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The effects of the RIDE strategy on teaching word problem solving skills to students with learning disabilities

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THE EFFECTS OF THE RIDE STRATEGY ON TEACHING WORD PROBLEM SOLVING SKILLS TO STUDENTS WITH LEARNING DISABILITIES

by

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Dedications

I would like to dedicate this manuscript to my mother, Naomi Heath Gibson and my daughter, Cassidy April Locke and my son, Carson Adam Locke.

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I would like to express my appreciation to my thesis advisor, Joy F. Xin Ed. D. for her guidance and support throughout this study. The skills and knowledge that I have gained are things that I will take with me into my next professional endeavor. I look forward to whatever challenges that come my way knowing that I am prepared to take them on.

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Abstract

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The purpose of the present study was to evaluate the effects of the *RIDE*, a mnemonic device on solving word problems for middle school students with Learning Disabilities and to examine the teacher and student satisfaction in teaching and learning using *RIDE* to solve word problems. Two male 8th graders participated in this study. They were both classified as having learning disabilities and were learning mathematics at a 3rd grade level. A single subject design with ABC phases was used in this study. During the baseline, the students were given a quiz with 5 word problems each day for ten days. In the intervention, these students were taught problem solving skills using the *RIDE* mnemonic. Their performance was evaluated by a weekly quiz, then assessed after one week following the intervention to examine their maintenance. Results show that all students increased their quiz scores when the *RIDE* mnemonic strategy was provided in math instruction. It seems that such a mnemonic strategy helps students with LD remember the process of problem solving, and increase their correct responses to quiz questions as well as their confidence in learning word problem solving skills.

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Chapter I

Introduction

Statement of Problems

Solving word problems is typically an area of concern for middle school students, especially for those with learning disabilities (LD). Word problem solving skills require students to synthesize knowledge, such as understanding of concepts, procedures, and application of strategic methods (van Garderen & Scheuermann, 2015). Commonly, these areas are difficult for students with LD. If multiple steps of a word problem process are required, these students would have more difficulties in understanding the problem, thinking of a clear and memorable strategy, and providing an operational process to figure out the correct answer. Thus, word problem solving requires a number of skills to be applied throughout the process, including reading the problems accurately, creating a strategy, determining the correct operational process, and completing all of the steps to solve the problem. In the classroom, students with LD commonly lack these prerequisite skills in both math and language (Babbit & Peterson-Miller, 1996). For example, these students may not comprehend specific mathematic vocabulary, therefore, they struggle with the language structure of the problem~~s~~ and understanding of the question~~s~~, and using the related information to solve the problem. In addition, lacking basic math skills, such as addition and multiplication facts and the computation process, impacts their skills on learning word problem solving.

According to the New Jersey Core Curriculum Standards (NJCCCS, 2014), middle school students are required to attain proficiency in mathematical problem

solving. These math standards were updated to emphasize problem solving as an area of focus for middle school students (Hott & Oettinger-Montani, 2014). To meet these standards, students are called upon to solve real world problems, which are considered as an essential (Mathematics Standards, 2015). Because problem solving skills support an individual's ability to function in the workplace and throughout their lives, mastering these skills are vital for students (Jitendra & Xin, 1997).

Teachers are required to provide students with explicit instruction on the process of word problem solving to meet the requirements of the NJCCCS (2014), but they are confronted with determining effective instruction to produce the best learning outcomes of their students. It has been found that Direct Instruction (DI) with modeling, repeated practice and individual testing to teach problem solving skills is effective to students with LD (e.g. Swanson, 1999; Jitendra & Xin, 1997; Xin, Jitendra, Deatline-Buchman, & Andria, 2005; Freeman-Green, O'Brien, Wood, & Hitt, 2015). The teaching process of DI entails reviewing the prerequisite skills, modeling and providing guided and independent practice (Archer & Hughes, 2010). Information is presented by the teacher in small chunks and students are given examples and non-examples, and opportunities for responses to receive immediate feedback from the teacher (Miller, 2007). Cognitive strategies, such as mnemonic devices are often applied in math instruction to help students with LD memorize steps or operations (Freeman-Green, O'Brien, Wood, & Hitt, 2015). A number of mnemonic devices have been used with these students in learning problem solving skills such as *SOLVE, STAR and RIDE* with an acronym to represent each step for learners to follow.

SOLVE is a mnemonic device, representing studying the problem, organizing the facts, lining up a plan, verifying the plan with action, and evaluating the answer (Freeman-Green, O'Brien, Wood, & Hitt, 2015). This device is used for middle and high school students with LD to increase their proficiency in problem solving (Enright, 2004). *SOLVE* is taught through Direct Instruction by breaking down the skill into a step-by-step fashion, for example, lessons address each of the five steps in small chunks of information. First, students learn how to solve a word problem by following a sequence which begins with studying the problem. In this step, students are instructed to determine what the problem is being asked. The second step is to organize the facts. Students are shown how to identify the important facts in the problem. The third step is to line up a plan. Students are instructed to plan to solve the problem without using numbers. The fourth step is to verify the plan with action. Students learn to verify the plan they created in the third step, plug in numbers and solve the equation. The final step is to evaluate the answer. Students are shown how to check their results by asking questions such as, does the answer make sense or is it reasonable and correct? *SOLVE* was shown to be a strong starting point for middle and high school students with LD to learn building problem solving skills, such as organizing information and identifying what is important in a problem (Freeman-Green, O'Brien, Wood, & Hitt, 2015). The explicit instruction, such as DI, to teach *SOLVE* in a step-by step format has ensured that students have repeated practice and guidance during the process of learning.

STAR is another mnemonic device for secondary students with LD to improve their mathematical problem solving skills (Freeman-Green, O'Brien, Wood, & Hitt, 2015). The process of *STAR* involves searching the word problem, translating the words

into an equation, answering the problem, and reviewing the problem. *STAR* is also taught in an explicit manner to students. The effectiveness of *STAR* has been examined, and the results indicated that it is an effective strategy in helping students with LD improve their skills to understand the problem, use the numbers to represent the words, follow the steps to solve word problems (Freeman-Green, O'Brien, Wood, & Hitt, 2015). However, a problem was found in mastery of the steps, because many students could not consistently recall the steps (Maccini P. & Hughes, 2000).

RIDE is also a mnemonic device in secondary math instruction for students with LD to increase their proficiency in word problem solving. This mnemonic device guides students to recall the operational steps to solve a problem (Classroom Cognitive and Meta-Cognitive Strategies for Teachers, 2010). It entails four steps: 1) to remember the problem correctly, 2) identify relevant information, 3) determine the operations and unit for expressing the answer, and 4) enter the correct numbers, calculate and check the answer. These steps are taught through modeling and repeated practice in class (Hott & Oettinger-Montani, 2014). Students are required to remember each step following each letter of the word *RIDE*, until they are ready to apply it independently. This strategy helps students in abstract thinking, memorizing steps and paying attention to task. To date, little research has been found about its effect, though mnemonics have shown positive outcomes of students with LD in learning problem solving skills (Jitendra & Xin, 1997).

This study attempts to examine the effects on mnemonic devices, specifically *RIDE* in math instruction for students with LD to determine if learning such a mnemonic strategy would increase their success in word problem solving. Although there are some studies to support the use of mnemonics (e.g., Hott & Oettinger-Montani, 2014; Freeman-

Green, O'Brien, Wood, & Hitt, 2015), further research is needed to examine the effects of a specific device, such as *RIDE* on the acquisition of word problem solving skills of middle school students with LD.

Significance of the Study

Solving word problems effectively and accurately is a challenge for students, especially for those with LD. The instructional strategies, *SOLVE, STAR* and *RIDE* are mnemonic devices used to assist these students in learning word problem solving skills. Reviewing literacy, limited research has been found with consistent findings in math instruction for students with LD using mnemonic devices. Further studies are necessary to evaluate specific strategies such as *RIDE* for those students. The present study is designed to examine the effects of *RIDE* on math instruction to improve word problem solving skills of middle school students with LD.

Statement of Purposes

The purposes of this study are to: (a) evaluate the effects of the *RIDE*, a mnemonic device on solving word problems for middle school students with LD; (b) examine the teacher and student satisfaction in teaching and learning using RIDE to solve word problems.

Research Questions

1. Will middle school students with LD increase their scores of weekly quizzes when utilizing the *RIDE* mnemonic device in learning word problem solving skills?

2. Will the students with LD be satisfied with employing the mnemonic device of *RIDE* to solve word problems?
3. Will the teacher be satisfied with using the mnemonic device of *RIDE* to teach their students with LD to solve word problems?

Chapter II

Review of the Literature

Word problem solving is a major component of the New Jersey Core Curriculum Standards (NJCCCS, 2014), but it is the most challenging area for students with LD (Freeman-Green, O'Brien, Wood, & Hitt, 2015). These students struggle with many of the prerequisite skills involved in word problem solving, such as reading problems accurately, creating a strategy, determining the correct operational process, and completing all of the steps to solve the problem. Students with LD commonly lack these prerequisite skills in both math and language (Babbit & Peterson-Miller, 1996). In the past years, instructional strategies have been developed to teach these students, of these, Direct Instruction (DI) and mnemonic strategies are noted. Mnemonics, utilizing visual aids, acronyms related to the students' familiar background and their life to assist students with LD in recalling information, procedures and increasing their comprehension of the word problem. There are different mnemonic methods to approach problem solving. This chapter presents a review of articles related to mnemonics in three specific strategies including *SOLVE, STAR* and *RIDE,* for teaching word problem solving skills to students with LD.

Mnemonic Strategies for Students With LD

Mnemonic strategies refer to a specific reconstruction of target content intended to tie new information closely to a learner's existing knowledge and to facilitate retrieval (Scruggs 1990). These strategies have been used in reading, math and content areas (e.g.

Scruggs & Mastropieri, 1991; Tolfa-Veit, Scruggs, & Mastropieri, 1986; Mastropieri, Scruggs, & Levin, 2001) and keyword, peg word and acronyms are commonly reported.

Keyword. The keyword method is often used in learning new vocabulary words or facts or concepts. This mnemonic method involves recoding the new word or fact to be learned to a keyword that is easy to remember by presenting a picture or a word that sounds similar to the target word or fact. This is often used in teaching English, Science and Social Studies (Scruggs, 2000).

In Scruggs and Mastropieri's study (1991), 20 middle school students with LD at 6th, 7th and 8th grades were taught to use a keyword strategy to learn science content. Of those students, 7 were girls and 13 boys, 19 Caucasian and 1 African American with an average score of 80 on Wechsler Intelligence Scale for Children Revised (WISC-R) (1974). They were enrolled in a special education classroom since 3rd grade.

The students were divided into two groups; however, each group received instruction with both the keyword and traditional method for five weeks. Mnemonic picture representations were used as well as acoustics, which are sound alike terms that facilitate memory for vocabulary terms. In the traditional method, students were taught using principles of effective teaching such as teacher modeling, guided practice and thinking aloud. In addition, students were told to do their best work possible. During the first two weeks, 2 units of life science were delivered based on both keyword and traditional instruction. Each instructional unit was one week long. Each lesson was 50 minutes long and was delivered 4 times per week. On the fifth day, students were tested with 23 or 27 items individually. The first two weeks were the training, where students were introduced to the concept of the keyword strategy. In the third week, only the

keyword strategy was used to deliver the unit of earth science content. Again, there were 4 days of instruction followed by testing with the same format. In the fourth and fifth week, students were taught another earth science unit using mnemonic instruction. At the end of the five weeks, students were surveyed and asked to rate the types of instruction they received, traditional or mnemonic.

Results showed that keyword strategy demonstrated lasting effects on the acquisition of science content, while traditional instruction without mnemonics was not. The performance rate of students in the mnemonic condition exceeded that of those learning with a traditional method. In addition, the survey following instruction revealed that students liked the keyword strategy (Scruggs & Mastropieri, 1991).

Two studies were conducted by Mastropieri, Scruggs, Levin, Gaffney and Mc Loone (1985), in which middle school students with LD learned the definitions of 14 English vocabulary words through either a keyword strategy or Direct Instruction (DI). The first study provided students with keyword mnemonic pictures and in the second, students were required to make their own mnemonic pictures.

A total of 32 middle school students with LD ranged in ages from 12 to 15 participated. Of these, 10 were 7th, 11, 8th and 11, 9th graders, 21 boys and 11 girls. Student IQs ranged from 80 to115, as measured by the WISC-R (1974).

In the first study, the students were evenly divided into two study groups, 16 were provided instruction using keyword strategy and the other 16 were provided with Direct Instruction on vocabulary words. The students in the mnemonic group learned two examples of vocabulary, and were assessed to evaluate their memorization of the words

learned. Next, the students were taught to use keywords for the other 14, and a short quiz was given at the end of the session. Students in the DI group were taught in a one to one setting, using an SRA program with scripted lessons to provide DI procedures. Results showed that students who received mnemonics outperformed the recall of words than those in the non-mnemonic group.

In the second study, 30 students with LD, 14, 7th, 8, 8th and 8, 9th graders participated. Of these, 23 were boys and 7 were girls with an age range from 12 to 16. Student IQs ranged from 81 to112, as measured by the WISC-R (1974). They were randomly assigned to either a group to create their own mnemonic keyword pictures to represent vocabulary words or another group to receive traditional instruction.

The procedure and materials of the DI were replicated for the second study. The procedure and materials for the mnemonic group were also close to that of the first study, however, students were shown cards with printed vocabulary, key words and definitions, then required to create their own mnemonic illustration.

The results showed a consistent finding with the first study and indicated that the recall of the mnemonic subjects was once again substantially and statistically higher than the non-mnemonic group. In each study, the keyword groups performed better than their peers received traditional instruction. These results illustrate that mnemonic strategies can facilitate students with LD semantic memory (Mastropieri, Scruggs, Levin, Gaffney, & and McLoone, 1985). However, little research has been found in math instruction, while most studies were involved in language teaching.

Peg word. The peg word strategy involves rhyming peg words to facilitate recall of numbered or ordered information. Peg words take the place of the number to be recalled and linked, for example, one is bun and two is shoe, three is tree, and so on.

In Elliott and Gentile's study (1986), 60 middle school students were taught English vocabulary words using a peg word strategy. A total of 30 students with LD and 30 typically developing peers participated. Each group of 30 was then further divided into two separate groups; a peg word and a traditional instruction group, with 15 each, 9 boys and 6 girls.

Students were informed that they would learn several lists of common nouns in numerical order. The words were paired with a position number. In the peg word group, the students first memorized the peg word rhyme, "One-bun two-shoe, three-tree" going up to 10, then practiced the peg word rhyme independently and with a partner for four times. They were tested on their knowledge of the rhyme, once a correct of 90% was reached, they were given practice to create an image in their mind. Next, they were given three examples for practice to prepare them to independently learn the words using this technique, followed by a test to evaluate their performance. They were given a number to write the paired words and the mnemonic drawing as well. The process was repeated twice with two additional lists of words. In the control group, students were asked to learn the words following DI procedures.

The results showed that both students with and without LD increased their memory of paired words and numbers when learning the peg word and performed better than those in the traditional group (Elliott, 1986).

Peg word and keyword. Peg word and keyword strategies are sometimes paired together when students need to learn both names and a numbered list of items.

In Mastropieri, Scruggs and Levin's study (1985), a combination of peg word and keyword was used to teach science content to 90, 9th graders with LD. Of these, 68 were boys and 22 girls, ranged in ages from 14 to 16, 73 Caucasian students, 10 Hispanic, 5 Native American and 2 African American with IQs ranged from 72 to 129.

These students were grouped according to their reading comprehension scores on the California Achievement Test (CAT). The first group included those who scored at or above the 40th percentile as the high group, and those who scored in the 30th percentile or below as the low group. From each of those groups, 15 students were assigned randomly to one of three experimental groups, with one using the peg word/keyword technique, one using a questioning method and the other with free study method to learn the hardness level of 17 different minerals.

All of the students in each group worked individually with an instructor for approximately 21 minutes. The students in the peg word/keyword group were taught the peg words for the numbers 1-10, such as one bun, two shoe, and three tree and were shown a 5 x 8 card with the peg word and its picture. This was followed by a practice of the numbers twice with an instructor to orally repeat the sequence. Next, the students were taught the keywords for three sample minerals, and the instructor combined the keyword that was on the back of the previously used 5 X 8 card with the peg word. The instructor explained how to use the peg word and keyword card, and the students were asked to tell the hardness of the three sample minerals and provided with corrective

feedback. Then, students were taught the keyword for 14 other minerals using the cards. Each of the minerals was studied one by one, then students were assessed.

The students in the questioning group were taught the science content with DI on the three sample minerals, and were shown flashcards with the minerals printed. The instructor directly taught the content and the students were questioned to check for their understanding. The lesson was closed with a recall test.

The students in the free-study group were taught to use their own method of study to learn. The instructor recommended types of studies as well as practice and modeling three minerals as examples. The students were provided with flashcards to review the other 14. The lesson was closed with an assessment after the students had studied using a method of their choice.

The results indicated that both the high and low performing groups of students with LD did best when using a peg word/keyword strategy to learn science content. The students in the mnemonics group outperformed those in the questioning and free-study groups. The effect of using the mnemonics was very positive and ~~was~~ regarded as the most effective strategy based on students' assessment scores. Mnemonic strategies were shown to facilitate student associative memory of factual science content (Mastropieri, Scruggs, & Levin, 2001).

In Tolfa-Veit, Scruggs and Mastropieri's study (1993), 64 students with LD were taught topics about dinosaurs using a pair of peg word and keyword. Of these, 23 were 6th, 22, 7th, and 19, 8th graders, 19 girls and 45 boys with an average WISC-R score of

92.5 (1993). All participating students were randomly assigned into two groups, a mnemonic and a control group.

The mnemonic group was taught a peg word/keyword strategy to apply to the science content. Three lessons were delivered, one every day on vocabulary, attributes and reasons for dinosaur extinction. In the lessons on vocabulary and attributes, the students were taught to use keyword technique, such as keywords and associated pictures to recall the information. In the lesson on extinction, the students were taught the peg word to remember eight reasons that the dinosaurs became extinct. They learned the peg word rhyme and paired the list of information and associated pictures with the peg word rhyming words.

The control group was taught using DI with teacher led lessons without any mnemonics. The teacher showed a card with information and the students responded and repeated the information back aloud. Following the teacher's instruction, the students were assessed immediately.

Results found that students using a mnemonic strategy scored statistically higher than those in the control group. It seems that mnemonics can be applied by students with LD to increase their associative and semantic memory capabilities (Tolfa-Veit, Scruggs, & Mastropieri, 1986). Again, research demonstrated that both keyword and peg word were used in language and science instruction but few in mathematics.

Acronyms. Acronyms provide students with letter prompts in order to remember a list of information or steps in a process, such as *SOLVE, STAR* and *RIDE*. Acronym

mnemonics are most effective when the first letters of a process or series spell out an entire word familiar to the students (Scruggs, 1990).

In Freeman-Green, O'Brien, Wood and Hitt's study (2015), 6, 8th graders with LD participated using the acronym mnemonic strategy, *SOLVE*. The students were divided into three groups of two each. The students were instructed using *SOLVE* through 8 lessons of 30 to 45 minutes each. The process began with pretesting to ensure that the students were unaware of the strategy. After the pretest, four initial lessons were given. These involved describing the process of the strategy and modeling the five steps. Each letter of the acronym *SOLVE* was modeled independently in order to reinforce the importance of each step of the process. After the initial four lessons, the fifth lesson focused on verbal practice where student could think aloud about the process. The sixth lesson allowed the students to participate in controlled practice which was a guided practice to receive immediate feedback from the teacher. The seventh lesson focused on providing advanced practice and teacher feedback. In the eighth lesson, students were given a post-test and a satisfaction survey as well. The final lesson of the sequence was to promote generalization and maintenance of the strategy. During this lesson, students were given tests on other math topics to see if the *SOLVE* acronym could be transferred to the different concepts.

The results of this study indicated that students with LD who learned the acronyms improved accuracy of word problem solving. The strategy allows students to work through a series of steps and utilize math reasoning skills to organize their thinking and better prepare for problem solving. In addition, they were more confident in word

problem solving and reported that it helped them to start and follow through the steps in the operation process (Freeman-Green, O'Brien, Wood, & Hitt, 2015).

In Maccini and Hughes' study (2000), 6 high school students with LD, 2 boys and 4 girls in grades ranging from 9^{th} -12^{th} participated to assess the effects of the acronym mnemonic strategy *STAR* on learning word problem solving. These students were at least two years below grade level for math and received math instruction in a resource room. Each of these students scored below an 80% on the baseline tests targeting problem solving skills.

Instruction began with the teacher introducing and modeling the use of the *STAR* strategy. Students were provided with a graphic organizer to follow the steps of the process with the teacher modeling. The *STAR* strategy was taught through a series of six steps in one lesson. First, the instructor identified the new strategy and purpose of learning. Then, the instructor described the strategy further and modeled its use. After this phase, students were provided with guided and independent practice. A post-test was then given to the students to assess their progress on using the strategy and accuracy of answers. Finally, students were provided with positive and corrective feedback from the instructor.

The results of this study indicated that *STAR* helped address a common problem of students with LD, which is applying a problem solving strategy and monitoring their own thinking. In addition, the study illustrated that once the students were able to use the steps to represent the problem, they were more successful with solving the word problem (Maccini P., 2000).

In contrast, Walker and Poteet's study (1990) examined the effects of a key word strategy by comparing with a diagrammatic strategy to solve word problems. Seventy 6th, 7th and 8th graders with LD participated. The students were placed into one group to learn a keyword strategy or a group to learn a diagrammatic strategy to solve both one-step and two-step word problems.

Before instruction began, students were given a pre-test to assess their computation skills to solve one-step and two-step word problems correctly. A total of 17, 30 minute lessons were given to each group. In the keyword group, students were taught how to locate information in a story problem, to write a number sentence and to solve the problem. In the diagrammatic group, students were also taught a strategy, however, the strategy involved drawing a picture to represent the word problem, writing a number sentence and solving for an answer. After 17 days of instruction, students were tested.

The results revealed that neither the mnemonic nor the diagrammatic strategy increased student performance, which resulted in an inconsistent finding to the previous studies that showed effects of mnemonics on teaching students with LD word problem solving skills. Further studies may be needed to validate the findings (Walker & Poteet, 1989-90).

Another acronym strategy is called, *RIDE*. To date, little research was found to address the effectiveness of the *RIDE* strategy for students with LD.

Summary

Students with LD often have difficulty remembering important information. A problem was found in their semantic memory, the ability to recall facts and memory

connections that impacts their academic achievement. A tool that targets the memory problems is to use mnemonic strategies (Scruggs, 1990).

Mnemonics have been repeatedly shown through several studies to be effective for students with LD across content areas to increase their learning potential; especially helpful in learning word problem solving skills (e.g. Scruggs & Mastropieri, 1991; Tolfa-Veit, Scruggs, & Mastropieri, 1986; Mastropieri, Scruggs, & Levin, 2001; Elliott, 1986; Mastropieri, Scruggs, Levin, Gaffney, & and McLoone, 1985; Freeman-Green, O'Brien, Wood, & Hitt, 2015; Maccini, 2000).

In the past, various mnemonic strategies were used such as keyword, peg word and acronyms, to support these students to activate their semantic memory in order to increase their academic achievement and enhance their recall of information. However, Walker and Poteet's study (1990) found limited effect of using key word to solve word problems for students with LD. Thus, further studies are needed to validate the findings. The current study attempts to use the acronym strategy, *RIDE*, to teach the process of word problem solving for middle school students with LD, and to evaluate their performance, in a hope to add information to the use of mnemonics in mathematics instruction.

Chapter III

Method

Context of the Study

Setting. The study was conducted at a junior/senior high school in southern New Jersey. The state Department of Education listed the District Factor Group (DFG) for the borough as "GH," based on the 2000 Decennial Census Data, which means that this district is in a community with a relatively high socio-economic status.

The school was built in 1910, to provide services to both junior and senior students from grade 7 to 12. In the school year of 2012-13, the student enrollment was 809. Students with disabilities are placed in inclusive classrooms or special education settings according to the decisions made by the Child Study Team in school.

Classroom. The study was conducted in an 8th grade self-contained classroom for students with disabilities. There were two students with learning disabilities (LD), one special education teacher and one paraprofessional in the classroom. The instruction was following a Direct Instruction model based on the textbook of *SRA Connecting Math Concepts*, Level D (2013), with scripted lessons.

Participants

Students. Two male 8th graders participated in this study. They were both classified as having multiple disabilities based upon the evaluation of the school's Child Study Team following the state's administration code and eligibility standards. Both students possess cognitive and communication impairments, learning mathematics at a 3rd

grade level. Each student had an Individual Education Program (IEP) with objectives in word problem solving, and receiving math instruction in the self-contained classroom. Table 1 presents their information.

Table 1

General Information of Participating Students

Participating students	Age	Ethnicity	DLM math scores*	Reading level
A	14	Caucasian	**Approaching target	3rd
B	13	Hispanic	**Approaching target	4th

*Note: DLM (Dynamic Learning Maps): a state assessment to evaluate English/Language Arts and Math performance of students with learning disabilities.

**Note: Approaching target: understanding of and ability to apply targeted content knowledge and skills represented by the Essential Elements assessed by the DLM.

Student A had difficulty in understanding regrouping and selecting a particular operation to solve a problem. Organizing various steps and deciding a correct strategy to solve a problem were a challenge to him. In addition, he had difficulties in reading, especially in reading comprehension, oral expression and fluency, which impacted his understanding of word problems.

Student B struggled with computation of higher level multiplication and division, and was often confused with regrouping. He also lacked the necessary skills to follow all steps required in word problem solving. In addition, he had difficulties with reading comprehension and fluency, which impacted his understanding of word problems.

Teacher. One teacher in the class participated in the study. The teacher had three years of experience teaching students with disabilities in both self-contained and inclusive classrooms. She delivered the mathematics instruction during the entire study.

Research Design

A single subject design with ABC phases was used in this study. During Phase A, the baseline, the students were given a quiz with five multiplication and division word problems each day for 10 days. In Phase B, the intervention, these students were taught word problem solving skills using the *RIDE* mnemonic device over 5 weeks and a test was given each day to evaluate their performance for 15 days The same students were then tested in Phase C, maintenance, to evaluate their word problem solving skills after one week following the intervention for 5 days.

Materials

Instructional Materials

Textbook. Problems were selected from the textbook of *SRA Connecting Math Concepts*, level D (2013); a primary text for the class. The problems were selected from the unit that the students were currently learning, Lessons 110-120. One type of word problem was presented to involve one-step multiplication and division problems. These problems were taught using Direct Instruction and the *RIDE* mnemonic strategy.

Graphic organizer. This is a chart to provide spaces to break down a word problem process into steps. There are 4 areas; the "Read" area provides lines for writing the question about the problem. The "Identify" area has lines for writing the important

information. The "Determine the Operation" area lists lines to describe the operation and the "Enter the Numbers and Calculate" area is a box for computation (See Appendix A).

RIDE poster. This is a graph to illustrate 4 steps of the process: R-- Remember the problem correctly; I-- Identify the relevant information; D-- Determine the operations and unit for expressing the answer; and E-- Enter the correct numbers, calculate and check the answer. The steps were outlined and an image of a boy riding a bike was used as a way to stimulate the memory of the process (See Appendix B).

Measurement Materials

Quiz. Each quiz consisted of five one-step word problems about multiplication or division with a total of 20 points, 4 points for each question. Two points were awarded for showing the process to problem solve and 1 point for a correct answer and 1 point for a correct label (See Appendix C).

Survey. The survey included three questions with "yes" or "no" responses. It was developed by the teacher to evaluate student's satisfaction with their experience in learning math and applying the *RIDE* mnemonic. The survey was given at the end of the intervention (See Appendix D).

Procedure

Instructional Procedures

Baseline (phase A). During the baseline, students were shown a poster that outlined the *RIDE* mnemonic as well as a brief review of steps for word problem solving,

then they were given 30 minutes to complete the quiz with 5 problems each day for 10 days.

Intervention (phase B*).* Direct Instruction approach was provided to teach the *RIDE* mnemonic strategy, followed by a lesson for 35 minutes each day. For example, in Day 1, the teacher presented the *RIDE* strategy to the students step by step using a graphic organizer and a poster to guide the students through the process. The first step, R-remember the problem correctly, was taught through a think aloud. The second step, I-identify relevant information, was modeled by presenting a sample problem through circling important math words. The third and fourth steps, D-determine the operation and E-enter the correct numbers, calculate and check the answer students were demonstrated by the teacher's modeling of the process. Subsequently, the students were required to complete a graphic organizer that listed the 4 steps of the process. At the end of the class, the teacher discussed with the students the benefits of using this strategy. Day 2: the teacher reviewed the process of *RIDE* with the class by asking questions about each step of the strategy. Students were involved in class discussion by responding to and asking questions, then they completed a worksheet with 5 problems for practice using their organizers as a guide (See Table 2).

Table 2

Instructional procedures

Week*	**Day 1**	**Day 2**	**Day 3**	**Day 4**
1	• Daily warm up: Fact families practice. • Direct	• Daily warm up: Fact families practice • Direct	• Daily warm up: Fact families practice • Direct	• Daily warm up: Fact families

Week*	Day 1	Day 2	Day 3	Day 4
	Instruction (DI) • Guided Practice • Independent Practice	Instruction (DI) • Guided Practice • Independent Practice	Instruction (DI) • Guided Practice • Independent Practice	practice • Weekly quiz given (30 minutes timed)

*Note: The schedule above reflects the basic lesson format. Over the five weeks of instruction the teacher followed the same procedure; however, the content or skills may be different according to student's performance.

Maintenance (phase C). One week following the end of the intervention, students were assessed with a 15 problem test on one-step word problems. The students did not receive any instruction on the *RIDE* mnemonic prior to the testing administration. The test was given to the participating students to complete in 42 minutes. The teacher read the directions and each problem aloud. Students were required to solve the problems independently using the *RIDE* mnemonic. No discussion was allowed; the quiz was submitted to the teacher when completed.

Measurement Procedures

Quiz. At the end of each week, a quiz was given to the participating students to complete in 30 minutes. The teacher read the directions and each problem aloud. Students were required to solve the problems independently using the *RIDE* mnemonics. No discussion was allowed and the quiz was submitted to the teacher when completed.

Survey. At the end of the intervention, the survey was given to the students. The teacher read the instruction and each question aloud to the students. The students

responded by circling either “yes” or “no,” then submitted to the teacher when completed.

Data Analysis

Means and Standard Deviations were calculated and presented in a table. A visual graph was presented to compare student performance across phases. The survey responses were calculated into percentages, and presented in a table too.

Chapter IV

Results

Student Performance

Quiz. During Phase A, Baseline, students were given one quiz per day for a 10 consecutive days. In Phase B, Intervention, students were given one quiz per week for 5 weeks. During Phase C, Maintenance, students were given two quizzes for two weeks after the end of Intervention.

Table 3 shows the means and the standard deviations of the quiz scores of the participating students during the baseline, intervention and maintenance. The mean scores of Student A are increased from 11.9 to 14.4 and 9.2 to 14.2 for Student B when utilizing the *RIDE* mnemonic device in learning word problem solving skills.

Table 3

Means and Standard Deviations of Test Scores Across Phases

Participants/Phases	**Quiz**	
	M	**SD**
Student A		
Baseline	11.9	3.21
Intervention	14.4	3.13
Maintenance	19.5	0.71
Student B		
Baseline	9.2	3.05
Intervention	14.2	4.09

Participants/Phases	Quiz	
	M	**SD**
Maintenance	19	1.41

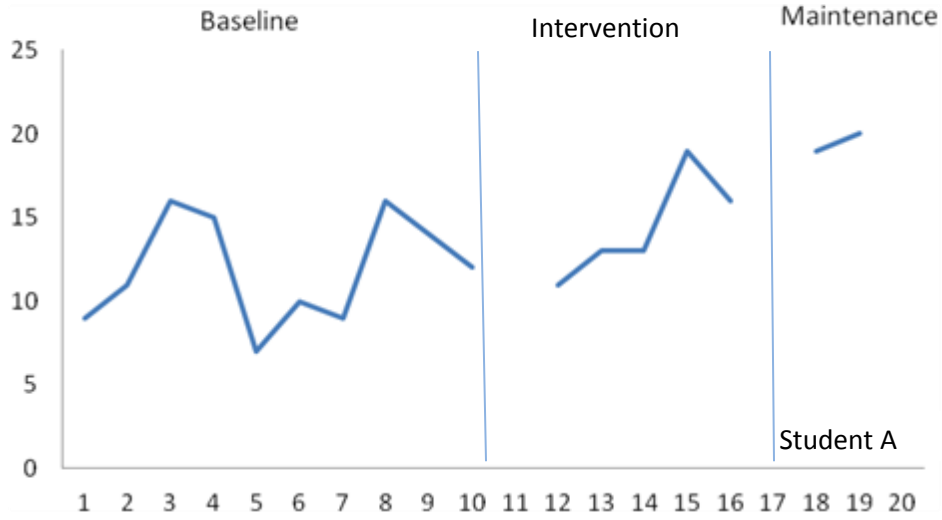

Figure 1. presents Student A's scores across phases.

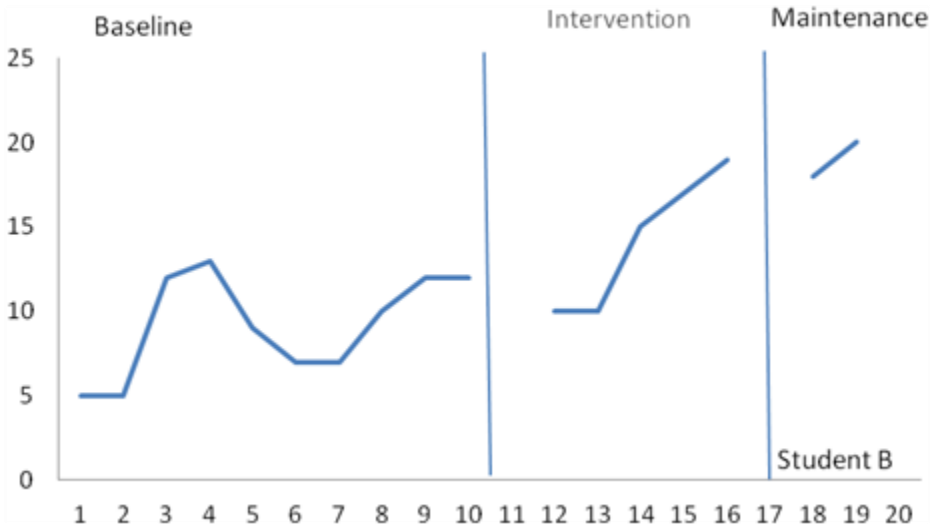

Figure 2. presents Student B's scores across phases.

Student A was given a quiz with 5 word problems each for 10 days during the baseline His scores ranged from 9 to 16 out of 20 as the total, with a mean of 11.9. During the intervention, the student was given one quiz each week for 5 weeks. His scores ranged from 11 to 19 out of 20, with a mean of 14.4. The student's mean score was increased 2.5 points after learning RIDE. In the maintenance, the student was given a quiz for two weeks. His scores ranged from 19 to 20 with a mean of 19.5.

Student B was given a quiz with 5 word problems each for 10 days during the baseline. His scores ranged from 5 to 13 out of 20 as the total, with a mean of 9.2. During the intervention, the student was given one quiz each week for 5 weeks. His scores ranged from 10 to 19 out of 20, with a mean of 14.2. The student's mean score was increased 5.0 points after learning RIDE. In the maintenance, the student was given a quiz for two weeks. His scores ranged from 18 to 20 out of 20 with a mean of 19.

Survey

At the end of the intervention, both students were given a survey to assess their satisfaction with using the RIDE mnemonic technique. Table 4 presents their responses.

Table 4

Participating Students' Responses to the Survey

Question	**Response Student A**	**Response Student B**
1. Did you enjoy using the RIDE strategy to solve word problems?	Yes	Yes
2. Did you feel like having a strategy to use helped you to solve the problems better?	Yes	Yes
3. Will you continue to use this strategy?	Yes	Yes

Students were asked three questions that required yes or no responses. The first question asked, "Did you enjoy using the RIDE strategy to solve word problems?" Both Student A and B answered yes. The second question asked, "Did you feel like having a

strayegy to use helped you to solve the problems better?" Student A and Student B responded yes. The third question asked, " Will you continue to use the strategy?" Both students answered "yes".

Student comments on using RIDE mnemonics included, "I liked the bike picture and that made me remember how to solve a problem." and "I liked to use RIDE because it was fun to think of when I did a problem." When asked if the RIDE helped solve the problems, Student A said that it helped to increase his confidence, e.g. "RIDE made me go slower and follow steps. It made me feel like I knew how to solve the problems we had." Student B indicated that using the RIDE strategy helped him to "get more questions right." He said, "When I learned to use RIDE, I got better at doing word problems. Word problems can be hard for me, but it helped me to do more." When asked if they would like to continue to use this strategy, Student A stated, "Yes, I use the picture of the bike in my notebook to help me. I will use it all the time." Student B said, "Yes. I like to use RIDE. I got better in math."

Chapter V

Discussion

The purpose of the present study was to evaluate the effects of the *RIDE*, a mnemonic device on solving word problems for middle school students with LD and to examine the teacher and student satisfaction in teaching and learning. The findings are limited by the size of the sample of student participants; only two students fit the criteria of participation. The study was also limited due to time constraints placed upon the various phases with a 10-week period. Also, the study faced regional limitations of being conducted in one classroom in one school.

The first research question asked if middle school students with LD would increase their scores of weekly quizzes when utilizing the *RIDE* mnemonic device in learning word problem solving skills. The results indicated both students gained in the intervention when RIDE was used, and maintained their scores in the maintenance after one week.

The second research question on students with LD satisfaction with employing the mnemonic device of *RIDE* to solve word problems indicated that it was viewed positively by this group. Student responses to the survey showed that they all enjoyed using the RIDE mnemonic technique. The participating students demonstrated a positive attitude towards using the technique. They reported that the strategy helped them to solve word problems better. Finally, both students were excited to continue the use of the RIDE mnemonic.

The third research question asked if the teacher would be satisfied with using the mnemonic device of *RIDE* to teach their students with LD to solve word problems. Results also indicated that it was helpful to the teacher in teaching word problem solving skills. The teacher found that the strategy was easily incorporated into weekly lesson planning and instruction.

When comparing these results to Freeman-Green, O'Brien, Wood and Hitt's findings (2015), similarities can be noted. In both studies the steps of a mnemonic strategy, SOLVE in their study and RIDE in the current, were provided for students with LD to learn word problem solving skills. The results of this present study show scores increased when the RIDE mnemonic strategy was used to remind the steps of word problem solve process compared to those in the baseline, which may indicate that the mnemonic strategy can be used with success to improve their math word problem solving skills. The present study and Freeman-Green, O'Brien, Wood and Hitt's study (2015) show that using an acronym mnemonic that breaks a problem down into components, students could follow the steps to solve the problem, which may result in higher percentages of correct answers and therefore, an increase in quiz scores. In addition, the results are consistent with previous studies, e.g. Freeman-Green, O'Brien, Wood and Hitt (2015); Maccini and Hughes (2000), to support learning mnemonic strategies to increase students' confidence and willingness to solve word problems. Mnemonic strategies, such as RIDE in the current study and SOLVE in the Freeman-Green, O'Brien, Wood and Hitt's study (2015) provide a tool for students with LD to gain confidence in solving problems that present the most challenge in their math learning.

The results of the current study differ from other studies, such as the one conducted by Walker and Poteet (1989-90). In their study, the results indicated that neither the mnemonic nor the diagrammatic strategy taught to students with LD had improved student performance. A possible reason for the difference between the current and that of Walker and Poteet's study (1989-90) may be related to the teachers who delivered instruction. There was only one teacher who delivered instruction in the current study, while in Walker and Poteet's study (1989-90) there were thirteen different teachers who worked with different groups. There is a possibility that the different teachers in Walker and Poteet's study (1989-90) varied in their effectiveness and delivery of materials, whereas in the current study there was only one teacher who carried out instruction in its entirety. Another reason for the different results could be that the current study only tested one-step word problem solving, while Walker and Poteet's study (1989-90) evaluated students on both one and two-step word problems. Including two-step problems may have resulted in lower scores of the participating students because the additional steps require more organizational math skills. More studies may need to validate the finding; especially involving students with LD in learning complex word problem solving using mnemonic strategies to further evaluate their performance.

Limitations

Although the results of this study indicate great promise for using mnemonic strategies in teaching word problem solving skills to students with LD, there are some limitations that should be acknowledged. The findings are limited by the size of the sample of students. There were only two students available for participation in the study. The small sample size might produce limited results. The length of study was limited,

which resulted in a shorter generalization period of two weeks. In addition, the study was conducted in one classroom, in one school, which might result in limited findings.

Recommendations/Implications

Based upon the results of this study, several recommendations can be made to further the study. The sample size of students should be increased and diversified to include male and female students at various age levels when possible. The length of the study should also be increased so that a longer maintenance period can be involved for students to continuously use the strategy. The regional scope of the study should be expanded so that it is not limited to one classroom of students or one school in a district.

Despite these limitations, the results of the current study provide implications for further research. Future studies should consider simplifying the mnemonic strategy for students with LD. A simplified mnemonic could possibly help the students to remember the steps and to retain the information for a longer period of time. More research could also be conducted to examine if students with LD continue to use the strategy over a longer period of time. The focus could be on the maintenance of these skills with students with LD, and to expand to various content areas such as English-language arts or science.

Conclusions

Solving word problems is typically an area of concern for middle school students, especially for those with learning disabilities. The New Jersey Core Curriculum Standards (NJCCCS, 2014) requires middle school students to attain proficiency in mathematical problem solving, therefore it is vital that students with LD can learn strategies and methods to solve these challenging problems. Through this study, it can be

determined that RIDE is a mnemonic device that shows great promise in helping students with LD to improve their word problem solving skills, increase quiz scores, and develop confidence in solving word problems. The results show similar findings to the previous research, such as Freeman-Green, O'Brien, Wood and Hitt (2015), and Maccini and Hughes (2000) that mnemonics can benefit those who are struggling in learning math and improve the mathematical problem solving skills of students with LD.

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Appendix A

Graphic Organizer

Name: _____ Date: _____

RIDE – Math Problem Solving Format

Read: What is this problem asking you to do? (write the question)

_____

_____

Identify: What information do you have to solve this problem? (write the important information)

_____

_____

_____

Determine the operation: Describe the operation

_____

_____

_____

Enter the Numbers and Calculate: Set up the problem, solve and check!

Appendix B

RIDE Poster

Let's RIDE with Word Problems!

R-- Remember the problem correctly

I-- Identify the relevant information

D-- Determine the operations and unit for expressing the answer

E-- Enter the correct numbers, calculate and check the answer

Appendix C

Quiz

Name: _____ Date: _____

Word Problem Quiz Week #1

Directions: Complete the following problems using the RIDE method. Use the *RIDE* worksheet to remember the steps.

1. All the boxes had the same number of video games.
   There were 250 video games and 5 boxes.
   How many video games were in each box?

2. The building had 9 floors and 270 windows.
   All the floors had the same number of windows.
   How many windows were on each floor?

3. There were 3 track teams.
   All the teams had the same number of players.
   There were 39 players.
   How many players were on each team?

4. There were 4 children.
   All the children had the same number of jelly beans.
   There were 88 jelly beans.
   How many jelly beans did each child have?

5. Every room has 5 windows.
   There are 30 windows.
   How many rooms are there?

Appendix D

Student Survey

Name: _____ Date: _____

Survey

Directions: Please answer the questions below by circling "Yes" or "No."

1. Did you enjoy using the *RIDE* strategy to solve word problems?

   Yes No

2. Did you feel like having a strategy to use helped you to solve the problems better?

   Yes No

3. Will you continue to use this strategy?

   Yes No