Vocabulary Instruction for Middle School Students with Learning Disabilities: A Comparison of Two Instructional Models

Cecil Fore III
Richard T. Boon[1]
Kathryn Lowrie
The University of Georgia

This study compared the effects of two types of instruction on the learning of content-area vocabulary words of six middle school students with learning disabilities. A multiple-baseline design across participants was used to evaluate the effectiveness of the two instructional models (i.e., definition and concept model) on the percent of vocabulary questions answered correctly. During the intervention condition, the concept model was implemented as the independent variable and compared with the definition model, the baseline. The concept model utilized a diagram encompassing the vocabulary word, the definition and characteristics, and examples and non-examples. In contrast, the definition model, which is more traditionally used by teachers, involved the students looking up and writing down the definitions of words and writing each word in a sentence. The dependent measure was the percent of vocabulary questions answered correctly after instruction, which indicated the degree of learning. Results showed that the concept model had a greater effect upon the learning of content-area vocabulary words than the definition model for all six of the students with learning disabilities. Limitations of the study, implications for teaching vocabulary instruction for classroom teachers, and future research questions are also discussed.

Key Words: Vocabulary Instruction, Instructional Methods, Language Arts, Resource Classroom, Learning Disabilities, Special Education

The ability to read and vocabulary knowledge are vital for school success in our society (Baker, Simmons, & Kame'enui, 1998; Cunningham & Stanovich, 1998). The fundamental components of reading are word recognition, vocabulary, and reading comprehension. A focus on vocabulary development during reading instruction leads not only to a greater ability to infer meanings, but also to an increased ability to comprehend what has been read (Rupley, Logan, & Nichols, 1998). Likewise, as comprehension skills increase, the ability to infer meanings of new words from context, and thus, vocabulary, increases. Vocabulary and reading comprehension skills are mutually beneficial in promoting development in reading (Daneman, 1991). Numerous researchers support Daneman's findings (Baker et al., 1998; Bryant, Goodwin, Bryant, & Higgins, 2003; Bryant, Ugel, Thompson, & Hamff,

1. Please send correspondence to: Richard T. Boon, The University of Georgia, Department of Communication Sciences and Special Education, 537 Aderhold Hall, Athens, GA 30602-7153; E-mail: rboon@uga.edu

1999; Harmon, 1998; Iddings, Ortmann, Pride, & Pride, 1999; Olle & Bazeli, 1996). Acquisition of vocabulary is attained through natural learning of word meanings while reading (Anderson & Nagy, 1993) or through vocabulary instruction. Given that the probability of a student learning an unfamiliar word while reading has been established to be 5% (Anderson & Nagy, 1993), clearly, vocabulary instruction is critical for academic success. However, this does not discount the importance or abundance of words learned from wide reading, defined by (Graves, 2000) as "extensive reading – reading a lot in a variety of materials" (p. 118). Students learn an average of 2,000 to 3,000 new words a year (Anderson & Nagy, 1993). Since research proposes that only about 300 to 400 words are directly and explicitly taught to students during a school year (Stahl & Shiel, 1999), most words must be acquired through reading. However, in order for students to comprehend many years of content-area material, vocabulary words found within the content must be learned. To facilitate this, these unknown vocabulary words must be directly and sequentially taught to students in the classroom (Biemiller, 2001).

Independent Word Learning

Vocabulary instruction falls into one of two categories: independent word-learning strategies or direct instruction. Traditionally, independent word-learning strategies have primarily consisted of using the dictionary and gathering meanings from context clues. The ability to use the dictionary encompasses various skills, including using guidewords, decoding, and discriminating the most accurate definition (Bryant et al., 2003). Unfortunately, many students become frustrated by the multiple definitions or unknown words used in dictionaries. Additionally, Anderson and Nagy (1993) pointed out that knowing the definition of a word is not necessarily the same as knowing the meaning of a word. According to Anderson and Nagy (1993), definitions define words using other words, as opposed to defining them with meanings connected to actions, objects, thoughts, and feelings. Beck, McKeown, and Kucan (2002) noted that reading and stating a word and its definition may not help in comprehending a passage. Such an activity does not engage the student in concept development in which the student connects the new information to previous knowledge (Rupley et al., 1998).

Trying to discern meanings from context clues can be equally challenging. Integration of different types of information from a passage, such as definitions, examples, and synonyms, must occur to decipher words (Beck & McKeown, 1991). Using context to determine word meanings requires knowledge of the content. Students encountering difficulties with word meanings may also be encountering difficulties with the content (Rupley et al., 1998). Stahl and Nagy (2000) suggested that the use of context clues may be beneficial only after numerous encounters with words. Further, the ease with which a new word is learned from context depends, in part, upon its conceptual difficulty (Anderson & Nagy, 1993). Nevertheless, because this method may be used in the absence of an instructor, competence at using it would lead to vocabulary growth (Carnine, Silbert, Kame'enui, & Tarver, 2003).

Independent word-learning strategies may be combined with direct instruction. Zimmerman (1997) studied the effects of a combination of independent reading and vocabulary instruction on students' knowledge of non-technical academic terms, using a treatment control group design. Study participants includ-

ed U.S. postsecondary-level English as a Second Language (ESL) students preparing for college entrance exams. Half of the students served as the control group; they were asked to read assigned texts independently. Vocabulary instruction was provided only if students asked for clarification. In contrast, the intervention group was asked to read assigned texts independently and was also provided vocabulary instruction for three hours a week. Results indicated that vocabulary instruction led to increased vocabulary acquisition and that vocabulary instruction was preferred over independent reading. Findings of the study suggest that reading be combined with vocabulary instruction for maximum benefit in vocabulary acquisition and student enthusiasm.

Reading Comprehension

Beck, Perfetti, and McKeown (1982) examined the relationship between the process of acquiring word meanings (semantic processing) and knowledge of word meanings. The authors stipulated that the three elements of semantic processing for reading comprehension are knowledge of word meanings (accuracy), speed of accessing meanings (fluency), and connection to prior knowledge (richness). The authors hypothesized accordingly that improving comprehension by improving vocabulary would affect one or more of these elements. An experimental group of 27 fourth-grade students was paired with a similar control group of students. The experimental group was taught 104 words over five months; the control group received no such instruction. All students performed tasks that were designed to elicit semantic processes, such as single-word semantic decisions and recall of stories read. Conditions were arranged in an effort to determine how vocabulary knowledge affected fluency and comprehension. Results showed the experimental group responded more quickly and accurately in all semantic processes than the control group.

Fletcher and Santoli (2003) found that teaching mathematical vocabulary enhanced student performance on math tests. Four freshman and five juniors were taught mathematical vocabulary with a focus on concepts as part of their mathematics instruction. Similarities, differences, and relationships of terms were stressed. In a control group, similar students received no vocabulary instruction as part of their mathematics instruction. Three weeks later, the students who received vocabulary instruction via the concept method showed substantial increases in comprehension of the reasoning behind math concepts. Thus, the study demonstrated that teaching vocabulary, even for a short length of time, significantly affected student comprehension of content-area material.

Blessman and Myszczak (2001) examined the effectiveness of teaching mathematics vocabulary to students. Fourteen high school students enrolled in a remedial math class were taught 50 mathematical terms by developing word meanings and reporting about related items found in newspapers. This vocabulary instruction supplemented traditional instruction. Seven students in a similar program served as the control group and received only traditional instruction. Results of pre- and posttests indicated a significantly greater improvement in the test scores of the experimental group.

Our understanding of a word's meaning is also dependent upon our purpose for knowing the word. Secondary (middle and high school) students encounter

new vocabulary in all content areas. Since students are required to read large amounts of text, the ability to comprehend the texts is vital (Rivera & Smith, 1997). Content-area textbooks are explanatory, detailed, and full of specialized and technical terms (West, 1978). Therefore, the vocabulary of secondary-level content-area textbooks requires a deeper understanding than words demonstrating nuances in descriptive terms. Knowledge of content-area vocabulary is essential to comprehension of expository texts. Lack of knowledge of the meanings of key concepts found in texts hinders not only comprehension of the text but also the ability to connect the content of the text to one's existing knowledge. To this end, vocabulary should be introduced and acquired in differing ways. In content areas, direct instruction should follow the introduction of the word and its meaning to ensure that students have adequate practice in using the word (Beck et al., 2002). Vanniarajan (1997) has demonstrated that difficulties in comprehension are more highly correlated with difficulties with vocabulary than with any other component of reading. These studies indicate that direct instruction of content-area vocabulary words leads to increased reading comprehension of the content-area material to be learned.

Vocabulary Acquisition

Vocabulary acquisition is hindered by memory and language deficiencies and by limited independent word-learning strategies (Baker et al., 1998), both of which are typical difficulties of students with learning disabilities (see Bryant et al., 2003; Jitendra, Edwards, Sacks, & Jacobson, 2004, for reviews). Students with learning disabilities generally do not read widely, nor employ independent word-learning strategies regularly (Bryant et al., 2003). According to Simmons and Kame'enui (1990), students with learning disabilities have significantly lower abilities than their typically achieving peers in numerous cognitive reading tasks, including phonemic awareness, word recognition, vocabulary, and comprehension. These authors contend that instruction that produces in-depth word knowledge and increases reading comprehension is critical for secondary students with learning disabilities to manage the reading demands encountered. Bryant et al. (1999) noted that students with below-grade-level reading have problems "learning vocabulary words even if they were defined in the book" (p. 1053).

Simmons and Kame'enui (1990) compared the vocabulary knowledge of 24 ten- and twelve-year-olds with learning disabilities with that of 24 ten- and twelve-year-old typically achieving peers without disabilities. Each student was presented with 45 vocabulary terms in a one-to-one setting. Vocabulary knowledge was determined by the students' unprompted (what is a ___?) and prompted (point to the ____?) responses. Overall, the vocabulary knowledge of the students with learning disabilities was lower than that of their peers. Specifically, students with learning disabilities had more difficulty in generating verbal definitions to vocabulary terms. Most represented partial concept knowledge, while those for typically achieving students represented full concept knowledge. In addition, students with learning disabilities were less able to produce unprompted responses of the vocabulary terms.

Instruction in the secondary classrooms typically consists of the teacher lecturing on textbook content and assigning students' textbook reading to the students (Bryant et al., 1999). Students are expected to identify facts and gather the meanings of terms to prepare for chapter tests. For students with reading disabilities,

this method is frequently intimidating and ineffective because they may not have mastered early reading skills and strategies (Deshler et al., 2001; Mastropieri, Scruggs, & Graetz, 2003). Students with difficulty reading often have meager vocabularies compared with their typically achieving peers (Simmons & Kame'enui, 1990), hindering their ability to relate new terms and concepts to previous knowledge. This, in turn, hinders comprehension of content-area textbooks. As these students progress through school, typically "the gap between what they can read and what they should read continues to widen" (Ciborowski, 1992, p. 7), affecting learning and reading in all subjects, generally, and, ultimately, thinking strategies and attention. To help students with reading disabilities comprehend textbook content, direct approaches to teaching word meanings and strategies for learning vocabulary as it appears in context should be implemented in the classroom (Carlisle, 1993).

Direct Instruction

MacLean (2000) examined the effects of interactive vocabulary instruction on the reading comprehension of one fourth-grade and three fifth-grade males identified as having learning disabilities in reading and writing. During the baseline condition, the students received no vocabulary instruction prior to text reading. During the intervention condition, the students were involved in various interactive activities to learn the meanings of vocabulary words. After each phase, the students were tested for comprehension and fluency. Results showed an increase in both reading comprehension and fluency during the intervention phase, indicating direct vocabulary instruction is effective for students with learning disabilities.

Schoenberger and Liming (2001) found that the mathematical thinking skills of both general and special education students improved through improved use of mathematics vocabulary and numerical operations. Sixth-grade general education students and ninth-grade special education students were found deficient in solving multistep problems involving mathematical vocabulary and higher-order numerical operations. After an intervention consisting of interactive instruction in mathematical vocabulary, both groups of students increased in their ability to use mathematical vocabulary in literal and abstract sentences, to identify parts of equations, to identify cue words in and operations needed to solve word problems, and to solve the word problems. Results further support the positive effect of direct instruction with students receiving special education services.

In a recent review, Bryant et al. (2003) reviewed research on vocabulary interventions for students with learning disabilities. Their review revealed four main categories of direct vocabulary instruction that brought positive results on measures of immediate recall, maintenance, and generalization for students with learning disabilities. First, computer-assisted instruction (CAI) has been used, requiring only initial teacher direction (Johnson, Gersten, & Carnine, 1987; Reinking & Rickman, 1990). Second, fluency building practice has been successful, as demonstrated by Stump and colleagues (1992). Third, in mnemonic strategy instruction, new words are linked or associated with familiar words or word sets to facilitate retention and recall of the new words (Condus, Marshall, & Miller, 1986; Mastropieri, Scruggs, & Fulk, 1990; Mastropieri, Scruggs, Levin, Gaffney, & McLoone, 1985). Finally, concept enhancement instruction has also proven effective in vocabulary development (Bos & Anders, 1990).

Concepts

Different levels of processing word knowledge have been reported. For example, Baker et al. (1998) indicated that depth of word knowledge exists on a continuum, from either no or little understanding of the meaning to a full understanding. Others have described the levels of knowledge using terms synonymous with *minimal, partial*, and *full* (Beck & McKeown, 1991; Nagy, 1998). Stahl (1986) distinguished the levels as those of association, comprehension, and generation. Baumann and Kame'enui (1991) pointed out how depth of word knowledge is related to instruction. That is, verbal association, the minimum level of knowledge, allows one to connect an unknown word to a particular definition or concept. An example is connecting the word *pauper* with the definition of "an extremely poor person" (Boyer, Ellis, Harris, & Soukhanov, 1983, p. 504). Partial concept knowledge enables one to limited use of a word and limited meanings of words with multiple meanings. For example, one might know that the word *grave* means "any place of burial" (Boyer et al., 1983, p. 305), but not be aware that *grave* also means "extremely serious" and "to engrave" (Boyer et al., 1983, p. 305). Full concept knowledge indicates the ability to use a word in new instances, discern the word's meaning from similar words' meanings, as well as discriminating among meanings of words having multiple meanings. Using the example of *grave*, therefore, possessing knowledge of the term's various meanings, the ability to use the word correctly with each meaning, and the ability to distinguish between a grave and a coffin, would indicate full concept knowledge.

Anderson and Nagy (1993) stipulated that instruction must focus on teaching concepts, postulating that the problem secondary-level students often have with comprehension of content-area textbooks is not unfamiliar words, but unfamiliar concepts. Students with learning disabilities must be helped in understanding unfamiliar concepts by building upon concepts they already know.

Tennyson and Cocchiarella (1986) stressed two phases in concept acquisition. In the first phase, one comes to understand a concept's functions relative to its attributes. New concepts are then connected to this known concept. In the second phase, one discriminates between and generalizes to new instances of concepts.

Numerous researchers promote the teaching of vocabulary concepts through the use of concept diagrams. For example, Rupley et al. (1998) emphasized that word meanings should be integrated with existing knowledge to build conceptual models of vocabulary for students in finding relationships between new and known vocabulary words. Schwartz and Raphael (1985) used a hierarchical method to enable conceptualization of a new term. Their "concept of definition" includes categories, properties, illustrations, and comparisons. Graphic organizers focus on the effects of concept enhancements. A good graphic organizer "can show at a glance the key parts of a whole and their relations, thereby allowing a holistic understanding that words alone cannot convey" (Jones, Pierce, & Hunter, 1988/1989, p. 21).

Monroe and Pendergrass (1997) compared the effects of a concept model, an integrated graphic organizer/discussion model, with the effects of a definition-only model of vocabulary instruction. In their study, 59 fourth graders were randomly assigned to one of two groups. One group received 5-10 minutes per day of vocabulary instruction using the integrated model. The students were taught how to

analyze and acquire new concepts through a group discussion of attributes, examples and non-examples, and the class or category of the concepts. The control group received 5-10 minutes of daily vocabulary instruction using the definition-only model. These students obtained the definitions of words either from a dictionary or from the teacher. They wrote the definitions down and were told to memorize them. Vocabulary knowledge was assessed through journal writings on the terms before and after instruction. Results indicated the group using the concept model recorded a larger number of concepts, indicating the concept model was more effective in teaching vocabulary.

Bulgren, Schumaker, and Deshler (1988) recommended presenting vocabulary words along with their definitions and then giving examples and non-examples. They conducted a study with 475 ninth- through twelfth-grade students, including 32 students with learning disabilities. A multiple-baseline-across-groups-of-students design was used. Data were collected during baseline and two intervention conditions. Intervention Condition One consisted of concept training utilizing a concept diagram, whereas Intervention Condition Two consisted of concept training and review. Results showed an increase in performance on tests of concept acquisition during intervention for both students with and without learning disabilities.

Lenz, Alley, and Schumaker (1987) investigated the effects of using one form of concept diagram, an advance organizer, with students with learning disabilities. Two female and four male students aged 16 to 19, all with learning disabilities, participated in the study. A multiple-baseline-across-students design was used, encompassing one baseline and two intervention conditions. In the baseline condition, the lessons were taught in the typical manner, without advance organizers. In Intervention Phase One, the students were given advance organizers and the teachers taught using the advance organizers. In Intervention Phase Two, the students were given advance organizers and were taught how to use the advance organizers, and the teachers taught using them. The dependent measure was the number of pertinent student responses per category taught in a post-session interview. Results showed that use of the advance organizers positively increased the students' retention and expressions of information taught, but only after the students were taught how to use the organizers.

Students with learning disabilities should especially benefit by learning strategies for independently developing a deeper understanding of the conceptual meanings of vocabulary words found in content-area textbooks. Because students with learning disabilities take even longer than their typically achieving peers to learn new strategies, strategies of vocabulary acquisition should be directly and explicitly taught (Biemiller, 2001).

In summary, middle school students are required to read and comprehend large amounts of content-area information. The vocabulary of such text is often specialized and technical. Knowledge of this vocabulary is essential to comprehension of the text material. Many middle school students need assistance in comprehension of the text and its vocabulary. Students with learning disabilities in reading especially need help in this area because they often have not mastered early reading skills and strategies. As a result, they have meager vocabularies compared with typically achieving peers.

Strategies to assist with comprehension of content-area vocabulary of secondary students, particularly those with learning disabilities, are needed. Research has shown that vocabulary instruction using the concept model has been more effective than the traditional definition model instruction; however, there is limited research on the effectiveness of the model at the secondary level. The purpose of this study was to compare the effects of the two types of instruction on the learning of content-area vocabulary words of six middle school students with learning disabilities.

The study aimed to answer the following two research questions: (a) Will the concept model of vocabulary instruction lead to a larger increase in the number of vocabulary questions answered correctly than the definition/sentence writing model for students with learning disabilities at the secondary level? and (b) Will students like learning vocabulary words more with the concept model compared to the definition/sentence writing model?

Method

Participants

The study included 6 seventh-grade students aged 12 years, 5 months, to 13 years, 8 months. All students were classified as having a learning disability (LD), as identified by the county school district following district and state guidelines. None of the students took medication on a daily basis. Table 1 provides the demographics for the participants.

Prospective participants were considered for inclusion in the study because they were all identified as having a learning disability and were currently enrolled in the teacher-researcher's resource language arts classes. Two students were chosen from each of three of the teacher-researcher's classes to enable staggering the introduction of the intervention across classes. These particular students were chosen because their attendance history was better than that of other students, thus, increasing the probability that they would be present during implementation of the study. All participants were required to be able to read at the third grade level, and have the ability to write. According to the most recent yearly academic testing, all students possessed the prerequisite skills.

Setting

The study was conducted in a middle school serving 2,300 students in the sixth, seventh, and eighth grades. The school qualified for Title I funds, but did not receive the funds due to consensus of community members. The school was located in a suburban area within a large metropolitan region in the southeastern United States with a population of 22,397. The racial demographics of the city was 76.04% Caucasian, 13.61% African-American, 3.17% Asian, .22% Native American, .10% Pacific Islander, 4.46% other races, and 2.41% two or more races, of which 12.14% were of Hispanic or Latin origin of any race.

The classroom in which the study was conducted was 1,200 square feet. All students sat at their desks facing the teacher and an overhead screen/projector. The researcher was the classroom teacher. The teacher stood next to the overhead projector, to the right of the class during the intervention, and either walked among the student desks or sat at her desk during baseline. All students in each of the three

Table 1
Student Demographic Information

Student	Name	Gender	Age	Ethnicity	Disability	Time in SPED Placement	Full Scale IQ Score	IQ Test	Reading Comprehension SS/GE	Reading Comprehension Test
1	Brenda	F	12/11	Caucasian	LD	6 years, 5 months	93	UNIT	101 / 7.9	KTEA NU
2	Alex	M	13/6	Bosnian	LD	4 years, 2 months	102	RIAS	104 / 8.8	KTEA NU
3	Phagen	M	12/5	Black	LD	7 years, 3 month	96	K-BIT	81 / 3.7	KTEA NU
4	Joe	M	13/8	Caucasian	LD	8 years, 4 months	85	WISC-III	88 / 6.5	WIAT II
5	Natika	F	13/5	Black	LD	7 years, 0 months	75	WISC-III	82 / 4.5	KTEA NU
6	Ricky	M	13/4	Hispanic	LD	7 years, 4 months	92	WISC-II	58 / 3.0	WIAT II

[a]Age in years and months.
K-BIT = Kaufman Brief Intelligence Test
WJ = Woodcock Johnson
WIAT = Wechsler Individual Achievement Test
WISC = Wechsler Intelligence Scale for Children
UNIT = Universal Nonverbal Intelligence Test
KTEA = Kaufman Test of Educational Achievement
RIAS = Reynolds Intelligence Assessment Scale

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classes received the intervention, but data were collected for this study only on the six participants described above.

Materials and Equipment

The materials and equipment used to conduct the study included an overhead projector and screen, five transparencies of blank concept diagrams, overhead markers, 150 paper copies of blank concept diagrams, one pre-written concept diagram for each intervention vocabulary word for experimenter use, paper, pencils, a dictionary for each participant, vocabulary tests for each set of five words comprised of two questions for each vocabulary word, and answer keys for the tests.

Research Design

A single-subject, multiple-baseline design (Tawney & Gast, 1984) across participants was used to evaluate the effectiveness of the two instructional models (definition and concept model) on the percent of vocabulary questions answered correctly. Data were collected during baseline (definition/sentence writing) and intervention (concept model implementation) conditions. If a change occurred in the percent of test questions answered correctly from baseline to intervention, and this change occurred for at least three individuals, we assumed that there was a functional relationship between the independent variable (concept model instruction) and the dependent variable (percent of correct answers). The replication of results across at least three individuals gave the study external validity. It was assumed that each participant functioned independently, but was similar enough to respond to the same intervention. The independent variable was the vocabulary concept model instruction, whereas the dependent variable was the percent of vocabulary questions answered correctly on the posttests. The target behavior was correct answers written for questions on vocabulary tests.

General Procedures

One session was held twice a week during the regularly scheduled time of the class for 20 minutes. If one of the two student participants in each class was absent, a given session was held the next day, even if one of the two participants was still absent. Five vocabulary words were given during each session for both conditions. Whatever the students did not finish in the first 20-minute session, they completed in the second 20-minute session. The teacher called on the students to participate an equal number of times, whether or not the students volunteered information. Reinforcement was given in the form of verbal praise. Grades satisfactory to the students also served as reinforcement. In the case of student misbehavior or inattentiveness, the teacher redirected the student(s).

Prior to either phase, each student was given a list of the 45 vocabulary words to be used in the study (see Appendix A). All of the words were mathematical terms taken from a list of mathematical terms published in the students' school agendas. They were chosen because they were content-area words the students were expected to learn that academic year. They were also chosen to provide unity across the types of words used, since they were all from one academic subject.

Students were instructed to write the definition for any of the mathematical terms they knew. This was done to determine the suitability of each word for the study. Any words for which more than two students gave an accurate definition were discarded, and alternate words were tested and included. An accurate definition was

expected for some words from some students, as the students might have encountered the words during the previous school year. Based upon these criteria, no words were discarded. The mean percent correct on the pretest was 3.70.

Baseline Condition

The baseline lasted for three weeks for Brenda and Joe, four weeks for Alex and Natika, and five weeks for Phagen and Ricky. During the baseline condition, students received the same instructions they had been receiving in class up to that point of the study. The purpose of the baseline condition was to determine how many questions each student answered correctly on vocabulary tests after receiving the regular vocabulary instructions. Instructions were presented in the following format:

1. The teacher wrote the vocabulary words on the board and pronounced them to the students.
2. She then instructed the students to look up the words in a dictionary, and write down the first, or most common, definition for each word.
3. When the students had written down the definitions, the teacher led the class in discussing the definitions and deciding upon a few key words that essentially defined each word.
4. The teacher wrote the key words on the board and instructed the students to do the same on their papers.
5. The teacher instructed the students to write each word in a sentence to show they knew the meaning of the word.
6. When the students had finished, the teacher collected the papers and indicated in writing on the papers whether the words were used correctly in the sentences.
7. The next day she handed the papers back to the students. She asked for and answered any questions about the definitions.

Intervention Condition

The intervention condition lasted for six weeks for Brenda and Joe, five weeks for Alex and Natika, and four weeks for Phagen and Ricky. The students were presented with five vocabulary words each week. The teacher stated that for the next six (four or five) weeks students would be using a concept diagram model to learn and discuss the meaning of their vocabulary words. Each word was presented using the following format:

1. The teacher presented a transparency of the blank concept diagram to the class and gave a paper copy to each student.
2. She stated and wrote the word. She instructed the students to write whatever she wrote on their diagrams.
3. She stated and wrote the definition of the word.
4. She stated that the class would now discuss characteristics present in the word (concept).
5. She stated, elicited from the students, and listed the characteristics that were always present.
6. She stated, elicited from the students, and listed the characteristics that were sometimes present.

7. She stated, elicited from the students, and listed what were never characteristics.
8. She stated that students would now list and discuss examples and non-examples of the word.
9. She stated, elicited from the students, and listed examples of the concept, linking them to the characteristics.
10. She stated, elicited from the students, and listed non-examples of the concept, linking them to the characteristics.
11. She elicited and answered questions.
12. She called on all students an equal number of times (on a list of students' names, she made a tic mark each time she called on a student, ensuring each student had an equal number of tic marks).

To measure the results during baseline and intervention, on Friday of each week the students were administered a test containing 10 objective questions (matching) on the definitions of the five weekly vocabulary words. The questions were organized into two groups, each of which contained a matching question for each of the five vocabulary words. The corresponding match for each word was accurate, but different between the groups. This was done to give the students an opportunity to use the matches they knew in one group to makes it easier for them to make the match with the word in the second group. The students were given 20 minutes to complete the test.

The teacher scored answers as correct or incorrect against an answer key. The number of correct responses were counted and divided by 10. The resulting number was multiplied by 100 to yield a percentage of correct answers. The paraprofessional also independently scored each test of each student. These recordings were compared against those of the teacher to determine interscorer reliability. The percentage of agreements was calculated as the number of agreements divided by the number of agreements plus disagreements and multiplied by 100.

Reliability was determined in several ways. Using a multiple baseline across participants as the experimental design ensured that results obtained were not unique to a single subject, but rather, were replicated across five similar subjects (Tawney & Gast, 1984). To calculate procedural reliability, a paraprofessional was given a copy of the concept instruction procedure, along with a verbal explanation. She observed the teacher instructing each class during presentation of the procedure. The paraprofessional recorded 1 point for each of the 12 procedures the teacher performed correctly, for a possible total of 12 points per vocabulary word. For instance, for procedure #12, she also had a list of the students and made a tic mark each time the teacher called on a student. She compared her list against the teacher's to verify they matched. To ensure procedures were followed reliably, the number of the 12 steps agreed upon was divided by 12, the number of steps possible, and multiplied by 100. The paraprofessional also examined each concept diagram the teacher presented to each class after the lesson. The paraprofessional recorded 1 point for each section of the diagram completed, for a possible total of 7 points per diagram. The number of sections agreed upon was divided by 7, the number of sections possible, and multiplied by 100.

Numerous threats to internal validity can arise in experiments of this kind. Threats of history were to be reported. Maturation was not expected to occur, as the teacher had determined each of the students could remain attentive for 20 minutes at a time, the length of each session. Testing was not an issue, as each test administered differed from all others. Applying only one intervention variable controlled for multitreatment interference. Attrition was to be reported. The same measuring and recording devices were used throughout the study, thus decreasing the possibility of instrumentation threats. Instability in behavior of participants was possible, but by holding sessions at a constant time in the day and following the procedures strictly, instability was less likely.

To determine social validity, students were asked to complete a questionnaire to determine their satisfaction with the use of concept diagrams. The mean rating and the range of ratings were calculated for each question on the questionnaire (see Appendix B). Data obtained were analyzed in several ways. For each participant, the percentage of questions answered correctly on the weekly tests for each condition was graphed. The mean, median, and range of scores for each participant were also calculated both within each condition and across the study. Finally, the same calculations were performed on the data for the participants as a group.

Results

Results indicated an increase in scores (mean and median) for all six students from baseline to intervention. Table 2 presents the percent correct per student per session, pretest and posttest. Scores on the pretest ranged from 0% correct to 8.89% correct, while posttest scores ranged from 57.78% correct to 82.22% correct.

Table 2
Percentage of Questions Answered Correctly per Student per Session

		Session									
Student	Pretest	1	2	3	4	5	6	7	8	9	Posttest
Brenda	0	30[a]	60[a]	60[a]	70	100	100	60	90	80	66.67
Alex	8.89	80[a]	60[a]	70[a]	100[a]	100	100	100	80	100	82.22
Phagen	0	50[a]	40[a]	60[a]	60[a]	60[a]	100	100	80	70	57.78
Joe	6.67	80[a]	60[a]	60[a]	80	100	100	80	80	100	73.33
Natika	2.22	70[a]	50[a]	60[a]	80[a]	100	100	100	100	80	77.78
Ricky	4.44	40[a]	100[a]	60[a]	80[a]	60[a]	100	100	70	100	71.11

[a]Scores using the definition model of instruction.

Table 3 presents the mean, median, and range of percent correct per student from baseline to intervention. The percent increase from baseline to intervention for the means and medians are also shown. The same data are presented for all students combined. As illustrated, the mean score for all students during baseline was 63.75% correct. The mean score for all students during intervention was 90.67% correct, which was an increase of 42.23%. The mean score for all students at posttest was 71.48%.

Table 3
Mean, Median, and Range of Percentage of Questions Answered Correctly per Student and for All Students

	M			*Median*			Range	
Students	Baseline	Intervention	% Increase	Baseline	Intervention	% Increase	Baseline	Intervention
Brenda	50.00	83.33	66.66	60	85	41.67	30-60	60-100
Alex	77.50	96.00	23.87	75	100	33.33	60-100	80-100
Phagen	54.00	87.50	62.03	60	90	50.00	40-60	60-100
Joe	66.67	90.00	35.00	60	90	50.00	60-80	80-100
Natika	65.00	96.00	47.69	65	100	53.85	50-80	80-100
Ricky	68.00	92.50	36.03	60	100	66.67	40-100	60-100
All Students	63.75	90.67	42.23	60	100	66.67	30-100	60-100

Brenda's mean score increased 66.66% from baseline to intervention, and her median score increased 41.67%. She had the highest mean score percent increase of all the students and the lowest mean baseline and intervention scores. Joe's mean score increased 35%, and his median score increased 50%. Alex's mean score increased 23.87%, and his median score increased 33.33%. Alex had the lowest mean score percent increase and the highest mean baseline score. He had the lowest median score percent increase. Natika's mean score increased 47.69%, and her median score 53.85%. She and Alex had the highest mean intervention scores. Phagen's mean score increased 62.03%, and his median score increased 50%. Finally, Ricky's mean score increased 36.03%, and his median score 66.67%. He had the highest median score percent increase.

Figure 1 depicts the mean scores for all six students combined for the pretest, baseline, intervention, and posttest.

Figure 2 shows the percent correct responses for Brenda, Alex, and Phagen for the pretest, baseline, intervention, and posttest. Figure 3 shows the percent cor-

Figure 1. Mean percentage of questions answered correctly for all participants.

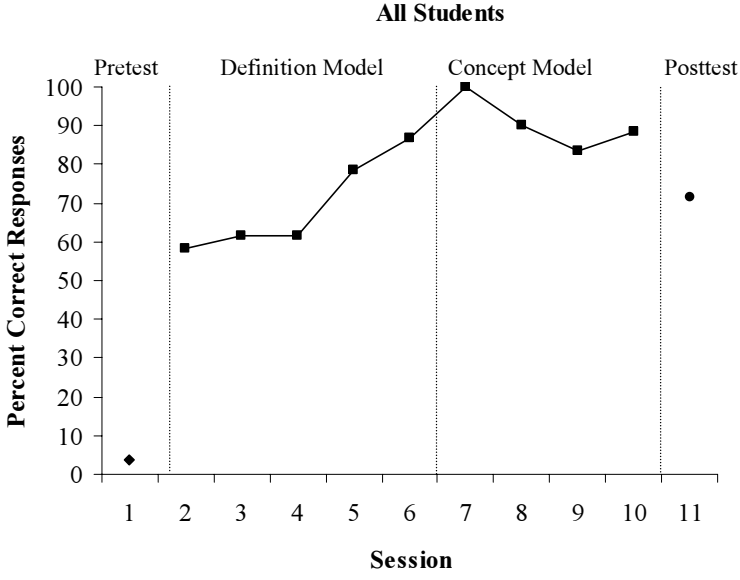


Figure 2. Percent of questions answered correctly by Brenda, Alex, and Phagen.

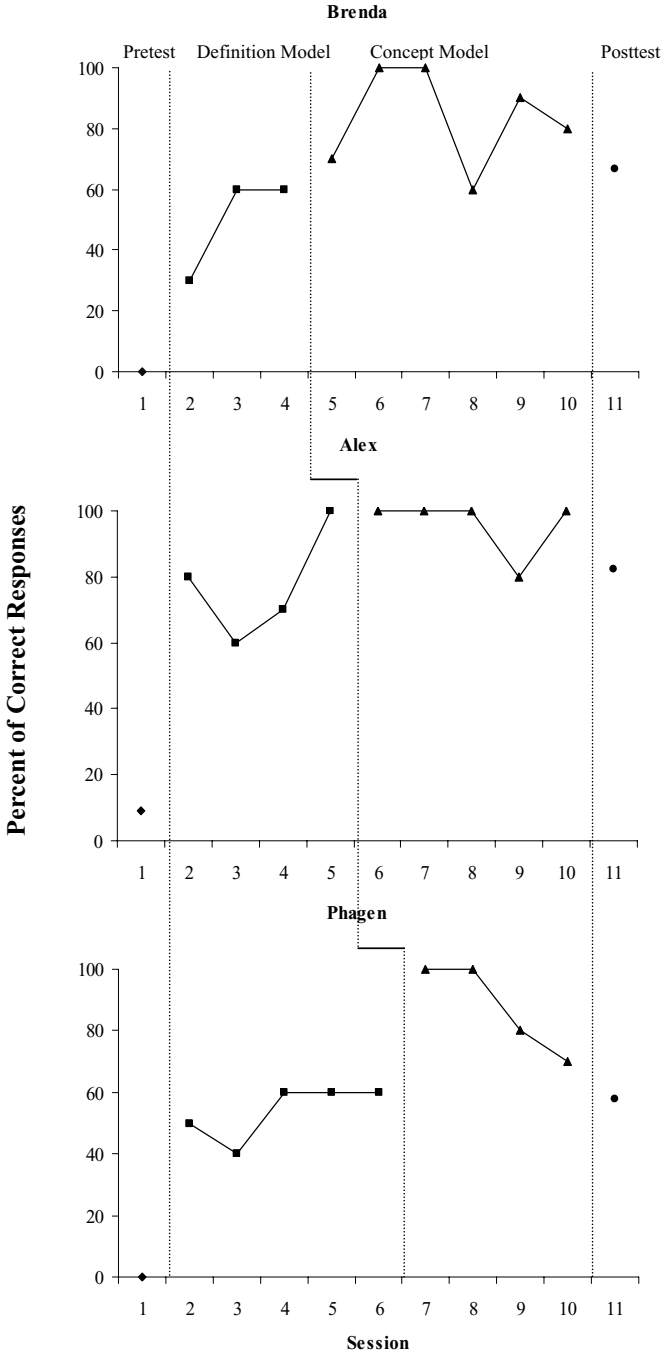
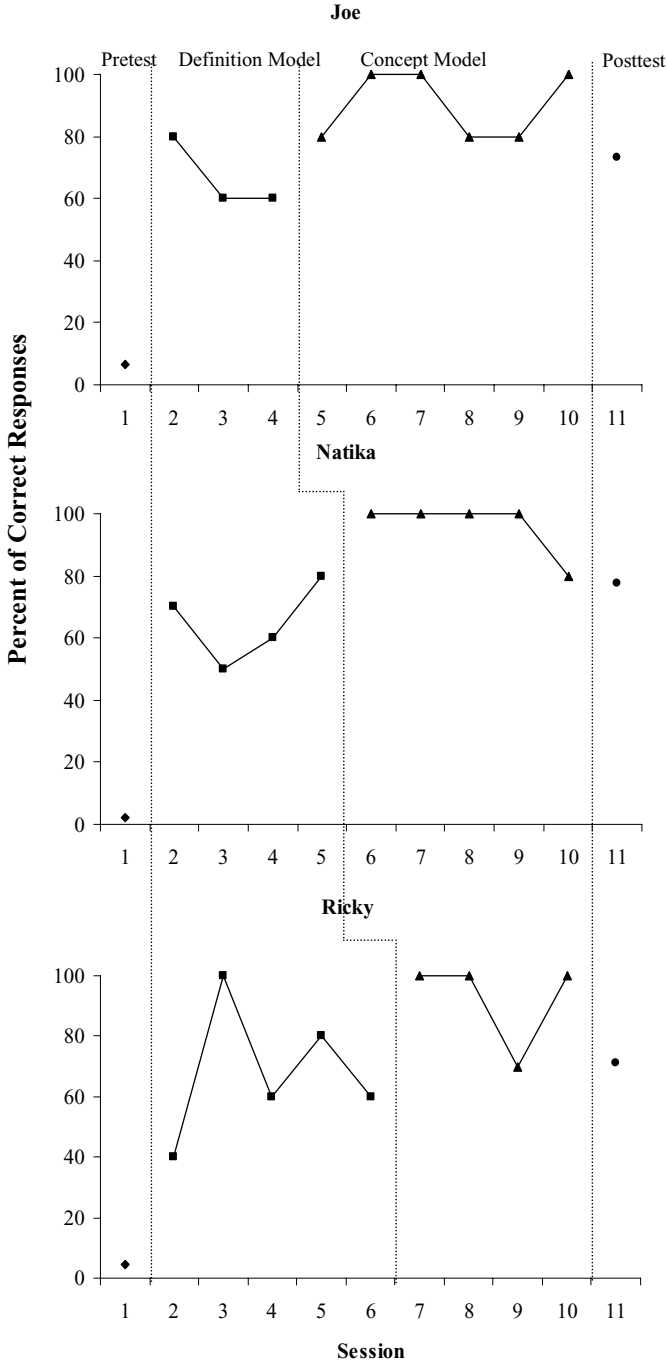


Figure 3. Percent of questions answered correctly by Joe, Natika, and Ricky.



rect responses for Joe, Natika, and Ricky for the pretest, baseline, intervention, and posttest. As illustrated, each participant's percent correct increased within the intervention condition. Four of the participants' (Brenda, Alex, Natika, Phagen) percent correct increased within baseline condition.

Attrition did not occur, as all students were present on the scheduled session days with one exception. Brenda was absent for the first scheduled session of week 3. As a result, both sessions of week 3 were conducted a day later than scheduled. Procedural reliability was calculated to be 100% for intervention implementation and concept diagram accuracy. The results of the student survey indicate high satisfaction with the use of concept diagrams. With possible ratings of 1 (not at all) to 5 (a lot), the student ratings ranged from 3 to 5. Mean ratings ranged from 4 to 4.83. The mean rating for all questions was 4.5 (see Appendix C).

Discussion

The purpose of the present study was to compare the effectiveness of two types of instructional models (definition versus concept model) on the learning of content-area vocabulary words for six middle school students with learning disabilities. The results indicated that all six students performed significantly better using the concept model of vocabulary instruction than the definition model in terms of learning new mathematical content-area vocabulary words from pre- to posttest. Specifically, the use of the concept model of vocabulary instruction led to a mean increase of 42.23% in the number of vocabulary questions answered correctly over the use of the definition/sentence writing model. In fact, when using the concept instructional model, the percentage of answers correct increased from between 23.87% and 66.66% per student compared to the definition/sentence model. Also, median scores increased from between 33.33% and 66.67%, with an average of 66.67%.

These findings corroborate and extend previous research on the use of the concept instructional model to improve and increase vocabulary knowledge for students with learning disabilities (Anderson & Nagy, 1993; Monroe & Pendergrass, 1997; Rupley et al., 1998). These findings can aid classroom teachers in instruction of vocabulary (concept) words. In addition, the results indicate that the concept model, as a method of direct instruction, should be explicitly taught to students to facilitate independent word learning.

A number of limitations must be considered when interpreting the findings of the present investigation. First, the sample consisted of only six participants with learning disabilities in three seventh-grade language arts resource classrooms. Thus, the results may not be representative of all resource secondary classrooms. In order to increase the external validity of the findings, the study would need to be replicated across more students. Second, maintenance and generalization measures for other content-area classrooms were not included. Finally, the study included only seventh-grade students with LD and, therefore, needs to be replicated with a broader range of students across a variety of age and grade levels, content areas, as well as disability categories.

However, despite the small sample size, the findings have implications for practice for both general and special education teachers and researchers. For exam-

ple, the study demonstrated that the use of the concept model was effective at improving the knowledge of new mathematical vocabulary words of secondary-level students with LD in a resource classroom setting. Also, the structured format of the concept model (designing a diagram of the vocabulary word, writing the definition and characteristics, and providing examples and non-examples) provides the students and teachers with a concrete outline or picture of the content-area vocabulary words to be learned compared to traditional (definition model) instruction.

Future research on use of the concept model of vocabulary instruction should focus on the impact of this model on teaching new vocabulary knowledge to secondary-level students with LD across instructional settings (e.g., resource and inclusive), grade levels, and content-area classrooms. In addition, further research is needed on the effects of the concept model with a variety of students with mild disabilities of varying ages and grade levels in middle to high school classrooms in order to determine the effectiveness of the model across content areas. For example, would use of the concept instructional model be effective in science or social studies instruction? Future research is also warranted to explore the effects of different versions or types of concept diagrams and vocabulary words for students with LD. Finally, in order to compare treatment effects, future research should employ more rigorous designs to allow for better comparisons, such as a group experimental research design, in which students are randomly assigned to one of two instructional conditions.

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Appendix A
Probe of Prior Knowledge of Vocabulary Words

Write the definition for any of the mathematical terms below that you can.

evaluate _____
bisect _____
bisect _____
altitudes _____
diameter _____
concave _____
geometry _____
integer _____
factor _____
octagon _____
histogram _____
monomial _____
parallel _____
quadrant _____
radius _____
trapezoid _____
range _____
septagon _____
convex _____
dividend _____
domain _____
decagon _____
origin _____
transform _____
adjacent _____
inverse _____
decrease _____
intersect _____
hexagon _____
area _____
acute _____
quartiles _____
polygon _____
statistics _____
frequency _____
prism _____
function _____
reciprocal _____
pentagon _____
lateral _____
plane _____
ratio _____
sequence _____
principal _____
variable _____
binomial _____

Appendix B
Student Questionnaire

For each question below, please indicate your answer by writing in the number that best describes how you feel.

1 = Not at all 2 = not much 3 = neither way 4 = a little 5 = a lot

1. How easy was it to follow along with what the teacher was saying while using the concept diagram? _____

2. Did the diagram help you to determine what was important and what was not important about the word's definition? _____

3. Did the concept diagram help you to know what the word meant?_____

4. Did the concept diagram help make it easy to study for the tests? _____

5. Did the diagram help you to improve your grades on vocabulary tests _____

6. Do you like using the concept diagram better than looking up definitions in a dictionary and writing a sentence using the word? _____

7. Were concept diagrams more helpful to you than looking up definitions in a dictionary and writing a sentence using the word? _____

Appendix C
Student Questionnaire

Level 1 2 3 4 5
Numbers below indicate how many students chose that level.

1. How easy was it to follow what the teacher was saying while using the concept diagram? _____/_____/_____/__2__/__4__

2. Did the diagram help you to determine what was important and what was not important about the word's definition? _____/_____/_____/__1__/__5__

3. Did the concept diagram help you to know what the word meant?
_____/_____/_____/__2__/__4__

4. Did the concept diagram help make it easy to study for the tests?
_____/_____/__1__/__1__/__4__

5. Did the diagram help you to improve your grades on vocabulary tests?
_____/_____/__1__/__4__/__1__

6. Do you like using the concept diagram better than looking up definitions in a dictionary and writing a sentence using the word?
_____/_____/__1__/__2__/__3__

7. Were concept diagrams more helpful to you than looking up definitions in a dictionary and writing a sentence using the word?
_____/_____/_____/__3___/__3__

	Q1	Q2	Q3	Q4	Q5	Q6	Q7
Mean Rating	4.67	4.83	4.67	4.5	4	4.33	4.5
Range of Ratings	4-5	4-5	4-5	3-5	3-5	3-5	4-5