An Analysis of Schema-Based Instruction as an Effective Math Intervention for Middle School Students Diagnosed with Emotional Behavioral Disorders or Identified as At-Risk in Texas

By

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Table of Contents

Abstract

This study gathered data on the effectiveness of schema-based instruction (SBI) as a viable math intervention for students either diagnosed with emotional behavioral disorders or classified as at-risk for failing math. Also, SBI is a potentially effective instrument to utilize during Response to Intervention procedures. There is an enormous demand for identifying successful math interventions for students, regardless of disability. Today, teachers simply do not have the resources or proper training to implement many of the academic interventions recommended by researchers. Time constraints also limit the successful implementation of strategies that could be beneficial to struggling students. As such, it is imperative the educator use strategies that are both effective and simple to execute in the classroom.

In this study, a single subject multiple baseline design across participants was used to determine the effectiveness of SBI on increasing student comprehension of math word problems as demonstrated by increased test scores. Also, the effects were analyzed in the absence of the intervention. Based on the results of this study, SBI demonstrates promise as a viable and effective math intervention that should be considered for struggling students, including those diagnosed with emotional behavioral disorders.

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List of Figures

List of Nomenclature & Abbreviations

At Risk – According to the Texas Education Code 37.006, a student is considered At Risk if the one or more of following conditions exist:

- is in grade 6, 7, 8, 9, 10, 11, or 12 and did not maintain an average equivalent to 70 on a scale of 100 in two or more subjects in the foundation curriculum during a semester in the preceding or current school year or is not maintaining such an average in two or more subjects in the foundation curriculum in the current semester;
- was not advanced from one grade level to the next for one or more school years; (Note: From 2010-2011 forward, TEC 29.081 (d-1) excludes from this criteria prekindergarten or kindergarten students who were not advanced to the next grade level as a result of a documented request by the student's parent.)
- did not perform satisfactorily on an assessment instrument administered to the student under TEC Subchapter B, Chapter 39, and who has not in the previous or current school year subsequently performed on that instrument or another appropriate instrument at a level equal to at least 110 percent of the level of satisfactory performance on that instrument.

DAEP – district alternative educational placement serves as a temporary place of education for district students due to various disciplinary infractions. DAEP placement occurs at an off-campus location (TEC 37.001).

Emotional Behavioral Disorder (EBD) - For the purposes of this study, EBD will be defined according to the following IDEA 2007 definition:

(i) An inability to build or maintain satisfactory interpersonal relationships with peers and/or teachers. For preschool-age children, this would include other care providers.

(ii) An inability to learn which cannot be adequately explained by intellectual, sensory, or health factors.

(iii) A consistent or chronic inappropriate type of behavior or feelings under normal conditions.

(iv) A displayed pervasive mood of unhappiness or depression.

(v) A displayed tendency to develop physical symptoms, pains, or unreasonable fears associated with personal or school problems. [34 C.F.R. § 300.8I(4)(i)(A – E)]

A child with EBD exhibits one or more of the above emotionally based characteristics of sufficient duration, frequency, and intensity that interferes significantly with educational performance to the degree that provision of special educational service is necessary. EBD is an emotional disorder characterized by excesses, deficits, or disturbances of behavior. The child's difficulty is emotionally based and cannot be adequately explained by intellectual, cultural, sensory general health factors, or other additional exclusionary factors (Individuals with Disabilities Education Act, 2007)

In School Suspension (ISS) – an alternative form of on-campus placement for students violating the student code of conduct for various infractions not as severe in nature as a DAEP placement (TEC 37.001).

Learning Disability (LD)/Math Disability – According to IDEA 2007, means a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, that may manifest itself in the imperfect ability to listen, think, speak, read, write, spell, or to do mathematical calculations, including conditions such as perceptual disabilities, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia.

Math Intervention - The implementation and use of an alternative form of mathematical instruction utilized to address identified academic deficits (Hodge, et. al, 2006).

Multiplicative Compare - A multiplicative comparison problem is one in which "*a* is *n* times as much as *b*." For example, Anna is 3x as old as her brother Eric. Anna is 21 years old; how old is Eric (Jitendra, Hoff, & Beck, 1999)?

Schema Based Instruction (SBI) - The use of schematic diagrams to represent the information presented in word problems and to assist students in figuring out what math operation is needed to solve the problem (Jitendra, 2007).

Vary Problem – A vary problem tells about the association (ratio or rate) between two things often stated in an *If-Then* format. For example, if a pair of socks costs $1.40, then how much does half a dozen pair of socks cost (Jitendra, Hoff, & Beck, 1999)?

Special Educators use acronyms frequently enough that individuals outside the field may be unfamiliar with their meaning. Here is a list of abbreviations used throughout this study:

EBD – Emotional Behavioral Disorder

LRE – Least Restrictive Environment

BIP – Behavioral Intervention Plan

NCLB – No Child Left Behind Act

MSI – Mnemonic Strategy Instruction

IDEA – Individuals with Disabilities Education Act

CB(M/A)– Curriculum Based Measurements/Assessments

PAL – Peer Assisted Learning

SBI – Schema Based Instruction

LD – Learning Disabled

FAPE – Free and Appropriate Education

MC – Multiplicative Compare

CCC – Cover Copy Compare

CHAPTER ONE

INTRODUCTION

In the past several decades, there has been a steady increase in the number of secondary students diagnosed with emotional behavioral disorders (EBD). As of 2003, approximately 8.1% of all students with learning disabilities in the United States were classified as EBD (Oswald, Best, Coutinho, & Nagle, 2003). EBD is a term identified by the Individuals with Disabilities Education Act (2004) that refers to the spectrum of students who experience social, emotional, and behavioral problems and who are served under special education guidelines (Cook et al., 2008). These students still exhibit academic deficiencies that cannot be attributed to any other identifiable cognitive disability. Unfortunately, the number of students described as having EBD is increasing (Sawka, McCurdy, & Mannella, 2002). According to the National Center for Educational Statistics, the number of students between the ages of 3 and 21 served in federally supported programs in the EBD category from 1976 to 2004 nearly doubled, from 283,000 to 489,000 (U.S. Dept. of Education, 2007). As of 2007, there are close to 700,000 students in the United States being served under the EBD category. Although these numbers are alarming, they demonstrate a steady increase in percentages that is commiserate to the overall growth of special education referrals. Students with EBD now represent close to 10% of the special education population and approximately 1% of the entire student population. Despite such figures, their numbers are growing (U.S. Department of Education, 2010).

Most of the research focuses on mitigating unwanted student behavior that interferes with the learning process. As such, academics often will take a back seat to maintaining a positive learning environment through behavioral interventions. Because students with EBD often demonstrate unwanted behaviors, teachers and researchers are quick to investigate and implement behaviorally focused interventions in hopes of addressing the misbehavior. Little attention is given to resolving the actual academic deficit. However, there has been more focus on academic instruction for students with EBD. Of all the academic areas, mathematical deficits for students with EBD continue to be an area of utmost concern for educators across the nation (Mulcahy & Krezmien, 2009). Nearly all states institute content or curriculum standards in mathematics (Woodward & Montague, 2002). The requirement of meeting such demanding standards mandated by governmental legislation leaves many children and youth diagnosed with EBD ill-prepared for their future (Wehby, Lane, & Falk, 2003). In a study conducted to investigate a national report called *The Academic Achievement and Functional Performance of Youth with Disabilities: A Report from the National Longitudinal Transitions Study-2 (NLTS)*, Wagner et al. (2006) noted in their review that although academic conditions are improving compared to years past, students classified as EBD are still more apt to become disconnected from instruction; drop out of school; or even become incarcerated. Furthermore, the pressure on educators to help students achieve higher levels of academic standards, as delineated by NCLB, leaves educators frustrated and at a loss for dealing with students that have academic deficits coupled with emotional or behavioral challenges.

Students identified by schools as being at-risk pose many of the same challenges as their peers identified as EBD, and were included in this study because of the many academic deficits these two subpopulations share. According to the Texas Education Code, there are several conditions that must be met for a student to be considered at risk in Texas. These include: not advancing at least one school year; failing grade appropriate state assessments; and not meeting certain socioeconomic identifiers (TEC 29.081). The research literature holds very few studies that identify or test effective mathematical interventions for students considered at-risk (Flores & Kaylor, 2007). In the past, both direct instruction and mnemonic strategies have proven effective in solving fractions, but word problems still pose a unique problem for students who struggle with mathematical procedures. Even as far back as 1990, the curriculum and instructional problems associated with students who are at-risk bear many similar characteristics of those students diagnosed as EBD. They include: “narrow curricula, a focus on lower-level skills, inappropriate instructional strategies, inappropriate materials and resources, over-reliance on standardized test results, tracking, and pull-out programs: traditionally educators’ beliefs and attitudes toward particular students and their parents have been blamed for students' failure” (Hixon & Tinzmann, 1990, p. 5). Although there is now an emphasis placed on integrating all students with disabilities in classrooms, the least restrictive environment (LRE) approach was not always considered the first placement option in years past; especially when these students would disrupt the classroom frequently, as was the case with children diagnosed with EBD. Knitzer, Steinberg and Fleisch (1990) advocated that educators should reconsider the practice of pull out programs because students with disabilities, especially those diagnosed with EBD, were often not exposed to grade level curriculum. They also noted that too much emphasis was placed on getting students with EBD to behave and not enough attention was focused on academic skills for these students to be re-integrated into the general education classroom with their peers. Knitzer and colleagues also alleged that these students should be provided better resources in the classrooms and given increased mental health services and supports to help them be more successful in school.

This study focuses specifically on a mathematical intervention strategy known as Schema Based Instruction (SBI). SBI was chosen because of the emphasis placed on learner acquisition of math word problem skills by combining both visual diagrams and schematics with direct instruction. Most students with learning disabilities struggle with math (Xin et al., 2002). Therefore, today's teachers can no longer simply teach their lesson without ensuring that all students not only understand what is expected of them, but can also apply this knowledge in different contexts. The National Council of Teachers of Mathematics (NCTM) emphasized the importance of students' understanding the conceptual nature of the math problem rather than relying solely on rote memorization (Maccini, Mulcahy, & Wilson, 2007). Educators must bridge the gap between what is written in textbooks to life beyond classroom walls.

What is SBI?

SBI involves the use of semantic cues and schematic diagrams to illustrate the relationship of objects in the problem text (Jitendra et al., 2009). A checklist is provided to each student while the teacher models the necessary intervention technique. As students progress in understanding, they eventually are able to use SBI to make their own link from conceptual understanding to application independently. According to a study conducted at Vanderbilt University, "the link between the development of schemas and problem solving, especially for young and low-performing students, awaits experimental demonstration. Establishing such a link is potentially important for extending our understanding of problem solving and for guiding effective instructional design in this area" (Fuchs et al., 2004, p. 636). Being able to solve word problems using mental maps and diagrams would be of great benefit to any student that is struggling to cognitively process given information. All too often, the student gets bogged down in simply understanding what is being asked of them. Students often struggle answering math questions because they do not possess a sufficient repertoire of strategies to access cognitively in order to reach a solution. This is akin to being lost in a large city without having a map or global positioning system (gps), which many people rely on to help them navigate locations. Similarly the math interventions taught to students are maps to help them navigate and reach their destination of understanding numbers and mathematical problems.

Asha Jitendra (2007), a leading researcher on SBI from the University of Minnesota, describes in her book that the emphasis of SBI is to make certain that students are able to move beyond simple rote memorization and actually apply concepts in order to improve understanding. As defined by Gick and Holyoak (1980), a *schema* is "a general description of two or more problems, which students use to group problems into types that require similar solution methods" (p. 307). SBI has been utilized to improve comprehension in other academic areas as well. For example, in science, Cosgrove (1995) concluded that schema-induced analogy could be used to "facilitate the meaningful association between new content and prior knowledge, which would result in a perceived improvement in learning as measured by concept recall and knowledge transfer" (p. 296).

Background of the Problem

Between 2-20% of the school age population demonstrate behavior patterns indicative of EBD (Walker, Ramsey, & Gresham, 2004). Students with EBD have externalizing and internalizing behavior patterns that, by definition, impede social, behavioral, and academic progress and create challenges for society as a whole. In the school environment, their lack of decorum and limited social skills often demand an inordinate amount of a teacher's attention; interfere with instruction; lead to impaired social relationships; and impede academic instruction and the subsequent learning of other students in the classroom. Further, students with EBD have poorer attendance, are more likely to be retained, and have higher school dropout rates than any other disability category (Bullis, Yovanoff, & Havel, 2004; Wagner et al., 2006a). Beyond the school setting, students with EBD are characterized by high rates of unemployment and under-employment; negative employment experiences; impaired personal relationships; and a greater need for mental health services (Bullis et al., 2004; Walker et al., 2004). Another undesirable outcome for many students with EBD is their increased likelihood of discipline referrals. According to a report generated by the non-profit legal agency Texas Appleseed titled *Texas' School-to-Prison Pipeline: Dropout to Incarceration,* in the 2005-2006 school year, students identified as requiring special education services accounted for 11% of the total student population who were receiving services through the Texas Youth Commission (Fowler et al., 2007). However, by 2011 across the state of Texas, their placements in alternative discipline settings have been doubled for district alternate educational placement (DAEP) (22%); out of school suspension (26%); and in school suspension referrals (21%). Almost a third of the school districts have referred students with special needs to DAEP (Fowler, 2011).

In the same article, Fowler states that students in DAEP are more likely to dropout or become part of the juvenile justice system. More alarming still was the estimated prevalence rate of youth in correctional facilities who have a diagnosed disability. In a national survey conducted by the U.S. Department of Corrections, up to 70% of juveniles incarcerated have a diagnosed disability (Quinn, Rutherford, Leone, Osher, & Poirier, 2005).

Although students with EBD represent the fewest number of students who had special needs and were being served in the general classroom, their numbers continue to grow, and inclusion for these students has been implemented without careful planning (Baker, Lang, & O'Reilly, 2009). General education teachers have reported a lack of the necessary skills needed to support students with EBD (Lopes, 2007). Many teachers report being frustrated at the lack of academic progress demonstrated by these students and by the lack of quality instructional math strategies available to them. Furthermore, with so much attention being paid to dealing with misbehavior, students with EBD are often neglected academically. Knitzer and Cooper (2006) reported that students with mental health problems were more likely to drop out of high school (44%) than any other disability category; receive failing marks (14%); become bullies (36%); be subject to disciplinary referrals (64%); or become incarcerated (35%).

Several additional academic interventions, aside from SBI, merit discussion. Students with EBD share many of the same academic deficits as their peers with learning disabilities (LD); therefore, many of the evidenced-based interventions used with students with LD have been found to be beneficial to students with EBD. In a 2007 study, Maccini, Mulchahy, and Wilson focused on three specific strategies educators used to teach students with LD who were struggling with mathematical word problems: Cover Copy Compare (CCC); Mnemonic Strategy Instruction (MSI); and Graduated Instructional Sequence (GIS). The authors used a multiple baseline across behaviors design (AB) to determine the effect of the CCC procedure on the percent of multiplication facts correctly completed by students with LD. The intervention phase consisted of instruction on the five steps of the CCC procedure: "(1) look at the first completed math fact, (2) read the problem aloud and copy the answer, (3) cover the problem, (4) read the problem aloud and write it from memory, and (5) compare the answer to the original problem" (Maccini, Mulchahy, & Wilson, 2007, p.63). The researchers reported an increase in the percent correct between baseline (31.6%) and the treatment condition (98%). The second strategy, MSI, used words to make associations when solving problems. Other research by Test & Ellis (2005) utilized a similar strategy: By using the acronym LAP (which stands for look at the problem) ask yourself "Will the denominator divide evenly into the numerator?" and pick your fraction type. The last strategy utilized was GIS, a three-phase process of moving from concrete instruction to semi-concrete followed by abstract instruction. Each strategy demonstrated varying degrees of success; however, these results must be interpreted cautiously because they are the result of a single case study for each intervention analyzed.

Another study conducted in 2003 focused on Peer Assisted Learning (PAL) coupled with curriculum based measurements (CBM) as a means of intervention. PAL occurs when students of similar academic levels are paired together and tutor one another in the deficient area. The participants are then given blocks of instruction to determine academic growth as evidenced by increased math scores. The study only demonstrated a moderate gain of computational skills (Calhoon & Fuchs, 2003). The outcomes were noted to be questionable because pairing individuals of like abilities yield like results and was a limitation noted by the researchers of this study.

Statement of the Problem

Students diagnosed with EBD or classified as at-risk learners need exposure to effective, research-based mathematical interventions to assist them with learning word problems. They often lack the ability to connect concepts to application. SBI, as evidenced by multiple studies, appears to be a viable solution for such students. However, research into SBI has been limited primarily to reading instruction.

In the field of mathematics, this strategy is typically confined for use with more mundane operational tasks such as addition and subtraction (Jitendra & Hoff, 1996). It has not been determined how effective SBI would be for more complex procedures. Also, since a majority of the studies conducted utilized a limited number of participants and were based on findings that were a result of single subject designs, being able to differentiate between whether SBI was the cause of the actual academic gain or a product of the more intense and individualized instruction has not been determined.

Schema acquisition is a fundamental aspect of being able to solve word problems (Xin et al., 2002). Students must be able to solve problems by understanding how they are similar structurally and subsequently develop an ability to generalize concepts from such recognition. It is a complex process that many students perform automatically. Yet despite how important this skill is, it is seldom taught in the general math classroom. Recently, there has been empirical evidence supporting SBI as a method for reaching struggling math students, especially those diagnosed with either LD or EBD (Jitendra, DiPipi, & Perron-Jones, 2002). In another study, participants learned how to first identify the problem structure (i.e., the type of math problem) and then how to use a schema diagram to organize and represent data in a manner which made solving the problem significantly easier (Xin, 2008).

Significance of the Study

This study is an extension of several studies that examined SBI as an effective mathematical intervention strategy for middle school students with LD. As educators and students are being exposed to more rigorous questions in the form of word problems on standardized tests, it is imperative that math interventions address the specifics of this type of skill deficit. Participants in this study were assessed using measurements created by Jitendra (2007) in order to ensure a higher degree of conformity between what is being taught and subsequently assessed. Unlike previous studies of SBI, this study was unique in that a) the participants were selected from a rural West Texas population, b) the focus of the research did not specifically include additional behavioral strategies, c) focuses were on solving more complicated math problems that include multiplication and division, and d) the participants involved both middle school students identified as EBD and at-risk.

Purpose of the Study

The purpose of this study is to determine how effective SBI is as an instructional math strategy for middle school students struggling with two types of math problems:

multiplicative compare and varying. Specifically, SBI uses a paradigm of teacher-mediated instruction followed by paired partner and independent learning activities. It scaffolds student learning using visual diagrams and checklists that are eventually faded as students become independent learners. A self-monitoring schematic or plan (FOPS; in which F represents *Find the problem type*, O represents *Organize the information in the problem using the diagram*, P represents *Plan to solve the problem*, and S represents *Solve the problem*) is used to anchor student learning in preparation for the transition from teacher-mediated instruction to independent learning (Jitendra & Star, 2011).

Research Questions

The following questions will addressed: a) What effect does SBI have on student understanding of math word problems that involve multiplicative compare and varying types of questions as demonstrated by increased scores on provided assessments? b) Are the effects of SBI maintained in the absence of intervention? and c) How will the participants evaluate the effectiveness and acceptability of SBI?

Limitations of the Study

There are several limitations on this study. First, the sample size utilized for this study was small (N=4). As such, the ability to generalize to other settings or larger populations may be difficult. Secondly, the participants in this study were familiar with the author of this study as a teacher on their school campu, which may have affected their performance. Thirdly, because the SBI program being utilized also encourages the teacher to use differentiation techniques to support learning, it becomes problematic to separate the effectiveness of SBI as a stand-alone intervention. Lastly, some researchers claim that the methodology chosen (Single Subject Multiple Baselines) is not as scientifically rigorous in supporting research driven decisions as larger, more quantifiable types of experiments (Parker & Hagan-Burke, 2007). However, given the inherit flexibility of using a single subject design (SSD) and the unique nature of this research, SSD was an ideal method for further inquiry.

CHAPTER TWO

LITERATURE REVIEW

The four primary categories of this literature review were selected from articles associated with schema-based instruction; general math strategies for word problems; specific interventions for students diagnosed with EBD; and math strategies for students considered at-risk. Numerous articles were identified that delineated the importance of understanding word problems by students. Many students diagnosed with EBD struggle with the application of conceptual math knowledge in order to solve such math word problems. To complicate matters, secondary students with EBD are more likely than their peers with other disabilities to earn poor grades; to be retained a grade; or to drop out of school before graduation (Wagner et al., 2006). Secondary general and special educators reported teaching mostly basic arithmetic skills rather than essential conceptual knowledge and skills to secondary students with EBD (Maccini & Gagnon, 2000). The literature clearly showed that the population of secondary students with EBD had limited access and success with non-computational mathematics concepts. Despite the known mathematic deficiencies of youth with EBD or at-risk of failing math, little attention had been paid to developing and implementing effective mathematics interventions for these students. In a methodological review of mathematics intervention research literature, Mulchahy and Krezmien (2008) found that only 11 studies had been conducted with secondary students with EBD since 1975. Furthermore, these studies focused primarily on basic skills and computation.

Even more alarming was the prevalence of learning disabilities among incarcerated youth in America. In general, the rate of offenders diagnosed with disabilities ranged from thirty to sixty percent (Morris & Morris, 2006). This was a staggering statistic that was even more compelling when actual numbers were considered. According to the Texas Youth Commission (2010), the number of new youth commitments had slowly declined from 2558 in 2003 to 1056 in 2010. However, this was offset by the increasing costs of providing for each youth per day. Costs were $154.94 in 2003 to $359.98 in 2010, an increase of 232%. The average length of stay of a juvenile in a correctional facility was 17.1 months or 521 days. If multiplied by $359.98, the cost was an astounding $187,549.58 per youth! In 2010, there were 1876 juvenile offenders, making the total costs of $351,843,012.10 to taxpayers in Texas. Of these juveniles, 93% were males; 34% were identified as receiving special education services; 34% were African-American; 13% were Caucasian; 21% were Hispanic and 44% were associated with gangs.

Emotional Behavioral Disorders

This literature review began by delving into recent research conducted on successful math interventions for students diagnosed with EBD (Templeton, Neel, & Blood, 2008). This study was a meta-analysis of which math interventions which effective for students diagnosed with EBD. In total, the researchers reviewed fifteen single subject research designs. A percentage of non-overlapping data (PND) was used to measure the treatment effects of the math interventions utilized in the 15 cases. To ensure that there was no dependency present, a Spearman correlation was used. Nine interventions (56%) focused on elementary aged participants, four of the interventions (25%) dealt with secondary students, and two on a mixture of both groups. Of those studies that reported gender, 91% were males. Half of the interventions took place in a public school setting. Six of these studies occurred in an isolated resource room and the rest in a general education classroom. In 50% of these interventions, the participant was in charge of his/her own intervention. Fourteen of the sixteen (87.5%) studies focused on math as the primary targeted deficit area. Of these studies, 62.5% were concerned with math computations rather than math facts. Furthermore, maintenance and generalization results were not entirely positive (Templeton, Neel & Blood, 2008).

The Center for Disease Control (CDC) reported in 2001 that the needs of students with EBD were a national concern and often required help beyond what schools could provide. This survey was conducted in 2001 and included interviews of 38,886 families with a 97.6% participation rate. Among the families identified as having a student with a learning disability, 28.7% parents reported EBD related behaviors both at home and in school. Furthermore, 64.8% of those families whose children were diagnosed with EBD in the survey had contacted mental health services.

Outcomes for students with EBD continued to be of great concern, as data had shown little improvement since the early 1980s, when the first longitudinal studies that included this population began. Longitudinal studies such as the Special Education Elementary Longitudinal Study (SEELS), the National Longitudinal Transition Study-2 (NLTS2), and the National Adolescent and Child Treatment Study (NACTS) established that only small gains had been achieved for students with EBD in the areas of academic achievement, social interactions, and long-term adult outcomes (Bradley, Doolittle, & Bartolotta, 2008).

In the past fifteen years, two major legislative acts have had considerable impact on the instruction of both general and special needs students. Originally titled the

Education for All Handicapped Children Act, the Individuals with Disabilities Education Act (IDEA), signed into law in 1975 and later reauthorized in 2004 to ensure that all children, ages 3 to 21, regardless of their type of disability, were given a free and appropriate education (FAPE). IDEA operates on six major principles: zero reject; due process; parent participation; FAPE; transition assistance; and least restrictive environment (LRE). The focus of a study by Mooney, Denny, and Gunter (2004) was to determine the academic impact of the legislative mandate of No Child Left Behind on students with EBD. The major tenants of NCLB are: "the hiring of highly qualified (HQ) teachers; decisions based on scientific research; adequate yearly progress (AYP); and access to the general education curriculum" (Mooney, Denny, & Gunter, 2004, p. 238).

As of 2005, all teachers had to attain specific requirements established by the state board of education. However, not all states had the same standards for meeting the mandates of NCLB. For instance, in Texas, teachers reached HQ status by passing certain assessments in addition to possessing a four-year college degree. In Indiana, educators needed only to meet the HQ standard by passing a Praxis II exam. A specific teacher preparation program (either traditional or alternate certification) was not required. Despite increasing such standards, there was still a lack of conformity of training for pre-service special education teachers. Additionally, most general education teachers were ill prepared for teaching students with disabilities because they had not been given enough exposure to differentiated instructional techniques and behavior management solutions that could assist them in delivering high quality instruction to all students, including those with disabilities.

Mooney et al. (2004) found that the answer to meeting higher academic standards did not lie solely within the requirement for more stringent licensing and content knowledge assessment. Higher achievement would be obtained by more effective instruction in the classroom in both special and general education. Yet the research on the implementation and maintenance of scientifically based practices was not overly promising. Both NCLB and IDEA addressed the level of instructional interventions used to help students with special needs in the classroom. In years past, special education teachers had used curriculum and materials that were available rather than any based on scientific research. As such, their students were exposed to a miasma of instruction. Basing their curricular decisions on evidenced-based research would enable teachers to focus on applying the appropriate interventions that had already been proven effective.

Another consideration of NCLB and IDEA was that all students, including students with disabilities, should be making adequate yearly progress (AYP) regardless of the nature of the disability. However, most state special education directors realized that AYP need not pertain to students taking alternative forms of the state mandated tests because of severe cognitive deficiencies (Mooney, Ryan, Uhing, Reid & Epstein, 2004). IDEA also ensured that students with disabilities had access to the same general education curriculum as their non-disabled peers. This requirement was one of multiple reasons that proponents of full inclusion insisted that students with disabilities be educated with their general education peers in the classroom. By giving students with disabilities the same access to the general education curriculum, students with disabilities had the same opportunity to strive for more positive academic outcomes alongside their same-age peers.

Lane (2007) stressed that various levels of academic interventions were most beneficial to struggling students who required more complex interventions. The first level of intervention involved more general, broad support to include curriculum-based measurements and other alternate forms of assessment. The majority of the students fell into this first level of intervention. The secondary level involved more intensive, one-on-one intervention to correct an academic deficit. Students with multiple risk factors were typically found to fit into this second level. The third level of intervention was for those few students who needed assistance beyond just academic intervention. Lane's study focused on two distinct populations within this article: elementary students and middle school students. It was the second population that is most applicable to this study. Specifically, Lane analyzed the relationship between academic underachieving and problem behavior. Sixty-eight students were identified based on school data (GPA < 2.7) and EBD diagnosis. Twenty-five of these students were 7th graders and forty-nine were 8th graders. Students were split into three groups and received intervention in one of three categories: study skills, conflict resolution, and regular school practices (control group). Data was actually collected on only forty-five students. Those students in the control group received regular daily instruction. Those in both the study skills and conflict resolution classes were taught over a period of 9 weeks in a 50-minute instruction block of time. The first 30 minutes was the instructional intervention, and the last 20 minutes was application of the intervention (study skills and conflict resolution). Pre- and post-tests were conducted, as well as a follow up maintenance probe. Although the results showed significant progress, students' overall general knowledge still remained low, with mean scores less than 70%. The results of this study did not prove to be as successful as expected. Although there were some gains, they were minimal in comparison to the control group's outcomes. Lane concluded that future research needed to be conducted which involved (a) extending the intervention length to longer than nine weeks, (b) focusing on more intensive interventions, and (c) utilizing team teaching in each group.

In another article, Lane and colleagues focused on the use of research-validated practices in classrooms for students with EBD and noted that the use of best practices in public schools were very inconsistent. Their observations asserted that the research-to-practice gap was due largely to the lack of clear and consistent criteria to determine what constitutes research-based practices and address the absence of support structures to assist educators in implementing research-based practices. This study called for the field of special education to develop and adopt a universal set of standards for the implementation of academic interventions (Lane, Barton-Arwood, Nelson, & Wehby, 2008).

Lane conducted another study in 2007 that examined (a) how students were identified as requiring additional academic interventions and (b) what research-based methods met both the academic and behavioral needs of students with EBD (Lane, 2007). Lane stated that most of the current academic research on students with EBD was in reading, with limited studies being conducted in other academic areas such as science, social studies, and math. She also stated that of the few studies available, similar limitations existed, including (a) very few secondary level students; (b) limited attention to higher level skill acquisition; (c) most designs lacked integrity, fidelity, generalization; and (d) very few replications had been conducted. This study consisted of eight students carefully selected by the researcher after parental consent was obtained. Three graduate students under the immediate supervision of Lane gave instruction to the participants. A specific positive behavioral support system called self-regulated strategy development (SRSD) was used in the research to increase writing scores. A multiple baseline across participants was then used to determine the effectiveness of the instruction. A positive correlation was established in all subjects that demonstrated an overall increase in scores after SRSD was provided. The results of this study revealed comparable improvements in both writing and behavior. Lane also suggested that the extended research should look at a larger subject pool and consider incorporating additional academic instructional material (Lane, 2007b).

Billingsley, Scheuermann, and Webber (2009) examined the effectiveness of three instructional strategies for students with EBD in high school: traditional direct teaching instruction; direct teach computer-aided instruction (CAI), and a combination of both methods. The 10 participants were in grades 9-11 and were selected because of their need for intense interventions. All of the subjects were served in a segregated, isolated resource room in a public, urban school setting. One of the researchers was also the teacher of record. A baseline was created using three curriculum-based quizzes. The students were then instructed using each of the three instructional techniques over a period of three weeks per intervention. The best treatment was then decided by the highest-scored mean average of the students. In this study, the dependent measure was teacher-constructed curriculum-based assessments (CBA). None of the instructional conditions were uniquely beneficial to every participant. Some participants had more success with computer-aided instruction, while others experienced success with a combination of direct teach and CAI. The results varied so much that the researchers were not exactly certain which methods were the most effective. Several students exhibited minimal gains, and one student actually regressed in academic achievement. As with most students who are diagnosed with EBD, it is quite possible that the student's behavior due to his/her disability interfered with the results of the study. Defiance was present in three instances that impacted the findings. A researcher must be careful not to immediately write off the interventions as ineffective until careful consideration was given to circumstances surrounding the study, and, primarily, the subjects and how they chose to participate in the research.

A study conducted several years earlier looked at which academic interventions would have the most impact academically on students with EBD (Pierce, Reid, & Epstein, 2004). This study looked at teacher-mediated interventions to improve the academic performance of EBD students in particular. Teacher-mediated interventions occurred when the teacher of record took responsibility for the intervention and manipulated antecedent/consequences. This would fall well within the realm of regular responsibilities of most teachers in charge of such students. Two distinct types of experimental designs were utilized to include single-subject and group studies. The use of both types of experimental designs complemented one another and addressed issues the other might not account for during a study (Kazak et al., 2010).

In 2010, the Council for Exceptional Children (CEC) published an article that looked at specific inquiry-based interventions for students with EBD (Cole & Washburn-Moses, 2010). According to the CEC, inquiry-based teaching was a student-centered approach that often involved students solving problems in groups that required them to apply a variety of mathematical skills in real-world contexts. Most of the teachers involved in this study stated that collaboration among teachers of students with special needs was non-existent. The authors identified several strategies for students with disabilities to include: schema-based instruction, cognitive strategies, peer-mediated instruction, scaffolding, concrete-representational-abstractional (CRA) instruction, and mnemonics (Cole & Washburn-Moses, 2010). CRA is similar to SBI in nature but with more emphasis placed on using manipulatives over diagrams. The implications of the study: that in order to be effective, teachers are going to have to incorporate a multitude of different strategies to reach struggling students. Acquisition is an integral part of comprehension and requires educators to develop instructional methods to develop the deeper student understanding. One example of a cognitive strategy mentioned in the article was “Say, ask, check” in which students can make certain they understand the meta-cognitive process of solving a problem. Scaffolding occurs when students build upon prior knowledge with assistance from the teacher. Peer-mediated learning occurs when two or more students are grouped together to facilitate learning. Although the tendency was to pair according to ability level, educators should be mindful that pairing low level students together often yields low results. Conversely, pairing a high level student with a low achieving student can be beneficial to the learning process, thus, teachers should be aware of what student pairing combinations work best. For instance, many educators paired struggling students with higher achieving ones in order to assist in the learning process through peer interactions. CRA started the learning process by introducing manipulatives to solve a math problem based on the individual needs of the student. Next, the student moved on to representational problems using pictures or diagrams. After this phase, the student was then tasked with solving the problem, as they would traditionally see it on paper. In other words, CRA addresses multiple learning modalities to solve a math question.

Fitzpatrick & Knowlton (2009) conducted a study that analyzed the perceived gap between research and practice for educators attempting to teach math to students diagnosed with EBD. This study considered the impact technology would have if integrated into instructional practices, and if by doing so, their participants would become more self-directed. Four barriers were identified that prevented general education teachers from incorporating research-based strategies into their classrooms: inadequate resource materials; lack of administrative support; personality differences between students and teachers; and student misbehavior (Fitzpatrick & Knowlton, 2009). The first suggestion made by the authors was to identify special education teachers willing to use technology in the classrooms. According to Fitzpatrick and Knowlton, technology seemed to come more naturally for the “younger” generation of teachers, especially those born in the 1970s & 1980s. Those teachers seemed to transition into technology more seamlessly than their older counterparts. Second, teachers and educators needed to collaborate more frequently. Furthermore, “regarding knowledge derived from research and knowledge drawn from practice, neither should be discounted in favor of the other” (Fitzpatrick &Knowlton, 2009, p. 255). The researchers then discussed the potential importance a virtual environment could play by enabling the students to take chances they normally would not, in order to learn. Students felt safer making decisions in a virtual environment without the permanent consequences of failing in reality. For example, there was on-going research being conducted using virtual reality software such as Second Life© in helping children with autism learn and relate to and from others (Ehrlich & Miller, 2009). Fitzpatrick & Knowlton (2009) conclude that technology is perhaps one method of overcoming the research-practice gap that challenges many educators today.

Nelson, Benner, Lane, and Smith (2004) studied the extent to which children diagnosed with EBD experienced academic achievement deficits according to age and gender differences, as well as specific behavioral problems stemming from issues. A cross-sectional design was used over a period of four months. The sample size consisted of 155 male and female students, ranging from Kindergarten to 12th grade, who had been identified as receiving special education services for EBD. The urban school district they were part of was overall, considered to be a fairly high achieving academic district located in the Midwest of the United States. Forty-six percent of the students in the study were in elementary and 54% were in secondary. Of these students, 23% of the elementary students were females; 77% were Males; and 13% of all the students were taught at the secondary level. Thirteen percent of these participants were Caucasian, 11% were African-American, 3% were Hispanic/Latino, and 2% were Native American. The African-American subset of this study was under represented in regards to overall percentage of population. In order to determine academic achievement levels, the participants were individually administered a Woodcock-Johnson III (WJIII-Ach) achievement test. A Child Behavior Checklist: Teacher Report Form (TRF) was also used to determine and record behavior problems. Each student's primary special education teacher administered the TRF to their respective student while six trained data collectors gave the WJIII-Ach and conducted any subsequent data follow-up. Both tests were given in an isolated setting away from potential distracters. Also, the data collectors recorded the mean IQ of each participant from their student records. The Wechsler Intelligent

Scale for Children (WISC-III) was the diagnostic tool used for determining intelligence. Twenty-nine males were randomly selected from the participants and analyzed in conjunction with twenty-nine female students in order to compare potential gender differences in the administered achievement clusters of the WJIII-Ach. The dependent variables in this study were (a) social adjustment; (b) academic achievement; (c) ethnicity: (d) hours of special education services received; (e) and IQ. No intervention was implemented; therefore, no independent variable was utilized. The first finding of this study reinforced the assumption that students with EBD have larger academic deficits than their general education peers. Secondly, math proved to be the more difficult subject for students with EBD to master despite scoring in the normal range in both reading and written categories. Lastly, the researchers demonstrated a positive correlation between the degree of external misbehavior exhibited and poorer academic performance.

At-Risk

Educators at all levels are concerned with the growing population of students who are at-risk for failing school. Over the past thirty years, the numbers of students that fit in this category are growing at an alarming rate. Although it is often difficult to get exact figures due to the complexities of obtaining data from these students and their families, the increasing numbers are alarming. In 1990, available data at that time showed that there were approximately 4,412,000 reported students in the United States that would be considered at-risk. As of 2008, that number was closer to 20 million (Nelson & Eckstein, 2008), which represents about 26% of the total student population ages 3-21. Students who are identified as at-risk for failure have unique and complex needs that must be met through a collaboration of stakeholders. Teachers and administrators alike have to meet the increasing challenges faced by students who are at-risk because these students are six times as likely to drop out of school prior to graduating as other students (Johnson & Perkins, 2009). Low-income schools and communities have been affected the most and are considered three times more likely to have a higher rate of at-risk dropouts than the national average of school-aged pupils (Bemak, Chi-Ying, & Siroskey-Sabdo, 2005). Counselors are now tasked with filling the dual role of advocate for students-at-risk-of -failure and school liaison to their families.

In 2007, an exploratory study was conducted to determine how effective direct instruction (DI) would be on at-risk middle school math students in Texas (Flores & Kaylor, 2007). The participants were thirty seventh-graders from a rural community outside of a large metropolitan city. None of the students involved in the research had a diagnosed disability, but all were identified as being at-risk for failure. They were categorized as at-risk because all of them had failed their designated state assessment, which is one of the requirements for at-risk classification listed in Texas Education Code 37.006. Student progress was measured before and after intervention, using a t-test to determine statistical significance. The curriculum adopted for the intervention came primarily the from text *Corrective Mathematics; Basic Fractions* (Engelmann & Steely, 2005). Instruction would occur over a 7-week period for four days week in a 50-minute timeframe consisting of twenty minutes of review and thirty minutes of new material.

The students were not given feedback on their pre-test performance. The average mean score was 20% with actual scores ranging from 0-57%. The most common errors were difficulty relating fractions to their whole parts (i.e., 12/12 = 1); adding/subtracting fractions; and multiplying/dividing fractions. Their post-test mean performance was 77%, demonstrating a perceived increase in understanding. The t-test result was 16.224, which was significant at the .005 level, thereby indicating a very small probability of the increase occurring by chance. The study reflects the current knowledge base that DI is a powerful instructional tool that can also increase time on task and inhibit undesired classroom behavior because the students are engaged in the learning process. One limitation of this study is that DI was taught not by the teacher of record, but by a trained specialist. Second, very few teachers on the campus had the prerequisite skills necessary to carry out the intervention on their own. Lastly, it was difficult to state how much of the success was DI or the curriculum used, or a combination of both, since they were used simultaneously. More research studies have been conducted (and are available) on DI than on SBI, which supports the importance of the current study.

Research has proven that the earlier educators can intervene and provide academic and behavioral support, the better children respond to such measures. In Hawaii, a study was conducted on first graders who were exhibiting both social and academic difficulties (Ornelles, 2007). The purpose of the research was to increase and sustain academic engagement and to initiate interactions by addressing the following issues: Can a structured intervention teach students how to participate in classroom activities, and initiate student interactions with teachers and peers? The setting for this study occurred in a large public school in an urban setting. The three students selected for this study were chosen based on the school district's kindergarten checklist and teacher referral. A multiple baseline across students was used to determine the effectiveness of the intervention to bring about the desired changes in student behavior. The first phase of the intervention focused on behavioral issues, and the second was concerned with addressing academic deficits. The results of this study did indicate increased levels of engagement and interaction and also demonstrated that a structured intervention can yield positive results for young students. Peer interactions are a valuable asset for learning. Another implication of this study was that additional emphasis needs to be placed on utilizing more peer interactions in the classrooms at all levels in order to increase engagement and learning.

Accurate assessments are vital to determining how well students are learning in the classroom. A quantitative study was used to determine the perceptions of students who are at-risk and the perceptions of their teachers on the use of classroom assessment and their related strategies (Rieg, 2007). Rieg was concerned with three primary questions: (1) What are the perceptions of junior high school teachers on the effectiveness and use of various assessments and assessment-related strategies?; (2) What are the perceptions of at-risk junior high students who are at-risk as to the effectiveness and use of various assessments and assessment-related strategies?; (3) How do the perceptions of junior high school students who are at-risk compare to the actual effectiveness and use of various assessments and assessment-related strategies? A total of 119 students identified as at-risk and 37 teachers were included in the research. All of the student participants attended public schools in suburban Pennsylvania. Two Likert-scale survey instruments were created to measure student and teacher perceptions related to assessments. The results of this study demonstrated that although teachers found assessments to be useful, not many were using them. Furthermore, students who were afforded an opportunity to choose which assessments are used in the classroom had a more positive perception of their use. Also, the integration of a supportive environment boosted student morale and increased student self-efficacy. A statistical significance (36%) was recorded between teacher and student perceptions. In contrast to the students' positive response to their choosing assessments, their teachers overall, were more critical of involving students in the decision-making process.

Math Word Problem Strategies

Another unique component to this review of literature was that it did more than delve into the effectiveness of SBI as an intervention. More specifically, it examined SBI as an intervention used to help struggling students solve math word problems. To expand on the current knowledge of how students diagnosed with EBD solve math word problems, Fuchs and Fuchs (2002) used a hierarchy of three kinds of mathematical word problems in an effort to determine which particular type of problem had the best results in initial student comprehension. The first word problems were arithmetic story problems, which presented essential text simultaneously with each question and required one-step number facts for solution. The next types of problems were complex story problems. These problems presented longer text that included nonessential details (but no irrelevant numbers) and required one- to three-step operations involving algorithms and applications. The last type consisted of real-world problem sets also requiring the same one-to three step math skills as those required for complex story problems, but infused with more practical situations encountered beyond classroom walls. On each measurement, the accuracy of the students' performance decreased across the three problem-solving tasks. Averaged across the performance dimensions, the accuracy of students with EBD fell from 75% for arithmetic story problems to 14% for complex story problems to 12% for real-world problem solving. Among students with both math and reading disabilities, these percentages were 55%, 8%, and 5% respectively. Although this study failed to find reliable differences between complex story problems and real-world problem solving, the result did show that the performance of students with sole math disabilities was better than the performance of the other group of students with both EBD and math disabilities. The results of the arithmetic story problems were compared to either of the more difficult tasks (i.e., complex story problem or real-world problem solving).

Another study looked at specific instructional strategies used by special education teachers to aid students having difficulty solving word problems (Van Garderen, 2008). Results from this study noted that, although the teachers were using study skills to help students develop better understanding, little attention was given to how the students actually retained the information. Another issue was that the word problem scenarios given to the students were not indicative of real life situations the students would have encountered. Van Garderen stated, "While speculation has been made about special education teacher practice, little is known as to what they are actually doing" (2008, p. 135).

Van Garderen (2008) stated that there are simply too many unknown variables when it comes to determining which teacher practices are most effective. These include delivery style; proximity to the student(s); years of experience; and/or the type of intervention. Most likely, it is a combination of multiple variables mentioned and some not even listed. Therefore, the purpose of this study was to examine what instructional practices were beneficial to solving math word problems for secondary students with disabilities. The researcher created a survey to address the following questions: (1) What instructional methods/materials do teachers use for students with disabilities to learn math word problems? (2) What types of word problems do they utilize? and (3) How much time is allocated for their students to solve these word problems? There were 89 teachers that participated in the study (11 male and 77 female), and they were categorized as either "push in" teachers (inclusion/mainstream) or "pull out" teachers (resource/self-contained). Forty-three percent of these teachers taught in an inclusion setting; thirty-seven percent taught in a self-contained setting; and twenty percent taught in a resource room. A majority of the inclusion/mainstream teachers surveyed were using a textbook at or above grade level. Conversely, those teachers in a resource or self-contained setting used below-grade level materials. There was no statistical significance regarding time spent on solving word problems between either "push in" or "pull out" teachers. Most of the teachers dedicated approximately one hour or less to solving word problems a week. The instructional practices analyzed were further classified as either concrete-visualizing in nature or requiring analytical processing skills. As with time dedicated to solving word problems, there was no statistical significance between teacher preferences of the concrete-visualizing over using analytical skill. Despite such findings, this study reported that most of the teachers prefered concrete-visualizing over the analytical (98%) processing. Of utmost concern from this study was that the participants in the study indicated that they use below level material to instruct "pull out" students, which contradicts the notion that all children should have access to the same general curriculum as their peers.

In a study conducted in Spain, Llinares and Roig (2008) illustrated that students, regardless of nationality, experience similar problems with solving math word problems.

The researchers in this study, rather than looking at instructional strategies, delved into how the students mentally constructed models in order to solve word problems. "Modeling should therefore be conceived as a process determined by the context in which the student is able to perceive both the situation and the mathematics in play as two separate but interrelated objects" and that "research indicates that students use informal strategies for solving problems in their attempts to give meaning to stated situations" (Llinares & Roig, 2008, p. 509). In other words, students may actually be able to give the correct answer but no idea what it means given the context of the situation. This study was conducted for two reasons: first, to explain the process of modeling situations as it pertains to student competence; and second, to help further understand how the student mathematically develops new concepts. This study consisted of 511 subjects ranging from 15 to 18 years of age. The initial survey provided three scenarios that required the student to mathematically solve. Next, each response was ordered on a scale of 0 to 3, with zero meaning the student was unable to accomplish the goal and unable to explain their reasoning. Level three indicated that the student possessed the skills necessary to structure their correct answer with justification. An emergent trend resulted from the data collected. Students were generally unable to distinguish the relationship between the general and the particular (76%), and they struggled with using their own experiences to help them solve situational problems. Students with higher cognitive abilities were able to make the transition more readily. Also, 61% of the students in the study had difficulty describing how they solved the problems. Because most of the word problems encountered in a math classroom are direct in nature, students have difficulty using models to assist them in conceptualizing, then solving the problem

(Llinares & Roig, 2008).

Researchers in Japan conducted a study that compared the class activities and perception of Japanese and New Zealander students as they used self-constructed diagrams when solving math word problems (Manalo & Uesaka, 2006). This study included 614 secondary students from Japan and New Zealand with the average means being 13.28 years and 13.97 years respectively. Of the 291 Japanese students, 45% were female and 55% male. The New Zealand cohort consisted of 41% females and 59% males. A booklet containing the problems and questionnaires were given to the Japanese and New Zealand participants. Each booklet was written in either Japanese or English depending on the student in the study. The emphasis on each problem was based on real life scenarios each student might encounter. One issue initially identified was that students generally did not feel the necessity to use diagrams when solving math word problems. They simply did not see the relevance of pairing visual schemas with conceptual learning despite the importance teachers place on using diagrams in the classroom. Often, a teacher would draw diagrams when solving a problem on the whiteboard, yet students seldom replicated such behavior. One of the researchers (Ichikawa) concluded from an earlier student interaction that “students do not use diagrams spontaneously if they do not perceive the efficiency that results from their use – even if they are perfectly capable of using diagrams as well” (Uesaka, Manalo, & Ichikawa, 2007, p. 326). Students in New Zealand, based on their national math standards, were more often exposed to rigor emphasizing the use of diagrams to solve math problems. Also, based on the Program for International Student Assessment (PISA), New Zealand students scored above average in the section on strategy usage, whereas the

Japanese students, despite scoring well overall on the exam, scored poorly on that specific area. Furthermore, other studies determined that Japanese students were more apt to give up on more difficult challenges (i.e. trial and error) if the problem was not initially solved. The results of the study favored the students from New Zealand. Because they were more inclined to use diagrams to solve their problems, they scored better on their assignments, sometimes as much as an average 28% better on one-step problems and an average of 20% better on two-step problems. This study emphasized the positive impact of being able to diagram word problems on student assessment scores.

Schema-Based Instruction

Although there is limited research addressing mathematical interventions for secondary students with EBD, SBI has begun to be noted in the research as a successful strategy. Asha Jitendra, a leading researcher on schema-based instruction (SBI), began to study the effects that SBI would have on elementary students as they struggled to understand addition and subtraction word problems (Jitendra et al., 1999). In 1999, Jitendra and colleagues studied the effect of SBI on four 3-4th grade students diagnosed with learning disabilities as they attempted to overcome deficits in solving mathematical word problems. The researchers used a multiple baseline across students and across two behaviors. When compared to the results of the normative sample (M=54%), the students using SBI scored significantly better (M=86%). The participants in the studies were two boys and two girls. In addition to those receiving the intervention, 21 normally achieving 3rd graders were included in the study as a control group. The research itself was conducted in a separate resource room in a middle school in Eastern Pennsylvania. The following criteria were utilized when selecting the participants: (a) a chronic neurological condition that interfered with the development, integration, or demonstration of language; (b) severe discrepancy between achievement results and intellectual ability; (c) specific deficits in receptive and expressive language, as well as deficiencies in maintaining attention; (d) normal or above normal intelligence; and (e) learning disabilities that are not a result of some other disabling condition. The one-step problem example is shown on the following page (Figure 2.1). The diagram has been already filled in with the correct answer response. The worksheet the student received did not. The students had to determine the correct answer on their own using the diagrams provided. In the two-step problem, the subjects had only to determine the differences in weights of Barbara and Vicki, but also to determine a second step in figuring out initially how much weight Vicki lost altogether (Figure 2.2).

The experiment was comprised of baselines, pre- and post-tests, and behavior maintenance throughout the study. The intervention itself consisted of SBI strategy instruction of one and two-step addition or subtraction word problems. The results were as follows: for one-step equations, there was a 17% mean increase from baseline performance using SBI. As for two-step equations, there was an increase of 24% over baseline. Generalization maintenance test results were even better at 39% increase over baseline. Overall student satisfaction based on surveys was promising in that each participant was satisfied with the strategy. There were several limitations to this study. First, the small number of participants affects the degree of generalization to a larger population of students. Second, the participants were learning material several grade levels below their current grade. Lastly, the high degree of fidelity may have been due to the instructor knowing the lessons were being recorded for the study.

Compare Story Situation

Jim delivered 26 newspapers on Monday. His friend Larry delivered 44 newspapers. Larry delivered 18 more newspapers than Jim.

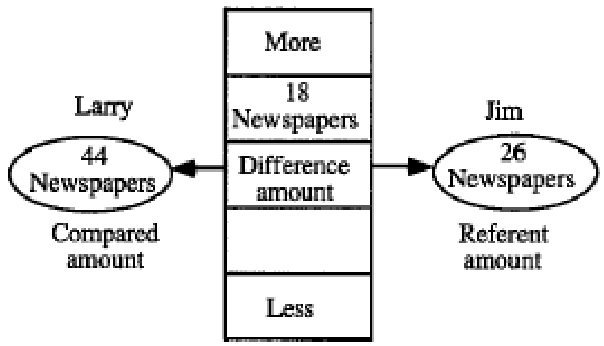

Figure 2.1. One-step compare problem type (Jitendra, Hoff, & Beck, 1999).

Two-Step Word Problem: Barbara and Vicki decided to see who would lose the most weight in one month. Barbara lost a total of 10 lbs. Vicki lost more weight than Barbara and went from 160 lbs. to 125 lbs. How much more weight did Vicki lose than Barbara?

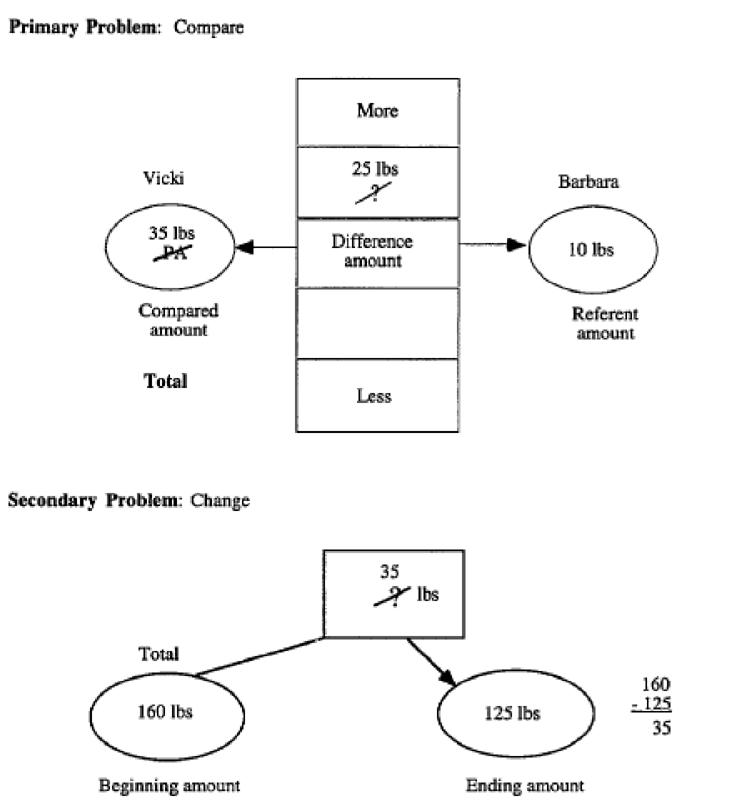

Figure 2.2. Two-step word problem example.(Jitendra, Hoff, & Beck, 1999).

Three years after the previous study, Jitendra and colleagues expanded the research to include elementary school students experiencing similar difficulties with word problems in math (Jitendra et al., 2002). The participants included in this study were four 5th grade students (3 males and 1 female). All subjects attended a suburban school in the northeastern United States. The students were selected based on diagnosed disability, poor academic performance, and/or teacher recommendation. The special education teacher conducted all of the interventions in a separate resource room. All students in the study were taught in the regular classroom in all subjects but received math instruction in the resource room. The dependent measure consisted of a series of word-problem tests of both single and multi-step problems. Transferability was measured using a similar type of test with problems similar in structure. At the end of the study, the subjects were then administered a strategy questionnaire. The teacher conducting the intervention was given a similar survey to determine if she would use SBI in the future. Prior to conducting the research, the special education teacher was given explicit instruction by the researchers on how to use SBI by the authors of the study. The study itself utilized a multiple probe across participants in order to evaluate the effects of SBI on mathematical performance. According to Jitendra, each experimental phase consisted of a baseline, instruction, response generalization, and maintenance (Jitendra et al., 2002). The results of the research demonstrated an improvement in word-problem solving for all participants. Additionally, the same students maintained their progress in later maintenance probes. Pretreatment generalizations for Sara, Tony, Percy, and Andy were 44%, 39%, 44% and 28% respectively. All four students showed marked improvement after intervention with scores of 78%, 88%, 91%, and 88% for Sara, Tony, Percy, and Andy. This study reaffirmed the notion that SBI is an effective instructional strategy for students struggling in math. Some limitations of this study were similar to her research in 1999, such as a very small participant pool, which could mitigate generalization. Also, there was a possibility of potential researcher bias due to the author's involvement with other SBI studies.

In a recent study, Jitendra and colleagues (2010) wanted to determine the effectiveness of SBI on secondary students with EBD that exhibited more severe cases of oppositional defiance or other aggressive outburst behaviors. There were only two participants selected for this study: Debbie and Matt. Debbie was diagnosed with a severe learning disability coupled with an emotional disorder. Matt was diagnosed with bipolar disorder along with math deficiencies. Both students received their instruction in a private school setting and in small, self-contained classrooms. The study was conducted over a 20 week period of time using 45-minute blocks of instruction per day 5 times a week. This was a very intense program. Their regular classroom teacher delivered SBI after she received the appropriate training. A pre- and post-test was given, as well as multiple probes to gauge participant understanding. Matt scored very low on his pre-test (27%). Although Debbie scored higher (72%), she was included in this study for having a history of underachieving. Matt's results were more sporadic in nature with no probe score being over 80%. However, his post-test score was 95%. As for Debbie, she demonstrated a gradual increase with the end results being close to 100%. This study was instrumental in demonstrating that students with EBD can learn by using SBI. One issue with this study was that it would be very difficult to replicate. There are not too many educators who could invest 20 weeks of instruction to test the effectiveness of an intervention, especially in a public school setting. Also, finding a significant number of students with EBD would also be a challenge since they make up a small percentage of a school's actual population.

Another study on SBI was conducted to compare the results of that intervention technique with general strategy instruction (GSI) for solving word problems by middle school students (Xin et al., 2002). While the focus of most SBI studies had been on arithmetic/subtraction problems, Xin and colleagues shifted attention to the benefits of SBI for solving word problems requiring multiplication and/or division operations. The design of the study used a pre- and post-test given to a random sample of 22 middle school students. The experimental group consisted of four randomly selected students from the initial sample. One of the participants was identified as having EBD, and three others were not identified as having a learning disability, but were still considered at severe risk of failing math. The control group consisted of 18 students without disabilities. All students attended a rural school in the northeastern United States. Participant selection in this study was based on the following criteria: teacher identification and a score of below 70% on a word-problem solving instrument administered by the math teacher of record. The instructors for the research consisted of two experienced special education teachers and two special education doctoral students. The experimental group of subjects received SBI while the control group was provided GSI strategies. Both groups received teacher-explicit instruction over the course of 12 sessions. The two groups solved the same number and types of problems. Although both groups were utilizing a four-step method to solve their problems, the primary difference between SBI and GSI occurred during the 3rd and 4th steps (Xin et al., 2002). The SBI group was taught to identify problem structure using a schema diagram. The GSI group was taught to utilize drawing a picture to help them solve the problem, with little emphasis placed on merging the abstract condition to their own drawings. Since the study combined both disabled and non-disabled students, the researcher used a 2x4 ANOVA to assess the effectiveness of the instruction. The SBI participants showed significant improvement of acquisition of skills from pre- to post-test, with a mean difference of 54.22 points and a SD of 17.17. GSI demonstrated a less significant improvement of 17.59 differences from pre to post-test with an SD of 10.29. For transfer of skills, SBI results indicated a mean improvement of 36.97 from pre- to post-test, whereas GSI showed only a 7.00 improvement of scores. As such, "results of this study indicated significant differences between the SBI and GSI groups on the posttest, maintenance, follow-up, and generalization tests. The effect sizes comparing the SBI group with the GSI group were 1.69, 2.53, 2.72, and .89 for post-test, maintenance, follow-up, and generalization tests, respectively" (Xin et al., 2002. p. 181).

Another study looked at the effect SBI would have on 3rd grade students who struggled with simpler math concepts (Fuchs et al., 2004). What separated this study from others like it is was the larger sample of participants, thereby allowing for more discrete analysis to be conducted and creating more opportunities for generalization. There were 24 teachers and 366 students selected for this research study. These students were split into three equal groups (low, average, and high) based on pretreatment measures and assigned to one of the teachers. Three different types of curriculum were utilized for each group. All three groups received instruction for three weeks. Each lesson lasted 30-40 minutes for a total of 180-240 minutes for three weeks. For each problem-solving measure, a two-factor mixed ANOVA model was used to determine statistical significance. However, problems solved by students with learning disabilities used a one-way ANOVA test. Also, a regression analysis was conducted to explore the relationship between schema development and problem solving. According to the researchers, SBI improved the ability of most participants to mentally transfer problems (77%). Results demonstrated that this approach to SBI improved mathematical problem solving among third-grade students of varying initial achievement status. On immediate-, near-, and far-transfer problem-solving measures, students in the SBI treatment consistently outgrew those in the contrast group. Those participants that struggled with transferring prior to the experiment continued to struggle but not as poorly as beforehand. SBI was also demonstrated to be beneficial in assisting younger students in sorting out categorical data when solving a word problem.

Van Garderen (2007) conducted a study on teaching students with LD to use diagrams to solve word math problems, which is essentially the primary feature of using SBI. As previously noted, several studies have been conducted that emphasized the effectiveness of using diagrams to help support the learning process. According to Van Garderen, "In general, the findings of these studies have suggested that students with LD can be taught to use diagrammatic representations to solve word problems. An improvement in problem-solving performance, though evident in some studies, was not always attained. In spite of what has already been done, there is a continued need to build on and further extend this research"(Van Garderen, 2007, p. 541). Van Garderen also identified several problematic issues with previous studies in mathematical intervention research. First, most studies focused solely on addition or subtraction processes. Second, the students were not afforded the opportunity to create their own schematic diagrams, but instead used pre-generated drawings, which brought up a valid concern. By using someone else's schematic map, were the participants truly merging their own unique abstract concepts with true understanding? In other words, were the provided diagrams merely another crutch in the learning process? Lastly, the instructions were not always clear and concise for student outcomes and expectations.

As a result of these findings, three research questions were generated by Van Garderen: (a) Can students with LD improve their own ability to generate diagrams to represent word problems? (b) Can the students then improve their performance in solving said word problems? and (c) Will the students with LD apply the acquired problem-solving skills to authentic, real world problems? The researcher chose three students in 8^{th} grade with math learning disabilities. These participants had to (1) meet a FSIQ of over 85 on the latest WISC-IV examination, (2) meet district eligibility requirements as LD in math, (3) and be identified as in need of additional practice in word problem solving. The students were selected from a junior high school located in rural New York State. The experimental design was a multi-baseline single subject across participants using a pre- and post-test design. The intervention phase consisted of diagram instructions used in conjunction with strategy instruction for one and two-step problems. A scripted lesson was also utilized, fashioned from a manual titled *Solve It*! (Montague, 2003), and was very similar in nature to the one later developed by Jitendra (2007). The dependent measures consisted of five different types of word problem tests that were randomly selected either from (or modeled after) word problems created by Montague (2003). During the baseline, the average score of all three students was 37.6%. After the initial intervention, their scores, increased to 78.6% for one-step problems and up to 79.2% on two-step problems. Maintenance results conducted three weeks later also demonstrated an average mean score increase to 81%. This study had encouraging results. However, some limitations noted were: the improvement could not be attributed to diagrams alone; it may also have been a result of the additional instruction provided; each participant was given individual instruction; and a stable trend in the data for two of the subjects was not clearly established.

Pilot Study

The purpose of the pilot study was to gain insight into conducting the experiment on a smaller scale, affording the researcher an opportunity to experience firsthand any potential issues that could arise prior to conducting the actual research. The two participants chosen for the pilot study were both students with math disabilities. The first student had been held back one academic year and was still several grades below grade level in both math and reading comprehension, based on her latest individual evaluation. The second student, also diagnosed with a math learning disability, had never been held back a grade level. Instead, he continued to either fail his classes or to barely pass them. Each student was given the same type of instruction, which consisted of scripted lessons and materials taken from two sources: *Solving Math Word Problems: Teaching Students with Learning Disabilities Using Schema-Based Instruction* (Jitendra, 2007) or *Schemas in Problem Solving* (Marshall, 1995). Each measurement (both baseline and intervention) consisting of five problems and a combination of multiplicative compare and vary types, for a total of fifteen examinations over a course of two weeks. No instruction or remediation was provided during the baseline phase for either participant. The intervention instruction for Student 1 was started after the fifth baseline measure was given and after the tenth for Student 2. A time limit of fifteen minutes was also allotted for each assessment, which was given at the beginning of every class. The intervention instruction for both Student 1 & 2 was approximately 45 minutes per day for five days totaling 225 minutes.

This pilot study was very beneficial because it gave the researcher an opportunity to become comfortable with the scripted lessons. This was significant because the vernacular used in the scripts and lessons can be confusing for both the teacher and student. The researcher had to modify the scripted lessons in order to be more user friendly for both. Going forward, it would be very beneficial to familiarize the participants to the terminology prior to conducting the intervention. Second, the students struggled at first with understanding what was expected from them. As the instructors became more familiar with the scripted lesson, they often were able to better explain concepts before they were presented to the students.

Purpose of Present Study

As mentioned earlier, the purpose of this study was to determine how effective SBI is as an instructional math strategy for middle school students with either EBD or At-risk who are struggling with solving math word problems. It will be determined if SBI can effectively be used by teachers in the classroom as an intervention technique that produces positive results.

Research Questions

The following questions were addressed: a) What effect does SBI have on student understanding of math word problems that involve multiplicative compare and varying types of questions as demonstrated by increased scores on provided assessments? b) Are the effects of SBI maintained in the absence of intervention? and c) How will the participants evaluate the effectiveness and acceptability of SBI?

CHAPTER THREE

METHODOLOGY

This chapter describes the method used to answer the following research questions: a) What effect does SBI have on student understanding of math word problems that involve multiplicative compare and varying types of questions as demonstrated by increased scores on provided assessments? b) Are the effects of SBI maintained in the absence of intervention? c) How will the participants evaluate the effectiveness and acceptability of SBI?

Participants

The participants included only those students who had met the following conditions: a) they were middle school students in grades 6-8; b) they had been diagnosed with EBD and were receiving special education services for this diagnosis or identified as at-risk by school personnel; c) they struggled in mathematics as evidenced by failing grades for at least one grading period; d) and they had a recommendation by the math and special education teachers. Four participants who met these criteria were selected for this study. Permission forms were obtained from the necessary school administrators and parents of the students involved in the study. Furthermore, participants' IEP information (if applicable) was scrutinized to ensure compliance at all times.

Participant Information

The population of students with special needs on this West Texas school campus was 16.2%, with four students being served as EBD or EBD in conjunction with other disabilities (3%). After receiving the signed consent forms from each student's parent or guardians, the researcher collected the following Public Education Information

Management System (PEIMS) data on the participants:

Research Subjects

Variables	Student A	Student B	Student C	Student D
Age	11	14	13	13
Gender	F	M	M	M
Ethnicity	W	H	W	H
Disability Label or Categorization	EBD	At Risk	LD/At Risk	OHI/ADHD
Difficulty Area	Math and Reading	Math, Reading and Writing	Math	Math and Written expression
SES (eligible for free/reduced lunches)	Free lunch	Reduced lunch	Reduced lunch	Free lunch
TAKS Math scores from previous year	n/a	1986 TAKS-A	2040 TAKS-M	1928 TAKS-A

Table 3.1. Research Subject Data

Note: OHI = Other Health Impairments; ADHD = attention deficit hyperactive disorder; LD= learning disabled; TAKS A = Texas Assessment of Knowledge & Skills Alternate; SES = Socioeconomic status. TAKS=Texas Assessment of Knowledge and Skills (A)lternate or (M)odified. An acceptable pass rating score for both TAKS-A & TAKS-M is 2100.

Student Information

Student A was a Hispanic 11-year-old female and member of a migrant family who had relocated often throughout her academic career. This student was in 6th grade and had already been to nine schools since Kindergarten. It was unknown if she had ever been placed into special education because her records were incomplete and inaccurate. However, she was referred for special education services and placed during this academic year. Her gaps could be attributed not only to her learning disability, but also to her transient lifestyle. She was also very defiant with teachers and peers. Since entering this district, she has been placed in both ISS and DAEP for various student code of conduct violations. During the study, she was receiving counseling through Mental Health and Mental Retardation agency for a bipolar disorder. Her mother was unemployed and father worked for the local gas plant part time. She was one of seven other children living in a two-bedroom trailer that used an oven for heat during the colder months. Because she was the oldest daughter, she was expected to help raise her siblings. Her latest TAKS-A scores were from 2008. In that year, she scored a 1964 in Math and a 2010 in Reading. A score of 2100 is considered passing on TAKS, TAKS-A, and TAKS-M assessments given through 2011. Also, her class benchmarks at the time of the study were very low. She averaged 37 and 28% respectively, whereas her peers averaged 74 and 76% on the same assessments. She was diagnosed as EBD by a school licensed psychologist. She was administered both Woodcock Johnson III cognitive and achievement tests. She scored the following where 100 is the mean average: Quantitative reasoning (62); Visual Spatial (59); Short Term Memory (61); Processing Speed (43); Calculation (37); Math Fluency (68); and Applied Problems (55). Her FSIQ was 72.

Student B was a 14-year-old Hispanic male who transferred to our school from another district located in East Texas. His grandmother lived in the district and parents felt that attending a smaller school would benefit this young man by getting him away from gangs and other bad decisions in his previous school. At the time of the intervention, he was currently finishing out the end of a carry-over DAEP term from his previous school. He was placed in DAEP for continually fighting other students. However, since moving to this new school district, he appeared to be trying really hard to make better decisions and follow school rules. He had not been in any trouble since arriving and had been very courteous to everyone trying to help him. He also responded well to his behavior intervention plan and focus interventions used by faculty members. Although he qualified in math, reading and writing, math appeared to be his stronger subject based on class assignments turned in prior to the study. He scored a 1986 on a TAKS-A assessment, meaning he was maybe four or five questions correct from passing. The diagnostic instrument used in his evaluation was a Woodcock Johnson III cognitive and achievement test. The following were his cognitive test results (where 100 is considered average): Comprehension Knowledge (60); Long Term Retrieval (71); Fluid Reasoning (58); and Processing Speed (49). He scored the following on his achievement test where 100 is considered average: Letter Word Identification (61); Passage Comprehension (70); Writing Fluency (66); Writing Samples (59); Math Fluency (66); and Calculation (77). His FSIQ rating was 81.

Student C was a 13-year-old (7^{th} grade) white male who was in DAEP for possession of a controlled substance and subsequent drug testing failures. He had been assigned to this setting since the beginning of the academic year. He lived with his grandparents because both parents were incarcerated. Although he was not outwardly hostile to faculty members and peers, he avoided completing assignments, which only made matters worse for him. Although he did have a math disability, it was often hard to determine when the lack of academic progress was due to his disability or his problem completing assignments. He often refused to complete assignments regardless of the consequences. On the previous TAKS reading test, he simply refused to take the test because he did not like the teacher. After much convincing, he reluctantly took the test and scored a 2040 on a TAKS-M. He had a BIP in place, but it did not prove to be effective. He was diagnosed with a behavioral disorder through a Vineland Adaptive Behavior Scale assessment. He was diagnosed with a learning disability using a Weschler Intelligence Scale for Children (WISC-IV) & a Kaufman Test for Educational Achievement-II (KTEA-2). The following grade equivalency scores on the WISC-IV were: Matrix Reasoning (2.8); Comprehension (5.8); Digit Span (5.8); Arithmetic (4.7); and Letter Number Sequencing (3.9). The following are his KTEA-2 grade equivalency scores: Math Concepts and Applications (2.5); and Math Computation (3.5). His FSIQ was 69.

Student D was a 13-year-old Hispanic male who had severe ADHD outbursts. He was not diagnosed with EBD, but due to his continual conflicts with school campus personnel, was included in this study. However, he did qualify for special education services for LD in both math and written expression. He was evaluated using the Woodcock Johnson III cognitive and achievement tests. He scored the following where 100 is considered average for his age: Comprehension Knowledge (61); Long Term Retrieval (44); Visual Spatial (69); Processing Speed (78); Word Attack (48); Writing Fluency (58); Calculation (71); and Applied Problems (73). His FSIQ score was 78. This student was quite capable of doing grade level work provided there were few distractions present. He received his instruction in an inclusive setting with his peers and additional assistance was provided by the inclusion teacher or in content mastery special education classroom. The previous year was the first year he had failed his TAKS test.

Setting

The setting for this study was the resource room in a middle school campus. The well lighted resource room was approximately 20’ x 30’ and consisted of: five round worktables; two teacher desks; and a Promethean board (an interactive white board). The classroom also contained various workstations that had laptops, Ipads©, and additional math manipulatives. The researcher made every effort to minimize interruptions.

Trainers

Another certified veteran math teacher with 15 or more years of experience in the content area assisted in the study. Prior to teaching the intervention, both teachers spent ample time becoming very familiar with SBI and the lessons required for its implementation. A minimum of 12 hours was dedicated to learning how to deliver the material in a consistent manner through modeling and collaboration.

Materials

Each participant had access to SBI checklists, workbook pages, calculator (if indicated on the student IEP), pencils, pens, and notebook paper. The instructors utilized Promethean interactive whiteboards and scripted lessons taken and adapted from *Solving Math Word Problems: Teaching Students with Learning Disabilities Using Schema-Based Instruction* (Jitendra, 2007).

Dependent Variable

The dependent variable in this study was percent correct on math word problems after utilizing SBI. Student performance was measured by the number of problems solved correctly. No partial credit was awarded. Assessments did not have a time limit placed on them and were created for screening, baseline, interventions, and maintenance probes. Each test contained ten target problems of *multiplicative compare (MC)* and *vary* problems similar in nature to the interventions introduced in this study. The MC problems were further divided into two problem sets where the *compared* is unknown; two problems with the *referent* unknown; and two problems with the *quantity of measurement* unknown. The vary problems consisted of two problems with the *unit value* unknown and two problems with either one of the *two ratio dimensions* unknown.

Independent Variable

The independent variable was the use of SBI as a math intervention for solving word problems. A more detailed explanation of SBI is provided in the procedure section of this chapter.

Research Design

A multiple baseline design across participants was used to determine the effectiveness of SBI. Baseline assessments were conducted for each participant. The first participant was given three baseline measurements and received the SBI intervention while baseline data on the other three participants continued to be collected. Once the first participant reached his or her fifth intervention assessment, the intervention was introduced to the second participant, and baseline collected for the remaining participants. When the second participant reached five intervention assessments, the third participant began intervention. This process was continued in this manner across the remaining participants for a staggered effect. In addition, maintenance probes in the absence of intervention were collected for all participants at least three times after the intervention had been terminated.

Procedures

The research was conducted in the fall of 2011. The study lasted approximately four weeks, with instruction in SBI given by the same teacher during this period. Each instructional session lasted 52 minutes in duration for five times a week over two weeks, for a total of approximately 520 minutes of instruction provided for each student. A maintenance probe was conducted several days after the posttest has been given due to time constraints and the end of school year activities annually provided at the school where the participants attended.

Screening Tests

Prior to the study, a screening test that contained ten word problems was provided to the potential participants who met the selection criteria. During the test, each student was presented with a worksheet and instructed to work the problems independently. No further instruction was given, but students were allowed to use calculators if their IEP authorized using them. Students scoring 50% or lower on the word problem solving test involving multiplication and division word problems met criteria for being included in this study (Jitendra et al., 2002).

Experimental Period

Baseline Probe

The baseline probe consisted of multiple ten-word problem tests administered to each participant. Each test consisted of MC problems and vary problems in the same manner described in the procedure section of this paper. The first participant began their intervention after a stable baseline was established comprising of three assessments.

There was no time limit on each assessment. Also, no additional instruction or feedback was given during the baseline probe.

Intervention

The SBI intervention consisted of two distinct phases: *problem schema instruction* and *problem solution phase.* According to Jitendra (2007),

> During the problem schema instruction phase (i.e., the first lesson in each unit), students are provided with story situations that contain only known information. They are taught to identify the problem schema (e.g., change, group, compare) and to represent the features of the story situation using schematic diagrams. The aim of this phase is to show the student the underlying structure of the problem type. Next, the student will map the details of the story onto the diagram.
>
> During the problem solution phase (i.e., subsequent lessons in each unit), students learn to solve problems with unknowns using a four-step strategy (FOPS) checklist. Eventually, the schematic diagrams are faded at the end of each instructional unit (p. *x*).

The instruction used for the intervention followed a scripted lesson created by Jitendra (2007) and modified by the researcher as necessary. Modifications were made only by changing values and semantics of the word problems while maintaining the integrity of the question itself. For instance, the following is an original problem from the text: *Julia spent 3 hours making 12 Christmas ornaments. How many hours will it take her to make 36 ornaments?* The new reworded question would look like the following: *Uncle Jed spent 45 minutes changing a flat tire. How many minutes would it take Uncle Jed to change four tires?* Each instructional session lasted approximately 30-45 minutes. Enough time was given at the end of each lesson to go over problems together. The study of literature recommends a minimum of twelve sessions of intervention as a reasonable timeframe to acquire new learning (Jitendra et al., 2002). In this study, the participants received instruction for a period of three weeks, five times a week, with additional flexible days built in to allow for unforeseen circumstances (i.e. school assemblies, etc.). Subsequent interventions began under the following conditions: the previous participant a) scored 80% on intervention assessments or b) after five sessions if the participant never reached 80%.

Instructional Material

The instructional material and word problem types utilized in this study were adapted from two programs of schema-based instruction developed by Asha Jitendra and colleagues: multiplicative compare and varying (Jitendra, 2007). The materials included scripted lessons for each instructional session, student note taking sheets, checklists and diagrams.

Multiplicative Compare (MC)

The participants were given a problem set that compared two or more objects, persons, or things using a common unit. However, instead of recognizing traditional compare words like *more than* or *less than,* students saw comparisons in the format of *4 times as many* or *a third as much as* a given quantity or measurement. In other words, "an MC problem tells the quantity of one thing as a multiple (e.g., 2 times as many as) or part (e.g., one third) of the other, and therefore involves the operation of multiplication or division to solve it" (Jitendra, 2007, p. 171). When teaching the multiplicative compare problems, the students were taught several things: to recognize a referent set of information, including its identity and its corresponding quantity; a comparison ser; to identify a corresponding quantity; and to create a statement that relates the compared set to the referent set (Marshall, 1995). For example, the participants were given the following scenario to consider: *Jim has 5 goldfish. Amy has 4 times as many goldfish as Jim. Amy has 20 goldfish.* The referent information in the example sentence is that Jim has 5 goldfish. The comparison set of information is that Ami has 20 goldfish. The statement that relates the referent set to the compared set is that Ami has 4 times as many goldfish as Jim. In some problems, the students were asked to solve for either the referent information or compared information. Prior to solving any problem, students had at their disposal a prompt sheet containing the key features of the problem type and the two strategy steps (i.e., **F**ind the problem type; **O**rganize the information in the problem using a MC diagram). Step one involved identifying and underlining the relational statement in the problem. Step 2 required students to identify the referent, compared, and their subsequent relationships on the MC diagram. They were then encouraged to check the completed diagram by reviewing information related to each component of the MC problem.

During the problem solving instructional phase (Steps 3 & 4), the students learned to solve for the unknown quantity in word problems with the FOPS checklist. In Step 3, students learned to translate the information in the diagram into a math sentence and solve for the unknown. In Step 4, the students solved the problem and wrote the complete answer. They then revisited their answer to see if it made sense from the initial query.

Vary Problems

When students were instructed for varying type problems, they learned that a vary problem tells about an association (ratio or rate) between two or more things often accompanied by an *if-then* statement (Jitendra, 2007). For example, *a pack of gum costs*

$1.24 a pack. If there are 12 pieces of gum in a pack, then how much does one piece of gum cost? In this example there are two specific items being compared: pieces of gum to a monetary value. For example, 12 pieces/$1.24. Students understood that their answer should be proportional to the original comparison. As with the MC compare problems, student received a FOPS checklist for solving varying problems. Step 1 involved identifying the problem type and the pairs of associations that form a rate or ratio then defining one as the subject and the other as the object. Step 2, the students identified the two pairs of associations and mapped the information onto the provided vary diagram. It was important that students correctly aligned the subject and object with the correct corresponding quantities. Students were also taught to use a question mark to flag the unknown quantity in both types of problems. The students then created their math equation using the diagram with cross multiplication to solve for the answer. The last step had the students write a complete math sentence in order to be certain that their answer was accurate and that it answered the initial problem. It is very important the students rationally explain the process and answer as a means of mastery demonstration.

Maintenance

After the intervention phase, the students completed two maintenance tests consisting of a format similar to previous assessments, with both MC and vary problems. These probes were administered in the same fashion as other prior tests but one week later. Participants that scored 40% or more increase over baseline results were considered successful. However, no additional instruction would given during these probes. The students were, however, given as much time as necessary.

Interrater Agreement

The researcher scored student work using an answer key. A second rater rescored the assessments. Interrater reliability was computed by dividing the number of agreements and disagreements and then multiplying by 100. For interobserver agreement, 50% of the intervention sessions and instruments were assessed. Interobserver agreement was 100%.

Treatment Integrity

Each student was provided a checklist they used while they were solving their problems. Each step was marked by the participant as they completed it. The researcher would then verify that the student had used the checklist correctly as instructed to support learning. The checklists were then compared between instructors to ensure compliance.

The researcher assessed the fidelity of the treatment by marking “Yes” on correctly followed items and “No” on incorrectly followed items. Fidelity of implementation was assessed 70% of the intervention sessions by either the researcher or teacher. Treatment fidelity was 100%.

Strategy Satisfaction Questionnaire

In an effort to determine if the participants would use SBI as an intervention once the study had concluded, a satisfaction questionnaire was utilized. The strategy satisfaction questionnaire was modified by the researcher from a survey developed and used in a prior study conducted by Jitendra, Hoff, & Beck (1999). In the first part of the modified questionnaire, a Likert-type scale of 1 (strongly disagree) to 5 (strongly agree) was used for the students to provide information about whether (a) whether they enjoyed the intervention, (b) whether the strategy was helpful in solving word problems, (c) whether their word problem solving skills were improved, (d) whether they would recommend using the strategy with their peers, and (e) whether they would continue to use it to solve word problems in the classroom (Jitendra et al., 1999). A question about their overall satisfaction with the strategy instruction was additionally included in this section. An open question about what they liked or what suggestions they had for the intervention was asked in the second part of the questionnaire. A special education teacher and a professor in special education reviewed the student satisfaction questionnaire for appropriateness prior to administration.

Data Analysis

Data was analyzed by visually comparing overall components of the study: actual performance of each participant and overall data trends (i.e. changes or consistent patterns in student performance) within and between the phases. Performance level changes were identified based on the increase/decreases of scores per participant. Level changes within a phase were identified based on median or range as a mean level of performance if there was a great deal of variability (Kennedy, 2005). If at least 80% of data points fell within a 15% value range of the median level line, the data was considered stable and mean level line acceptable (Kennedy, 2005). Trend was be determined by examining both magnitude and direction of data points presented visually on the graph. Functional relation was when the intervention was effective only when the independent variable was introduced and replications were seen across participants.

CHAPTER FOUR

RESULTS

Four research questions guided this study: a) What effect does SBI have on student understanding of math word problems that involve multiplicative compare and varying types of questions as demonstrated by increased scores on provided assessments? b) Are the effects of SBI maintained in the absence of intervention? and c) How did the participants evaluate the effectiveness and acceptability of SBI?

RESEARCH QUESTION ONE

What effect does SBI have on student understanding of math word problems that involve multiplicative compare and varying types of questions as demonstrated by increased scores on provided assessments?

In this study, each participant’s results were analyzed in order to answer the first research question. This first research question examined the effects SBI would have on the accuracy performance of students participating in the study. The participants had to solve a combination of either multiplication or division word problems.

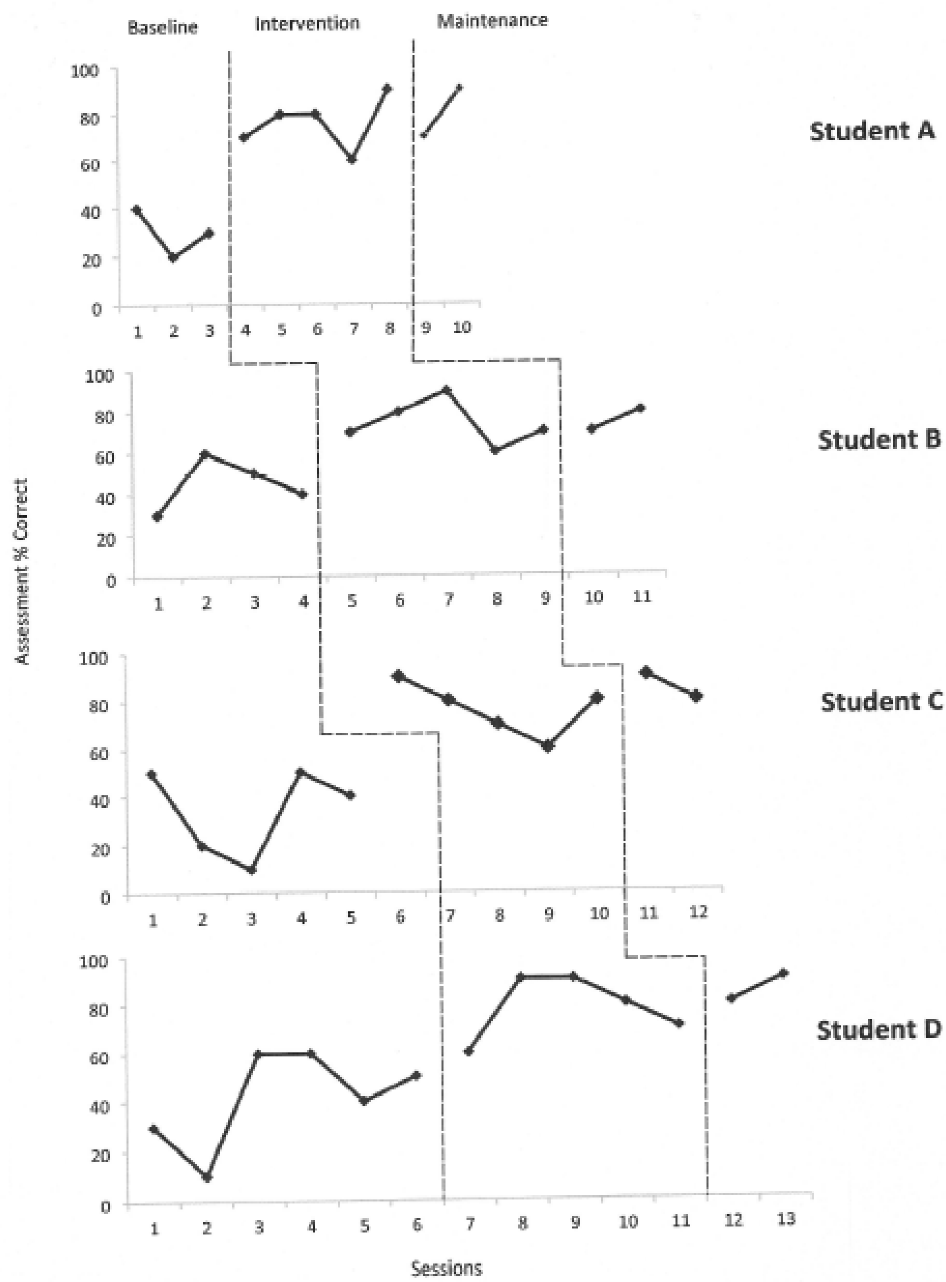

Figure 4.1.SSD Accuracy Percentages Across All Phases for Students A-D

NOTE: Examples of each problem type are located in the Appendix section

The results for all participants are displayed on Figure 4.1. More detailed results are presented as follows:

Student A

Baseline

During baseline, Student A scored a 40%, 20%, and 30%, respectively, with an average of 30%. On the first baseline test, the only questions answered correctly were *mc/referent unknown; mc/scalar function unknown; and vary/unit value unknown.* On her second baseline test, she answered the *mc/scalar function unknown and vary/unit value* problems correctly. On her third baseline test, she answered the *mc/referent unknown* and *vary/either two dimensions unknown* incorrectly.

Intervention

Student A participated in five intervention sessions. Her mean average after receiving the intervention instruction was 76%, which was an increase of 46% over baseline average. During this phase, the participant demonstrated a trend level of 60% on the y-axis, demonstrating a moderately unstable upward trend. There was clear change in level and increasing trend in intervention sessions. On the first intervention assessment (70%), she missed problems on *mc/scalar function unknown* and *vary/either two dimensions unknown*. The results on the second test (80%) saw the participant miss questions on *mc/compared unknown* and *vary/unit value unknown.* The third intervention test (80%) resulted in the student missing two problems: *mc/referent unknown* and *vary/either two dimensions unknown*. She missed four problems on the fourth intervention test (60%) on the following: *mc/referent unknown*, *mc/scalar function* *unknown,* and *vary/either of two dimensions unknown*. Student A missed only *vary/either of two dimensions unknown* problem type on the fifth test (88%).

Student B

Baseline

Student B took four baseline assessments prior to beginning his intervention instruction. His percent correct scores were 30%, 60%, 50% and 40% for an average of 45%.

Intervention

Student B participated in five intervention assessments. His intervention average was 74%, or 31% increase over baseline average. This phase of the study showed a trend of 40% on the y-axis, demonstrating a moderately upward stable upward trend. On his first assessment (70%), he missed the following problems: *mc/scalar function unknown*; *vary/vary unit unknown; vary/either two dimensions unknown*. On the second assessment (80%), the participant missed the *mc/referent unknown* and *mc/compared unknown*. The only incorrect item on the third assessment (90%) was *mc/scalar function unknown*. He missed the *mc/scalar function unknown, vary/unit value unknown,* and *vary/either two dimensions unknown* on the fourth test (90%). On the fifth assessment (70%), Student B missed problems covering *mc/referent unknown* and *vary/vary unit unknown*.

Student C

Baseline

Student C completed five baseline measures for an average of 34%. He scored a 50%, 20%, 10%, 50%, and 40%. This participant did not demonstrate a stable baseline.

Intervention

Student C took five intervention assessments for an average of 75%, resulting in a trend of 40% on the y-axis, which culminated in a downward stable trend. The intervention average was a 41% increase above baseline average. On the first test (90%), the only question missed was a *mc/referent unknown* problem. The second test (80%) resulted in the student missing two questions: *mc/scalar function unknown,* and *vary/either two dimensions*. He scored a 70% on his next assessment, missing problems on *mc/referent unknown, mc/scalar function unknown,* and *vary/either two dimensions unknown*. On the fourth measurement (60%), he missed *mc/referent unknown; mc/scalar function unknown;* and two *vary/either two dimensions unknown.* On the fifth test (80%), the only problem missed was *mc/referent unknown* and *vary/either two dimensions unknown*.

Student D

Baseline

Student D scored a mean average of 42% on baseline measurements scoring 30%, 10%, 60%, 60%, 40%, and 50%.

Intervention

Student D took five intervention assessments with an average of 78%, which was an increase of 36% over baseline results. A moderately stable upward trend of 60% on the y-axis was the result. The first test (60%) resulted in four missed problems: *mc/referent unknown,* two *mc/scalar function unknown,* and *vary/either two dimensions unknown.* On the second test (90%), he missed *mc/referent unknown.* The problem missed on the third assessment (90%) was *vary/unit value unknown.* The participant missed two *vary/either two dimensions unknown* problems on the fourth measurement (80%). He missed three problems on the fifth assessment (70%): *mc/referent unknown; vary/unit value unknown;* and *vary/either two dimensions unknown.*

RESEARCH QUESTION TWO

Were the effects of SBI maintained in the absence of intervention?

In order to demonstrate recall, the results of the maintenance measurements were analyzed and compared with results from baseline and intervention tests. The maintenance test averages were similar to the intervention averages. Student A's differences between intervention and maintenance were 7.5%; Student B's difference was 7.59%; Student C's difference was 10.9%; and Student D's was closer at 3.2%. The maintenance tests were conducted two weeks after the participants took the last intervention assessment. This gap in time was essential in order to determine if the participants were able to retain the information taught earlier without having any bias carry over from previous intervention assessments.

Student A scored a 70% and 90% on the maintenance test conducted two weeks later. Her average was 80%. On the first maintenance test, she missed problems on *mc/referent unknown, mc/scalar function unknown,* and *vary/unit value unknown.* On the second assessment, she missed a problem on *mc/referent unknown.* For Student B, the maintenance test average score was 75%. On the first maintenance measurement (70%), he missed problems on *mc/compared unknown,* and *vary/unit value unknown, and vary/either two dimensions unknown*. The second maintenance test (80%), he missed the *vary/unit value unknown* and *vary/either two dimensions unknown.* During maintenance, Student C scored a 90% on his first test by missing *vary/either two dimensions unknown* and a 80% on the second, for an average of 85%. This score was 51% better than the baseline average and 10% better than the intervention average results. On the second test, the two problems missed were *mc/referent unknown*. Student D scored an 85% average on both maintenance assessments, which was 43% above baseline average, and 7% above intervention average. He missed two problems on the first maintenance assessment: *mc/referent unknown* and *vary/unit value unknown.* On the second measurement, the only problem missed was a *vary/either two dimensions unknown.*

RESEARCH QUESTION THREE

How did the participants evaluate the effectiveness and acceptability of SBI?

Results of the Likert questionnaire in this study (Appendix C) indicated that, overall, the four participants were satisfied with the strategies utilized in this study. The overall average for all four students on question one (I enjoyed using the math word problem solving strategy used by the instructor) was 4.25. The results average for the second question (I found the diagrams to be helpful in understanding and solving the word problems) was 3.5. The third question (I liked the problem solving strategies because it helped me get better at solving math word problems) results yielded a 4.25. The fourth question (I would recommend using this strategy with other students my age) average was 4.5. The fifth question (I am going to continue using this strategy to solve word problems in my classroom) resulted in an average response rate of 4.5. The last question (I feel satisfied with the overall process of the word problem strategy) produced an average of 4.25. Based on the results of the questionnaire, the students seemed to respond favorably to most categories. The lowest category was the perceived benefit of using diagrams to assist in solving the problems. The highest categories were whether the participant would recommend the strategy to others and if the participant would keep using the strategy later.

SUMMARY

Based on the comparison of results of the baseline, intervention, and maintenance assessments, there is clearly an increase in performance utilizing schema-based instruction. Upon further inspection, each participant was able to exceed his or her baseline measures by a substantial amount: Student A by 53%; Student B by 49.3%; Student C by 51%; and Student D by 55%. Also, each participant seemed proficient at transferring what he or she learned during the intervention phase to the later maintenance assessments. Each participant involved in the study performed poorly on the baseline assessments with a positive, upwards trend during and after intervention. Lastly, based on survey results, the students seemed generally satisfied with the intervention and its results.

CHAPTER FIVE

DISCUSSION

The purpose of this study was to determine if SBI was effective in helping struggling students analyze and solve math word problems using multiplication and division. The results of this study demonstrated that the participants in the study made progress based on comparisons of the baseline and intervention. In addition, the participants maintained the content learned after withdrawing the intervention. This chapter will focus on analyzing the findings and conclusions of each research question. Also, study limitations and implications for practice are provided.

RESEARCH QUESTION ONE

What effect does SBI have on student understanding of math word problems that involve multiplicative compare and varying types of questions as demonstrated by increased scores on provided assessments?

All participants in this study demonstrated notable gains on the intervention phases over the baseline results. As such, these findings provide pragmatic evidence that SBI is an effective mathematical intervention for students struggling with word problems. Prior to intervention, the participants simply added or subtracted numbers to reach their answers. It was apparent that they did not utilize any strategy to solve their answers, and it was evident in their baseline scores. Also, they became easily frustrated and sometimes would simply give up rather than answer the question. During the intervention instruction, each participant was exposed to organizing the information they received in word problem format and then to use these strategies to assist in understanding the nature of the problem and how to generate the correct answer. Checklists were provided to assist in scaffolding instruction as well. The students closely followed the necessary steps taught by the researcher. As such, they were able to better organize the information provided and then translate the data in the diagram into a solvable math equation.

There were several inherent features of this intervention that merit discussion. First, modeling was employed occasionally when a student was having difficulty working some of the problems independently. Modeling is a beneficial technique that has been successful in all academic subjects (Sterling, 2007). Aleccia (2011) states that modeling is "an aspect of accomplished teaching that teacher educators should model for their students is being a reflective practitioner" (p. 87). Modeling is a reflective learning process that builds crucial self-efficacy skills. Another study conducted in 2010 analyzed the impact of modeling on increasing self-efficacy in secondary students in a Physics classroom (Sawtelle, Brewe, & Kramer, 2010). In this study, researchers demonstrated that modeling actually provides for more occasions for "vicarious learning experiences resulting in more genuine learning opportunities" (p. 290). A study in 2011 analyzed the impact of modeling on increasing the working memory of elementary students' math problem abilities (Zheng, Swanson, & Marcoulides, 2011). Results of this study established that teacher modeling of instruction played an important role in student success on math word problems. Explicit instruction is another important feature of this intervention, which allows the student to process the underlying structure of problems in order to master essential math skills and concepts (Jitendra et al., 2002; Jitendra & Hoff, 1996; Marsh & Cooke, 1996; Xin et al., 2002). Another consideration is that the nature of the intervention requires individual instruction exclusively. During this time, both guided practice measures and the researcher, which included corrective and instructional feedback, facilitated independent practice. Also, each participant was allowed to progress at their own pace. Many studies have shown the importance of both guided and independent practices as essential to developing the necessary math skills for secondary students (Garcia, Jimenez, & Hess, 2006; Montague & Dietz, 2009; Mulcahy & Krezmien, 2009).

There are several studies that specifically looked at SBI as an intervention tool for students struggling in math. Although participant and setting variables were different in these studies, the overall results were very positive. In 2002, an exploratory study was conducted to introduce the feasibility of using SBI in a middle school classroom (Jitendra et al., 2002). During baseline, student performance was 41%, which was also consistent with the results of this study (37.75%). Upon further investigation, however, there are several key differences between the study conducted by Jitendra et al. and this one. In the previous study, the participants were taken from a pool of low-achieving students, but were not necessarily classified as having a learning disability. In this study, every participant involved had a diagnosed disability. Furthermore, two participants were also dealing with disruptive behavioral issues in conjunction with cognitive deficits. In the 2002 study, the setting took placed in a controlled environment on a university campus away from potential everyday distractions at school. Although the intervention in this study occurred before and after school, the potential for interruptions was more readily apparent. Other students would occasionally interrupt learning by inadvertently entering the classroom during intervention. When this occurred, the distraction was very minimal and had very little impact on the learning process.

Another study determined that SBI was also effective for a younger participant age group (Fuchs et al., 2004). Twenty-four third graders were divided into control and experimental groups to determine SBI effectiveness. The experimental group receiving SBI showed better assessment gains than their control group peers of an average 2.42 SD. The results of this study corroborate the findings of the Fuchs et al. study. This study was different in that it also delved into the ability of SBI to transfer knowledge to both short and long term student recall. The results show moderate gains in that area as well. The differences in the 2004 study and current one involve the participant ages (primary v. secondary); setting (urban v. rural); and students with no diagnosed disability v. diagnosed disability.

Another similar study was conducted to determine the effectiveness of SBI compared to general strategy instruction (GSI) (Xin, Jitendra, & Deatline-Buchman, 2005). This study consisted of students with and without disabilities. Significant differences were recorded between the two instructional strategies. Students using SBI scored up to +2 SD above GSI participants. Also, according to the researchers, "results of this study also indicated that only the SBI group significantly improved their performance on the generalization measure after the schema-based instruction" (Xin et al., 2005, p.187). The Xin et al. study was different from the current study in that no attempt was made to compare different learning strategies. Instead, the current study focused solely on the viability of SBI introduced to students diagnosed with SBI and at risk for failing math. Both studies established that SBI is a viable instructional intervention that can benefit struggling students.

There are also several performance characteristics that could have affected the dramatic increases in participant performance. As mentioned earlier, initially the students did not possess the prerequisite knowledge or skill set to solve the problem independently and accurately. Gradually, though, as the students became more comfortable with the material, they began to incorporate those strategies taught during the intervention instruction period resulting in a more thorough, accurate response. Another contributing factor in solving word problems was the current reading level of the students at the time of the study. Both Students A & B had diagnosed reading disabilities and were significantly below their peers (7^{th}& 8^{th} graders) in reading fluency and comprehension. At the time of the study, Student A was reading on a third grade level and Student B on a fifth grade level. As such, each participant would simply not understand what he or she read even before attempting to solve the problem mathematically. Each participant was encouraged to slow down and comprehend what he or she read prior to solving. Although the assessments were not timed, both participants took longer than the others, which is a concern because they both potentially lost focus throughout the tests. Also, student attitudes and perceptions influenced the study results. For instance, on several occasions, participants would perceive a problem as particularly difficult and be less willing to work as hard trying to solve it. Also, if a student was having a difficult time, they would try to avoid work by stalling or refusing to try very hard. In those instances, the researcher was able to get the participant back on track through positive reinforcement, most often praise. There were several occasions each participant had to step away from instruction in order to re-focus on the task at hand. There was only one incident in which instruction had to be given on another day due to events related to a student's behavior. In this instance, instruction resumed the day afterwards

RESEARCH QUESTION TWO

Are the effects of SBI maintained in the absence of intervention?

The maintenance results of this study were very positive. Each participant demonstrated notable gains. The maintenance results were very encouraging with the students showing dramatic gains. Each participant had the following maintenance results: Student A was 75%; Student B was 70%; Student C was 80%; and Student D was 85%. Study results indicated that the participants were able to maintain a higher assessment result due to familiarity with the questions being posed and the ability to form relationships to solve the problem.

Maintenance results from several studies on SBI reached the same conclusion. In one study, maintenance results for participant's average over 40% higher than baseline measures (Jitendra et al., 2002); in this study the average maintenance increased over baseline was 42.5%. In 2004, another study showed similar maintenance results as well (Xin et al., 2005). In this study, maintenance results were slightly lower at 37% average for all participants involved. A study conducted by Fuchs et. al (2004) resulted in a +2 SD of maintenance results over baseline results.

RESEARCH QUESTION THREE

How will the participants evaluate the effectiveness and acceptability of SBI?

The results of this survey indicated that the participants believe the intervention to be helpful. Each survey category yielded positive results. Because self-perception has been determined to be integral to academic success (Mooney, Ryan, Uhing, Reid, & Epstein, 2005), it is imperative the teacher account for the impact of their students' mindset, which could potentially have an adverse affect on academic results. Struggling students often lack self-confidence due to prior learning struggles in the classroom. This was evident in this study where all but one of the participants did not seem overly excited about doing more math word problems. Given the results of the survey, those attitudes shifted to a more favorable outcome.

In one study, all of the participants indicated that SBI in general, and utilizing schematics specifically, to be very beneficial and worthwhile to learn (Jitendra et al., 2002). The overall mean strategy satisfaction results were 5, 4.5, 4.2, 4, and 5 respectively, with 5 being very satisfied and 1 being not satisfied. Another study did not use a Likert rating system, but instead used a more open ended script for both of the participants (Jitendra, 2007). Each participant also wrote that SBI was easy to use and they felt comfortable using it in the future.

LIMITATIONS OF THE STUDY

There were several notable limitations of this study that merit careful consideration. First, the nature of the intervention itself often led to the researcher conducting individualized instruction with the student. Although ideal for struggling students, this may not be practical for larger groups of students. Also, individualized instruction by itself is considered a stand-alone intervention recommended by many for increasing student performance. Therefore, it is difficult to determine exactly how much of the student success was from the intervention itself; the individualized instruction; or both. Second, because there were only four participants, it is difficult to generalize the findings to a larger population of students. Third, the intervention occurred either before school or afterwards because it satisfied the requirement of not interfering with valuable classroom instruction during school hours. Therefore, student stamina is a factor as well. In the early session, the students had difficulty straying focused because they were still half asleep. This is an issue many teachers face teaching early in the morning. To combat fatigue, the researcher would incorporate engaging lessons (being very animated, light background music, or even providing breakfast) as often as possible. Anything to help them maintain focus on the task at hand was utilized. Fourth, a non-standard instrument was utilized in all phases of the study. As such, the information collected is suspect to systematic errors that could exaggerate or mitigate the results. Lastly, because of the small number of participants used in this study, generalization to a larger population is difficult.

IMPLICATIONS FOR PRACTICE

Based on the results of this study, schema-based instruction shows promise as an effective intervention technique. Word problems seem to be especially difficult for learning disabled math students. Therefore, SBI is a viable alternative strategy to bridging learning deficit gaps. Based on the positive results of this study, educators can also look towards other interventions that draw on diagrams as potentially beneficial. Students with disabilities struggle with processing and analyzing information in an organized format (Boardman, Arguelles, Vaughn, Hughes, & Klingner, 2005; Bottge, Heinrichs, Mehta, & Ya-Hui, 2002; Calhoon & Fuchs, 2003; Fuchs & Fuchs, 2002; Maccini et al., 2007). Therefore, the integration of checklists in solving problems is also beneficial.

IMPLICATIONS FOR FUTURE RESEARCH

There are several considerations to make for future research: larger sample size; different target population or subject; different setting; and accounting for teacher perceptions of the intervention. As mentioned above, because majority of the studies conducted using SBI to date have drawn upon a small number of participants, it is difficult to make generalization to a larger population. As such, one suggestion would be to analyze the effectiveness of SBI using a larger sample size. Ideally, a researcher's sample would be drawn upon a randomized selection process that is reflective of a larger target population. Also, the researcher's sample size should be large enough to be statistically significant.

Another consideration is to change the participant demographic. For instance, a researcher could see if the same positive effects of SBI translate to students who have a different disability category (i.e. dyscalculia). To date, research on SBI has been limited to learning disabilities and students with EBD. Other disabilities could very well benefit from this intervention, and research should be conducted to that effect. SBI is also a viable solution to assist in the RTI process. Researchers should also expand the investigation to establish the impact SBI would have on students without disabilities.

The basic tenant of the intervention (i.e., scaffolding through the use of schematics) would be equally beneficial in learning science, social studies and even reading. For instance, SBI is similar to concept mapping, already used in many reading classes today. SBI could also be used to establish correlation between causes and effects in a science experiment. In addition, teacher perception of SBI is also very important and has had little consideration in past studies. Teachers are not going to utilize an intervention for which they have little understanding or confidence. A larger study could incorporate teacher insights as to whether they would actually use it in the classroom and if they thought it was effective.

Another consideration would be the integration of SBI in a regular classroom. All of the studies were conducted in resource rooms away from the general student population. For SBI to become truly marketable as an instructional strategy, research needs to be conducted on the use of the intervention in a regular classroom with all of the potential distractions present that a teacher would encounter during classroom instruction.

Also, the selection criteria utilized in this study included participants either diagnosed with EBD and/or considered at risk for failing math. However, since both student types are often integrated into the same classroom, there is relevancy to using them in this study. There were only a few issues with collecting data and intervention implementation. One issue was that one of the participants, half way through the study, missed a week of school due to an emergency in the family. Also, the nature of the emergency may have impacted the participant's ability to focus. He was very willing to continue to the work, and no notable difference was noted. The researchers of this study were very careful to monitor the participant's mental state throughout the process. As mentioned in the previous limitations section, because the intervention occurred before or after school, fatigue may have been an issue as well. This study's participants were given ample time to become alert and responsive prior to instruction. On occasion, the researchers provided breakfast to the participants if they did not eat prior to instruction.

Teachers should consider utilizing SBI for several reasons. Time constraints are a real issue for most teachers. They simply do not have enough time in the day to implement alternative strategies that require a lot of planning and time for implementation. Most interventions are only effective after several months of execution. With SBI, that time frame is cut down considerably. As such, a teacher could begin to see results in weeks instead of months. Also, SBI is a great tool for Tier 2 RTI response, which requires the teacher to use research-based strategies to support classroom instruction. Lastly, there are very few researched based math interventions that have proven successful for students with emotional behavioral disorders. The alternative strategies to SBI are very few.

Administrators should also consider SBI for similar reasons. SBI is much more cost effective compared to other interventions that require costly software licenses or expensive equipment. However, school principals will have to be supportive in initial expectations. As with any intervention, the results may vary depending on the student. Also, changes do not occur overnight. Instead, the student gradually builds up a knowledge base through immersion in the program. Administrators are going to have to merit the effectiveness of SBI on an individual basis to determine if it is something they want to implement on a larger scale.

SUMMARY

The purpose of this study was to determine if SBI was an effective solution for students struggling with solving math word problems. The intervention session was implemented after a staggered baseline was used to determine initial student mastery. The study consisted of a baseline, intervention, and maintenance assessments, all of which contained eight questions: four multiplicative compare and four vary problems. There was no time limit associated with the assessments. During the intervention instruction, each participant received 30-45 minutes of instruction over a period of three weeks for a total of fifteen sessions. Students were provided guided instruction using premade checklists and diagrams to help them solve the word problems. The success rate of each participant was much greater than previous baseline averages. When the maintenance test was administered two weeks after the last intervention assessment, results were still similar to intervention results.

As such, the results of this study reveal that schema-based instruction is a viable intervention strategy to help students struggling with math word problems. Regardless of limitations, SBI helps struggling students process and transfer conceptual information to application in a more systematic manner. Furthermore, this strategy also assists participants in maintaining the information learned as evidenced by maintenance results. Teachers should consider this method of intervention, especially to meet the stringent requirements of Response to Intervention or as a form of differentiated classroom instruction. SBI shows a lot of promise. Educators need to continue to expand the literature on SBI to include different student populations; subjects; and duration. In the future, educators should consider conducting a SBI study involving more students in order to generalize to other settings.

This study also proved that educators must be deliberate in their instruction. They have to set specific goals and incorporate different methods to reach their students. Teachers can no longer afford to disregard or ignore other instructional avenues. They, with the support of the administrators, must seek out relevant research to help their student grow cognitively. There are multiple resources available to help teachers. That teacher has to be willing to take the time to find the information and use it. Each struggling student's future depends on it.

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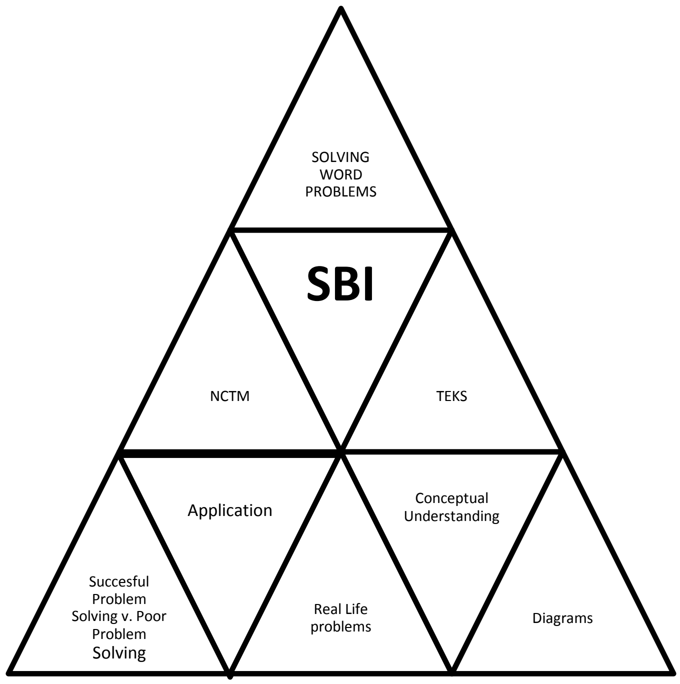
APPENDIX A

THEORETICAL FRAMEWORK



Purpose of the study: The purpose of this study is to determine how effective SBI is as an instructional math strategy for middle school students who are struggling with analyzing, processing, and solving math word problems when encountered with two types of problems: multiplicative compare and varying.
Research Questions: First, what effect does SBI have on improving participant math scores on word problem solving questions? Second, do our participants maintain the knowledge learned of varying and multiplicative compare strategies using SBI as evidenced by probes conducted later in the study? Third, how effective is SBI in transferring SBI strategy to real world scenarios using a math interest survey (Allsopp, et. al, 2008)? Lastly, how did the participants view their own knowledge of solving word problems using SBI as evidenced by an exit survey created by the researcher?
Significance of the Study: This study is an extension of several studies that looked at SBI as an effective mathematical intervention strategy. Because educators and students are being exposed to more and more higher order questions in the form of word problems, it is imperative that the intervention addresses the specifics of this kind of deficit. Participants will be assessed using measurements created by Asha Jitendra (see Appendix) in order to ensure a higher degree of conformity between what is being taught and subsequently assessed (Jitendra, 2007). Unlike previous studies of SBI, this study is unique in that a) the participants are EBD selected from a rural West Texas population and b) the focus of the research does not specifically include additional behavioral strategies. Most often, misbehavior is a result of student disengagement. By experiencing success with SBI, inappropriate behavior should be curtailed significantly.

APPENDIX B

SCREENING TEST EXAMPLE

Student #___________

SCREENING TEST

Instructions:

Solve the following word problems and show how you solved them.

1. **The Eiffel Tower in Paris, France is 1063ft tall. The Eiffel Tower replica in Las Vegas, Nevada is 1/20 the size of the original tower. How high is the replica?**

Answer: ____

2. **Carlos watched 18 Texas Rangers games this summer. His sister, also a fan, watched 1/3 as many games. How many games did his sister watch?**

Answer: ____

APPENDIX C

STUDENT SATISFACTION QUESTIONAIRE

Name: ________________________________ Date: ____________

PARTI **Direction**. You learned to solve word problems using diagrams. Please circle the best answer for each item. Circle only one answer and do not skip any items	STRONGLY DISAGREE	DISAGREE	UNSURE	AGREE	STRONGLY AGREE
1. I enjoyed using the math word problem solving strategy used by the instructor.	1	2	3	4	5
2. I found the diagrams to be helpful in understanding and solving word problems.	1	2	3	4	5
3. I liked the word problem solving strategy because it helped me get better at solving math word problems.	1	2	3	4	5
4. I would recommend using this strategy with other students my age.	1	2	3	4	5
5. I am going to continue to use this strategy to solve word problems in my classroom.	1	2	3	4	5
6. I satisfied the overall process of the word problem solving strategy	1	2	3	4	5

Part II
Direction Write down what you liked during this intervention or want to suggest for the intervention.

Note. Adapted from Jitendra, Hoff, and Beck (1999)

APPENDIX D

IRB APPROVAL

TEXAS TECH UNIVERSITY
Vice President *for* Research

June 15, 2011

DeAnn Lechtenberger
Ed Psychology & Leadership
Mail Stop: 1071

Regarding: 502936 An Analysis of Schema-Based Instruction as an Effective Math Intervention for Secondary Students Diagnosed with EBD or Classified as At-Risk

Dr. DeAnn Lechtenberger:

The Texas Tech University Protection of Human Subjects Committee has approved your proposal referenced above. The approval is effective from June 15, 2011 to May 31, 2012. This expiration date must appear on all of your consent documents.

We will remind you of the pending expiration approximately eight weeks before May 31, 2012 and to update information about the project. If you request an extension, the proposal on file and the information you provide will be routed for continuing review.

Sincerely,

Rosemary Cogan

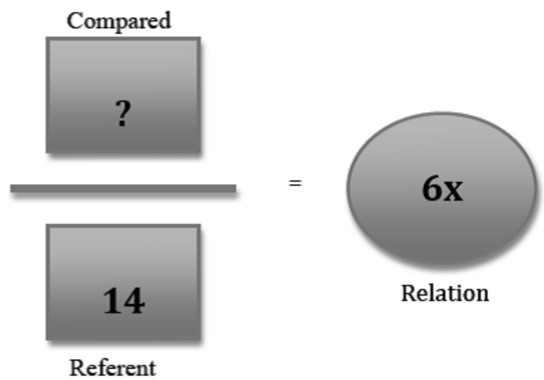
Rosemary Cogan, Ph.D., ABPP
Protection of Human Subjects Committee

APPENDIX E

SBI PROBLEM TYPES

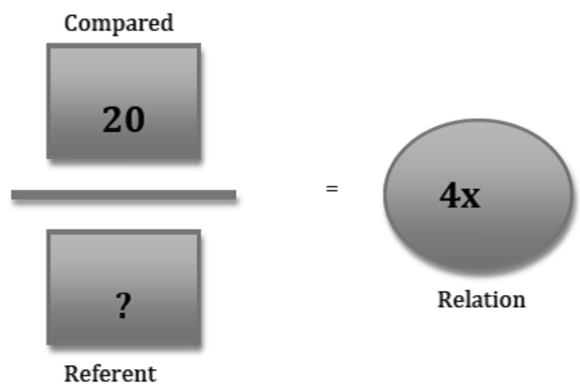
Multiplicative Compare/Compared Unknown

Eric has 14 dollars. His sister has 6 times as much. How much money does his sister have?



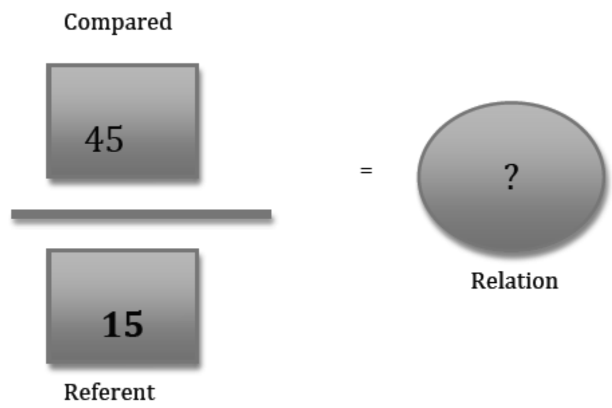
Multiplicative
Compare/Referent Unknown

Eric spent $20 at a store. He spent 4 times as much as his little cousin. How much did his cousin spend?



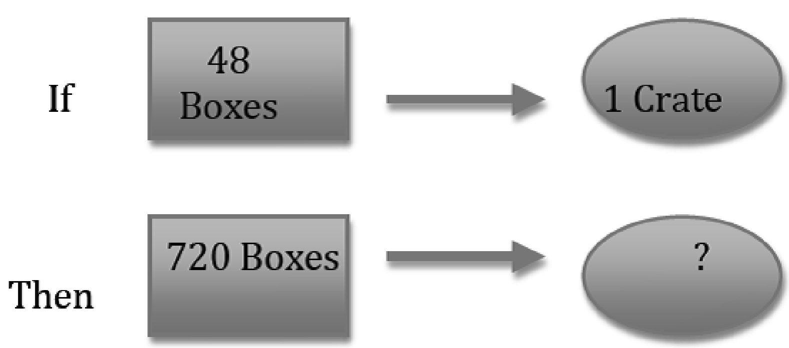
Multiplicative Compare/Scalar Function Unknown

Eric has 15 video games. His Uncle Garrett has 45 video games. How many times as many games does his uncle have than Eric?



Vary/Vary Unit Unknown

The Kellog Company packs 48 boxes of cereal in each crate. How many crates will the company need to pack 720 boxes of cereal?



Vary/Either Two Dimensions Unknown

Students are required to cover their textbooks the first weeks of class. If Eric needs to cover 10 books, how much paper does he need? Use the information from the table below.

Number of Books	**10**			**60**
Amount of paper needed	**?**			**12**