in comparison to the control group of students who did not receive guided reading instructions in mathematics. A Mann Whitney *U* test statistic revealed the control group scored 6.89 points higher than the experimental group when using the end of semester grade level progress scores. The experimental group score was 15.08 and the control group score was 21.92. The results indicated support of the conclusion that the control group was comprised of more advanced readers than the experimental group. The *U* test statistic indicated $U = 100.50$, resulting in a p value of .04.

Implications of Findings

By exploring the need to integrate literacy in the content of math for ELL students, teachers can identify and implement strategic strategies to increase students' academic achievement simultaneously in reading and mathematics. Teaching students how to ask and answer questions about word problems using academic language is a necessary skill that learners can apply to increase high-stake testing outcomes in all content areas (Marzban & Jalili, 2014). Question and answer sessions increased students' level of critical thinking in a risk-free environment. The ELL participants who received the intervention actively engaged in self-questioning and clarification that promoted higher-level thinking. Learners became comfortable and welcomed the challenge to problem solve.

The summarization component of the graphic organizer supported teachers' aspirations to increase ELL students reading comprehension and writing abilities, which are major and vital skills for native speakers of English (Azarkia, Aliasin, & Khosravi, 2015; Marzban & Jalili, 2014). In a nation where ELL students are enrolling in public schools at an increasing rate (Halladay & Mosses, 2013), this research could be utilized to provide administrators and staff with approaches that can be emphasized in professional development regarding efforts to increase students' academic performance.

With only 2 weeks of research, the comparative results of the math pretest revealed a higher mean score for the experimental group, even though the control group were more advanced readers. This study is supported by other literature with respect to the issue that merely being a good reader does not constitute comprehension of text. Based on the results, students are in need of instructional approaches that engage their thinking to facilitate an understanding of word problems. The researcher gained a deeper insight of the importance of implementing reading strategies in mathematic discourse to increase ELL students' literacy development and academic performance. Incorporating literacy in content has shown positive findings that are beneficial in all subject areas and help close the achievement gap for this subgroup of students.

Limitations

This experimental research had four limitations to be considered with regard to future studies. First, the length of time for the intervention was too short. The researcher experienced significant delays in processing at the university and district level for approval to begin the study. The targeted standard for the quarter was scheduled for a duration of 9 weeks. The researcher was only able to captivate the last 2 weeks of this period. A longer period of time would have likely generated a more accurate assessment of reading strategies on math and reading achievement. The belief of this researcher is that two weeks were not sufficient to utilize reading pre- and posttest data to measure the impact of the intervention on reading scores for the current study. This resulted in the researcher using the end of semester grade level progress reading scores for data analysis.

Second, the random selection of participants posed a limitation. The administrators at the research site did not disclose the method used for sample selection. Additionally, the small number of participants did not reflect the ELL population of the school district. Targeting only ELL students narrowed the generalization of the outcomes with students of different races, ethnicity, and culture.

Third, the school has a high transient student rate. One of the participants in the control group was not present on the day of the posttest. This mortality may have affected the outcome of the statistical data.

Fourth, the time frame of the study impacted results. Conducting the experiment during the second semester may have resulted in different findings than those gathered during the first semester.

Recommendations

The researcher recommends the following for further investigation of the study:

- The length of time for the intervention should be longer to assess a clearer impact of guiding reading strategies on math and reading achievement for struggling readers.
- A larger sample of participants should be selected across grade levels of elementary mathematics classes to ensure valid and reliable information.
- The intervention should be conducted in other settings and demographics with a different socioeconomic environment.
- Careful attention should be paid to methods used for random selection in hopes to avoid having one group higher in math and the other higher in reading at the onset of the study.

- Instead of using the end of semester grade level progress scores for determining the impact of literacy integration in mathematics on learners' reading, pre- and posttest reading assessments should be administered.

In conclusion, it is this researchers' belief that more research should be explored on integrating guided reading strategies in the content of math to increase academic performance for ELL students as well as the global population. Results of the study emphasized a positive effect of using guiding reading instructional strategies to increase ELL students' academic achievement in the content of mathematics discourse. If literacy is included in math curriculum consistently, students will make astonishing progress (Bursuck & Damer, 2011). Relative to the impact of guided reading strategies increasing students' benchmark reading scores, further research could involve exploration and confirmation of the results to determine if this intervention meets ELL students' needs or helps to promote student academic achievement. Review of the literature in this dissertation indicated that mathematics and language are cohesively intertwined to positively impact ELL learners' reading and math skills (Molina, 2012).

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Appendix A

Graphic Organizer

Word Problem Graphic Organizer

<table>
<tr><td colspan="3">Word Problem:</td></tr>
<tr><td>What is known?</td><td>What is the question?</td><td>What is learned (calculation)?</td></tr>
<tr><td colspan="3">Summary</td></tr>
</table>

Appendix B

Pre- and Posttest

Pre- and Posttest

Operations and Algebraic Thinking

1. Tyler has 13 plastic farm animals. Each month he collects 4 more. How many farms animals will Tyler have after 5 months?

   A. 37 farm animals
   B. 33 farm animals
   C. 39 farm animals
   D. 20 farm animals

2. There are 35 campers equally sharing 5 tents. How many campers are in each tent? Draw an array to prove your answer.

   E. 9 campers
   F. 7 campers
   G. 30 campers
   H. 40 campers

3. Conrad hiked 36 miles in 4 days. He hiked the same number of miles each day. How many miles did Conrad hike each day?

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

4. Olivia has 16 animal pictures in her scrapbook. There are 4 animal pictures on each page. How many pages of animal pictures are in Olivia's scrapbook?

   E. 4 pages
   F. 12 pages
   G. 16 pages
   H. 20 pages

5. Dore earned $16 feeding cats last month. He walked dogs 6 days for $8 each day. How much did Dore earn last month feeding cats and walking dogs? Use the equation to solve the problem. The letter x stands for the unknown.

   $16 + (8 \times 6) = x$

   A. $64
   B. $54
   C. $48
   D. $30

6. Chandra un-wrapped 9 boxes of water glasses. Each box holds 6 glasses. How many water glasses are there altogether?

   E. 15 water glasses
   F. 36 water glasses
   G. 45 water glasses
   H. 54 water glasses

7. Ben saved $80 to buy a new helmet. He saved an equal amount of money each week for 10 weeks. How much money did Ben save each week?

8. Ned records the miles he walks each month.

   12, 18, 24, 30, 36

   If the pattern continues, how many miles will he walk after 6 months?

9. Lauren cleans horse stables for 2 hours each weekend. How many hours did Lauren clean stables after 7 weekends? Explain your thinking.

   ____
   ____
   ____
   ____
   ____.

10. Miguel makes animals out of pipe cleaners. He uses 3 pipe cleaners to make 1 animal. Making a table, how many pipe cleaners does it take to make 8 animals? Explain your thinking.

    A. 15 pipe cleaners
    B. 18 pipe cleaners
    C. 21 pipe cleaners
    D. 24 pipe cleaners

____
____
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____.