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RESEARCH ON VOCABULARY INSTRUCTION IN THE CONTENT AREAS: IMPLICATIONS FOR STRUGGLING READERS

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This article provides an overview of current knowledge about vocabulary teaching and learning—understandings that influence learning across different disciplines. Research on the teaching and learning of vocabulary in particular subject matter areas, including mathematics, social studies, and science, is discussed. Based upon the instructional implications evident in this body of work, this article also offers suggestions for providing effective vocabulary instruction for students reading below grade level.

"Some parts of the Sahara are giant sand seas. . . . These large areas called ergs are what most people picture when they think of a desert—loose sand blown into tall dunes by the wind. But most of the Sahara is made up of desert pavement and hammadas. Desert pavements are vast plains of gravel and boulders, and hammadas are rocky plateaus. Both surfaces are the result of the erosion of the soil due to the wind." (Hatfield et al., 1998, p. 534)

Consider the vocabulary load of this excerpt from a middle school geography textbook. It contains many terms that may be new to

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students. Such words as *ergs*, *dunes*, *hammadas*, *plateaus*, and *erosion* are important conceptual labels for understanding the geographic features of the Sahara Desert. Now consider the vocabulary load of the following excerpts taken from other middle school content area textbooks:

> **"A number line can be used to display different types of numbers. Zero is neither positive nor negative. . .. Two numbers are opposite of one another if they are on opposite sides of zero and the same distance from zero. The opposite of zero is zero. . .. Integers are whole numbers and their opposites. Positive numbers are numbers greater than zero. Negative numbers of numbers less than zero. . .The absolute value of a number is the distance it is from zero." (Charles et al., 1999, pp. 62–63).**

> **"Relative humidity is a measure of the amount of water vapor in air, compared to the total amount of water vapor it has room for at a particular temperature. If you hear the weather forecaster say that the relative humidity is 50 percent, that means that the air on that day is holding only 50 percent of the water vapor it is capable of holding. Weather forecasters measure humidity because change in humidity often indicates a change in weather" (Feather et al., 1995, p. 254).**

> **"Star and I got our kindling fired up in the little potbelly stove and started stoking it with wood we'd split and kept dry while we were gone, in anticipation of this moment. Pretty soon the cabin was toasty hot. Across from us, Heather had her cabin's chimney puffing, while Rita staked out the showerhouse. She watched as Pug came and went, restoking his fire in the boiler and testing the temperature of the water." (Hobbs, 1991, p. 35).**

These excerpts, which are representative of the vocabulary that students encounter daily as they go from class to class, provide an interesting view of the vocabulary demands that may be placed upon middle students at any given time during the school year. To understand each excerpt, students need to have a well-developed word knowledge base to handle the demands of each reading. Moreover, this well-developed word knowledge base assumes an existing knowledge base for the concepts that are addressed in each passage. For example, in the geography passage, students must understand the features of deserts and how the descriptions in the paragraph correspond with their existing knowledge. For the mathematics passage, students must have a clearly defined

understanding of the set of integers in order to conceptualize how these numbers can be either positive, negative, or zero. Students must understand the relationship water vapor and relative humidity have to weather changes in the science passage, and in the literature passage, they must envision a potbelly stove, a showerhouse, and a boiler.

While students in middle-school classrooms comprise a range of word knowledge, it is not surprising that these excerpts can be problematic for many students, especially struggling readers. Viewed collectively, the students reading these excerpts during a typical school day are bombarded by a wealth of concepts represented by many unfamiliar terms that many times are not integrated across content areas. Furthermore, there may be gaps in some students' content reading ability that only reveal themselves in certain content types. For example, the science passage may be easy for a student to understand, but the same student may be confused and frustrated while trying to understand the mathematics description of the types of integers or the different geographic configurations of the Sahara Desert. In addition to the variations in student interactions with these passages, there are also specific considerations inherent in each subject matter area that can impact vocabulary learning for middle-school students.

Research has provided a wealth of information about vocabulary teaching and learning over the past two decades. Studies have addressed such issues as what it means to know a word, size and growth of vocabulary, degrees of word knowledge, vocabulary assessment, sources of vocabulary learning, and instructional techniques to support vocabulary growth and development (Anderson & Freebody, 1981; Baumann & Kameenui, 1991; Beck & McKeown, 1991; Graves, 1987; Nagy, Anderson, & Herman, 1987). Even with this abundant research base, many questions still remain. As Baumann and Kameenui (1991) so aptly state, "We know too much to say we know too little, and we know too little to say that we know enough. Indeed, language is difficult to put into words" (p. 604). The language of different content areas presents an even greater challenge, as most words in these areas are low-frequency words, many of which do not appear in other contexts. Such limitations narrow the multiple exposures students need to internalize word meanings and develop word ownership. Given these constraints, instruction for helping students learn content area vocabulary embodies not only the features of effective practices for general vocabulary but also unique features that address the language of different content areas.

In this article, important tenets about vocabulary learning that influence learning across subject matter areas are presented. Then the research base specifically for vocabulary teaching and learning

in mathematics, social studies, and science is discussed. Finally, based on this research review, suggestions for providing effective vocabulary instruction for students reading below grade level are presented.

VOCABULARY IN THE CONTENT AREAS

As a critical goal of instruction at the middle school and secondary level (Alvermann & Swafford, 1989; Armbruster & Nagy, 1992), vocabulary knowledge is closely linked to the difficulties many students experience in handling the demands of content textbooks. Teachers have voiced frustration and sometimes helplessness over what to do to help their students become more fascinated with science books, better equipped to handle math problems and social studies texts, and more appreciative of good literature (Bintz, 1997). While these teachers talked about their "reading nightmares" on a broad level, they would no doubt agree that a critical aspect of students' difficulty in understanding texts in their content area would be a lack of sufficient vocabulary knowledge. They would also agree that they frequently and consistently teach vocabulary words but see little positive results from all their efforts. What could help alleviate this problem and foster word learning success? The literature suggests that success in supporting vocabulary development in the content areas must consider students as word learners, the nature of content vocabulary, and the special features of effective vocabulary instruction.

Students as Word Learners

Students who engage in wide reading develop extensive vocabularies (Nagy & Anderson, 1984) and are better prepared to address content area reading assignments, where unfamiliar and sometimes complex concepts can be challenging to even the most proficient reader. However, students who lag behind their peers in reading achievement engage in less reading, know fewer words, and hence find it increasingly more difficult to handle all reading tasks, including content area reading (Allington, 2001).

General trends in the reading achievement of students provide insight into vocabulary acquisition. These trends indicate that factors such as parent education level and family income influence reading achievement (Grissmer et al., 1994). In regard to content vocabulary development over time, Chall, Jacobs, and Baldwin (1990) found that while children from low-income homes tested on grade level in vocabulary development in second and third grade, by fourth grade these children tested below grade level on vocabulary measures. They

attribute the decline in scores in fourth grade and above to the vocabulary tests themselves. These tests contain vocabulary words that are typically more abstract in nature and include technical words associated with specific content areas. Children in grades 4 or 5 who fall behind in vocabulary and reading achievement then become at high risk of poor academic achievement in high school (Chall & Snow, 1988). Yet, the authors also found that low-income children in the intermediate grades who were more likely to handle grade level work had teachers who highlighted vocabulary learning not only during reading and language arts but also during content area instruction. These teachers supported vocabulary by providing students with opportunities to consider word meanings in different contexts.

Struggling readers need assistance not only in learning new words but also in developing independent word learning strategies for the content areas. In her investigation of vocabulary overview guides, Carr (1985) found that students learned and retained content vocabulary when they learned how to self-select important terms in a passage, make personal connections with the term, and monitor their progress. Along similar lines, students' perceptions of themselves as word learners also play a role in vocabulary development. While Alvermann and her colleagues (1996) found that secondary students preferred to figure out unknown words without teacher intervention, many are strategically ill-equipped to construct legitimate meanings for content specific words.

Nature of Content Area Vocabulary

The processes for learning content area vocabulary can differ somewhat from those needed for general vocabulary in terms of the nature of the reading tasks as well as the type of word learning tasks involved. Beck and McKeown (1991) point out that we have varying levels of "knowing" a word, from no knowledge, to partial word knowledge, to complete knowledge where students take ownership in reading, writing, listening, and speaking. In reading narrative texts, students may be able to keep comprehension intact by having only partial knowledge of unfamiliar words. However, many times in content area reading, students need a thorough understanding of vocabulary because the words are labels for important concepts. Furthermore, retention of these word meanings is crucial to the learning of subsequent concepts (Blachowicz & Fisher, 2000).

The type of word learning tasks associated with content area vocabulary is another important consideration. In all content areas, students will confront new words for both known and unknown

concepts. Teaching students new labels for familiar concepts differs from teaching them new labels for unfamiliar, complex concepts (Graves, 1987). In both cases, some word meanings are easily explained, while others may require extensive time and effort to explain, especially if complete understanding is needed. Learning new meanings for familiar words is another word learning task that affects content area reading. Many words have both a common meaning plus a specialized meaning for a particular subject area. These polysemous words also need to be addressed in content area instruction (Graves, 1987).

Effective Instruction

Effective practices for promoting vocabulary focus on the importance of impacting comprehension, not word knowledge alone. Studies indicate that explicit instruction positively impacts vocabulary acquisition (Beck & McKoewn, 1991; Blachowicz & Fisher, 2000; Graves, 1987; Stahl & Fairbanks, 1986). Several features characterize this instruction: integration, repetition, and meaningful use (Nagy, 1988). First, *instruction* must relate newly acquired words to other words and concepts. Tied to schema theory, this feature suggests the importance of the interrelationships among words and the importance of connecting new learning with existing knowledge. The second feature, *repetition*, refers to the need for students to not only acquire new word meanings but to also have sufficient practice in using the meanings so that the meaning can be automatically accessed during reading. The third feature, *meaningful use*, is tied to the level of word processing needed to perform a task, or rather, the level at which students are actively engaged in using the word meanings. The higher the level of processing, the more likely students will learn and retain word meanings (Nagy, 1988).

VOCABULARY LEARNING IN MATHEMATICS

Because the language of mathematics is complex, content-bound, and largely abstract, there is an inherent difficulty in communicating mathematics terminology to others (Kouba, 1989). This difficulty manifests itself in reading mathematics texts, as researchers have reported a relationship between success in reading mathematics and specific reading strategies, including knowledge of technical vocabulary (Gullatt, 1987). In fact, Schell (1982) asserts that mathematics texts present challenging reading because this content area has "more concepts per word, per sentence, and per paragraph than any other

area'' (p. 544). The existing research on vocabulary and mathematics indicates a concern and curiosity about the nature of mathematical words and instructional interventions.

Nature of Mathematical Words

In regard to the nature of mathematical words, researchers have examined the types of words typically used in mathematics and the implications these types may have for instruction. A few studies found that general vocabulary words frequently appearing in elementary reading materials differed from the generalized vocabulary words in mathematics textbooks (Panchyshyn & Monroe, 1992). In another study, Durkin and Shire (1991) found that primary age children had difficulty identifying synonyms for multiple meaning words when the mathematical meanings of the words were used. Sullivan (1981) compared the effects of the vocabulary instruction of ''little'' words typically found in math word problems with a drill of basic mathematics operations on students' ability to solve word problems. She found no significant differences between either approach in improving the problem solving abilities of intermediate grade students.

Others have categorized mathematical terms in ways that can be useful for designing vocabulary instruction. Monroe and Panchyshyn (1995), in particular, discuss four categories of mathematical terms: technical, subtechnical, general, and symbolic. They define technical words as those that represent mathematical concepts and have only one meaning, such as *trapezoid* and *rational number*. Subtechnical words, such as *volume* and *degrees*, have multiple meanings and traverse all content areas as well as everyday experiences. Such words can be problematic for students to conceptualize because of the variation in meanings. General words in mathematics can differ from general words in typical reading experiences (Stauffer, 1966). Words such as *number line, negative, notation*, and *simpler* can be troublesome for many readers. The last category, symbolic vocabulary, is unique to mathematics and can also be problematic. These symbols represent highly abstract numbers that can be difficult to define and conceptualize. Monroe and Panchyshyn (1995) illustrate this category with different contexts for numerals, such as 4, in 84, 45, and 3 to the 4th power. One subcategory of symbolic vocabulary contains mathematics abbreviations, such as *oz.* and *in.*, which add another challenge to mathematics readers. Knowledge of these categories can help teachers understand the cognitive demands that are placed on students as they grapple with the words in their mathematics textbooks as well as with the oral explanations of the teachers themselves.

Vocabulary Instruction

Studies focusing on vocabulary instruction varied in terms of the types of instructional interventions and the mathematical concepts that were explored. For example, Jackson and Phillips (1983) found that vocabulary activities significantly enhanced seventh-grade students' learning of ratio and proportion. The set of vocabulary activities used in this study facilitated an understanding of mathematics concepts and included recognition of terms and symbols, knowledge of literal meanings for the terms and symbols, categorization of terms and symbols through inclusion and exclusion tasks, and identification of examples and nonexamples of the concepts.

In another study, Monroe (1997) examined the effects of two vocabulary instructional models on the mathematical vocabulary of fourth-grade students. She compared a definition-only model with the Concept of Definition graphic organizer model. A Frayer-type discussion format accompanied the graphic organizer model. When measuring student knowledge through writing, results indicated that the writing of students using the Concept of Definition/Frayer discussion model contained more mathematical concepts than those students who experienced the definition-only instructional model. It appears that the use of graphic organizers accompanied by in-depth discussions can effectively impact the mathematical vocabulary of fourth-grade students. The effectiveness of various graphic organizers in teaching technical vocabulary in mathematics and in other content areas has been well documented (Merkley & Jefferies, 2000/2001; Moore & Readence, 1984). Still other studies have examined the nature of mathematics word problems and have noted the importance of vocabulary knowledge in students' understanding and conceptualization of the problems (Cloer, 1981).

While the studies on mathematics vocabulary instruction are not extensive, they do provide several important implications for instruction. First, teachers need to make students aware of the different terminology and how the mathematics context can change the meaning of even the simplest of terms. Developing this awareness is a continuous process lasting the entire school year. Another implication is that teachers should acknowledge the close relationship between conceptual understanding and vocabulary knowledge, providing numerous opportunities for students to apply their newly acquired understandings and vocabulary in varied language modes, such as in writing, speaking, and visual representations. Finally, teachers need to help students handle the reading demands of mathematics textbooks

instead of shelving the books and relying on oral explanations of mathematics concepts only. Students must be given opportunities to confront, problem solve, and then, hopefully, actively engage in mathematics reading.

VOCABULARY LEARNING IN SOCIAL STUDIES

Social studies texts have been used in many vocabulary studies where the focus has been primarily on vocabulary issues and not necessarily targeting social studies specifically, examples include Schatz and Baldwin's study about the unreliability of context clues (1986) and Nagy, Anderson, and Herman's investigation of learning word meanings from context (1987). Such studies have made contributions to our understanding of vocabulary teaching and learning across both narrative and expository texts and naturally go beyond the area of social studies. While these studies influence instructional procedures for supporting vocabulary in social studies, there are few studies that focus specifically on social studies vocabulary learning as a unique word acquisition context. Those that have concentrated on social studies vocabulary have examined different topics, including the nature of social studies words, textbook issues, and instructional techniques.

Nature of Social Studies Words

Investigations about the nature of social studies words are varied and discipline-specific. For example, in the content area of geography, student understanding of concepts is heavily influenced by geographic place vocabulary. This term refers to a student's ability to name and locate places on a map or globe. While the focus in recent years has been on higher order thinking skills in the social studies, Smith and Larkins (1990) believe that the neglect of helping students develop such skills as place vocabulary has led to a generation of American people who have little basic geography knowledge and hence fall short in their ability to engage in higher order thinking and problem solving about geography. In their examination of elementary social studies textbooks, Smith and Larkins (1990) found that publishers addressed place vocabulary in a cursory manner and did not provide any systematic approach to guide instruction. They also found a significant increase in place vocabulary between grades three to four and recommended the frequent use of systematic drill and mnemonic devices as effective ways to help students learn place vocabulary.

Milligan and Ruff (1990) also carefully examined social studies terms. In their survey of the glossaries of five social studies textbooks across different grade levels, they found approximately 71 percent of the terms contained meaningful affixes and roots. From this finding, they advocate the use of a linguistic approach to help students understand social studies vocabulary. With this approach, teachers highlight meaningful components within a word (e.g., *port* meaning "carry" in the term *transportation*) and help students make connections with other familial terms, such as *import*, *export*, and *portage*. Milligan and Ruff (1990) note several advantages for emphasizing the Latin and Greek roots of many social studies words, such as the opportunity for students to develop an interest and curiosity about the origin of words, acquire a more exact meaning of a term, and transfer these meanings to unfamiliar words in other contexts and content areas.

Harmon, Katims, and Whittington (1999) studied the use of a social studies learning strategy identified by the acronym PEP, which stands for "person, event, or place". They contend that social studies passages can be approached from the perspective that the content of the passage will include information about people, places, and events. The implementation of this strategy with seventh graders proved to be an effective way to engage students with social studies texts.

Textbook Issues

Along a different line, textbooks, as major instructional tools in content areas, have been continually questioned because of the difficulties students have in reading them (Beck & McKoewn, 1991; Hill & Erwin, 1984, Wade, 1983) and the dearth of instructional support (Armbruster & Gudbrandsen, 1986; Ciborowski, 1992). In regard to social studies textbooks, Harmon, Hedrick, and Fox (2000) conducted a content analysis of vocabulary instruction in the teachers' editions of social studies textbooks for grades 4–8. They found that publishers continued to include traditional methodologies for supporting vocabulary learning. Many activities were low-level tasks that required students to fill in the blanks with correct terms or match the terms with the definitions. While some publishers included higher, generative word processing tasks such as writing, they neglected to include support for these activities.

Instructional Techniques

Vocabulary studies on instructional techniques have frequently used social studies passages for implementing strategies under investi-

gation and have achieved positive results. For example, Carney, Anderson, and Blackburn (1984) found that the preteaching of social studies vocabulary terms significantly improved the reading comprehension of fifth-grade students when they read passages containing the terms. Grubaugh and Metzer (1986) advocate their Spoken Word activity, in which students present to the class their ideas about a social studies term. The student defines the word and then provides a comparative example based upon personal or vicarious experiences.

Similar to mathematics, the studies on social studies vocabulary are not very extensive. However, there are some implications for instruction that appear to be useful. One implication is the incorporation of structural analysis as a means for supporting and expanding vocabulary knowledge. Many social studies terms have Latin and Greek roots that lend themselves to word study activities that are transferable to other areas. In addition, teachers can address social studies vocabulary through categorization by people, places, and events. This teaching strategy is especially helpful for struggling readers who have difficulty with understanding social studies texts. Finally, general instructional strategies for teaching vocabulary, such as prereading tasks, categorization, and contextual approaches, can work effectively with social studies readings.

VOCABULARY LEARNING IN SCIENCE

The vocabulary load in science textbooks also presents a great challenge to middle school and secondary readers because of the heavy use of scientific terminology to explain concepts. In an analysis of four secondary science textbooks, Groves (1995) found that publishers continue to place a considerable emphasis on science terminology. This heavy load of technical vocabulary raises the readability level of science textbooks and impedes the reading comprehension of many students. In order to handle the demands of these textbooks, students resort to memorizing terms and facts at the expense of developing a deep understanding science concepts and at the risk of perceiving the nature of science as a collection of facts to be internalized (Songer & Linn, 1991). Groves (1995) argues, instead, for reducing rote memorization and focusing on the use of vocabulary as a guide to conceptual learning.

The importance of vocabulary in helping students acquire science concepts has received attention in the research field in much the same way as the importance of vocabulary in social studies and mathematics. The topics for investigation have focused on the nature of science terms and instructional interventions.

Nature of Science Terms

Some studies concerning the nature of words have examined other terminology besides concept-specific vocabulary. For example, in their study of students' comprehension of nontechnical science words, Marshall and Gilmour (1991) found that many New Guinea students in grades 7–12 had a superficial level of understanding for nontechnical words, resulting in an inability to effectively communicate science ideas to others during class. The nontechnical words, words that are not conceptually loaded terms but are used frequently in science textbooks, are words that are rarely addressed instructionally by teachers. Teachers typically assume that students understand nontechnical words, such as *component*, *consistent*, *exclude*, and *interpret*. Marshall and Gilmour (1991) concluded that secondary teachers need to determine both the lexical and conceptual knowledge base of their students as they present science information. Moreover, teachers need to pay attention to nontechnical words that may hinder comprehension in science.

Marco (1999) also examined the terminology used to signal conceptual relationships between ideas in science discourse. These signals, or procedural vocabulary, are not part of any particular schema but can be viewed as connectors that contextually link conceptually loaded words. This corpus of signal words and phrases, such as *be similar to*, *be considered*, *be different from*, *be characteristic of*, *arise from*, and *be the result of* are minimal and thus can be easily taught.

Instructional Interventions

Many studies on instructional interventions have explored the use of pre-reading activities, direct student involvement, and the role of discussion in science vocabulary learning across different grade levels. For instance, Snouffer and Thistlethwaite (1979) compared the use of two pre-reading activities, structured overviews and vocabulary pre-reading task, with college freshmen as they read physical science and history texts. They found that the vocabulary pre-reading tasks impacted the science reading more than the history reading, and attributed this finding to the importance of mastering science terminology in order to comprehend science texts. In another study on pre-reading strategies, Stahl & Kapinus (1991) found that a teaching technique called *Possible Sentences* was effective in helping students learn science vocabulary and in recalling facts about the concepts. This technique contains a prediction component that helps students become more deeply involved in learning the content. In contrast,

however, other studies illustrate the difficulty in trying to measure the effectiveness of pre-reading vocabulary strategies. Seaver (1991) found no significant differences in the use of three pre-reading strategies—glossary usage, context, and semantic mapping—for enhancing the science vocabulary and comprehension of sixth-grade students.

Discussion and direct student involvement also appear to be important components in science vocabulary instruction. Stahl and Clark (1987) investigated the effects of discussion on the science vocabulary learning of fifth-grade students. They found that discussion proved to be more effective in vocabulary learning than having no discussion about the words. Moreover, Carlisle, Fleming, and Gudbrandsen (2000) found in two studies that incidental word learning occurred among fourth-grade and eighth-grade students in science classes where teachers used hands-on activities and discussion. In both studies, students with some knowledge of the topics learned the appropriate word meanings, while those with limited topical knowledge made less progress learning the word meanings and understanding the science concept being taught.

In regard to direct student involvement, Lloyd and Contreras (1985) investigated whether hands-on experiences along with teacher and student interactions would increase the vocabulary knowledge and reading comprehension of fourth-grade students as they read science texts. When compared to traditional dictionary work, the students who engaged in the hands-on/discussion instruction performed significantly better than the dictionary group and a control group that received no special instruction.

In another study, Moran (1990) inquired into the use of intensive direct vocabulary instruction in science with sixth-grade migrant students. Students' performance in science at the end of nine weeks increased at least one letter grade. The vocabulary instruction consisted of structural analysis, repetition and drill of science concepts, and the pre-teaching of science terms.

These studies point to several implications about science vocabulary teaching and learning. While instruction in conceptually loaded terms is a critical aspect of instruction, teachers must not ignore the nontechnical words and connecting phrases that can hinder students' understanding of the relationships between and among concepts. The procedural vocabulary words and phrases that contextually link conceptually loaded words serve as signals for students and, given the limited number of these phrases, can be realistically added to instruction. Science vocabulary instruction must also be addressed in pre-reading activities, such as *Possible Sentences* and semantic mapping, where students have the opportunity

to activate and build important background knowledge about science concepts and the terms associated with the concepts. Science vocabulary is also supported in hands-on experiences and class discussions.

IMPLICATIONS FROM THE RESEARCH: SOME SUGGESTIONS FOR STRUGGLING READERS

Drawing upon the research reviewed across the subject areas, we offer the following suggestions for helping students who struggle with print develop broader vocabulary knowledge:

- *Provide opportunities to engage in independent reading.* It is a well-established fact that wide reading increases vocabulary knowledge (Nagy, 1988; Nagy & Anderson, 1984). Students who find reading connected text difficult and overwhelming are, as would be expected, less apt to engage in reading activities outside of classroom requirements. Consequently, unlike proficient readers, they do not have recreational reading as a source for developing and expanding their existing vocabularies. They undertake each reading task knowing fewer words and therefore find the concept load encountered in the content areas to be challenging and frustrating (Allington, 2001). Struggling readers need numerous opportunities each class day to read material they can handle with relative ease to enable them to increase their lexicon incidentally through recreational reading. Findings from the National Assessment of Educational Progress in Reading (Donahue, Voelkl, Campbell, and Mazzeo, 1999) indicate that students who reported more reading both in and outside of school had higher achievement test scores.
- *Relate below grade level trade books to content area topics.* Another suggestion to develop vocabulary of struggling readers is for classroom teachers is to keep available trade books written below grade level that are topically related to areas under study. A number of textbook publishers are providing easy-to-read fiction and non-fiction books on topics typically found on state courses of study in science, social studies and literature. Having students read trade books on a related topic of study, such as the Civil War or volcanoes, has shown promise as a means of helping students gain conceptual knowledge as a prelude to the more difficult textbook reading (Harmon & Wood, 2001; Hedrick, Harmon, & Wood, 2003).

- *Use contextual-based approaches.* Teachers working with low-level readers achieved success when they highlighted key vocabulary terms during content area reading and illustrated how words can be used in different contexts (Chall & Snow, 1988). Therefore, it is recommended that teachers use contextual-based approaches for vocabulary instruction, such as the *Preview in Context* approach (Readence, Bean, & Baldwin, 1989) or the *Contextual Redefinition* approach (Cunningham, Cunningham & Arthur, 1981). Such approaches help address Graves' (1987) concern that polysemous words, those words with specialized meanings in particular subject areas, be taught for their multiple meanings in different contexts.
- *Encourage independent learning by allowing students to self-select terms to be studied.* The findings from this research review have pointed to the value of having students self-select important terms to help them become independent word learners (Carr, 1985). Two strategies that aid in this process of student choice are the *Vocabulary Self-Collection Strategy* (VSS) (Haggard, 1986) and the *Personal Vocabulary Journal* (PVJ) (Wood, 2001). In VSS, students work in groups to select words that are important to the content studied. The students define the word in context, seek clarification from the teacher and classmates, and justify why the word should be selected for a final list. With PVJ, students are asked to seek out words related to the unit under study from any sources available, including television news, the Internet, trade books, radio, textbooks, and verbal communications. On a special form, they write down the sentence in which the word appeared, what they think it means, the dictionary definition, their new sentence, and what it reminds them of. These words can be shared with the class, and students can be tested on their individual selections.
- *Teach key vocabulary explicitly.* While the first and second suggestions on this list provide opportunities for struggling readers to learn some vocabulary incidentally through the wide reading of below grade-level material, the need for explicit instruction in vocabulary development cannot be ignored. Direct approaches, such as illustrating the word in context and showing relationships among other words using a graphic organizer, appear to be helpful in many subject areas—particularly mathematics, where the vocabulary terms are both technical and symbolic (Merkley & Jefferies, 2000/2001; Moore & Readence, 1984).
- *Provide opportunities for multiple exposures to key terms.* The need for repetition and increased exposure in varied contexts to key

vocabulary has been well documented in the literature (Nagy, Anderson, & Herman, 1987). While this practice may seem obvious, it is an essential one, especially for those readers who need more time and repetition to learn key vocabulary than other students. Merely pre-teaching key terms is often not sufficient; highlighting and drawing attention to these terms during the reading and then reviewing them again after reading is one way to provide multiple exposures to targeted words for struggling readers as well as students of all ability levels (Rhodes & Dudley-Marling, 1996).

- *Avoid drill and practice activities*. The practice of giving students worksheets with fill-in-the-blanks, seek and find, or matching words and definitions has long been denounced as inadequate means of developing students' conceptual understanding of important vocabulary (Armbruster & Gudbrandsen, 1986; Beck & McKowen, 1991; Ciborowski, 1992; Harmon, Hedrick & Fox, 2000). Apparently, the drill and practice approach was employed with the belief that it provided the appropriate skills for struggling readers and that such students were not cognitively capable of handling tasks involving deeper processing. However, there is ample research in the literature on vocabulary instruction that students in classes with all ability levels present greatly increase their understanding of new words when teachers provide "rich instruction" involving student input and interaction (Nagy, 1988).
- *Emphasize structural analysis when teaching vocabulary.* Providing students with an understanding of the meanings of roots and affixes has shown much promise in the teaching of social studies terminology (Milligan & Ruff, 1990). Focusing on meanings of Latin and Greek roots is beneficial in all subject areas (e.g., *pent-*; *oct-*; *dia-* in mathematics; *micro-*; *bio-*; *gene-* in science) and has the potential to assist readers of all ability levels unlock the meanings of new words encountered in text (Vacca & Vacca, 2002).
- *Provide staff development training in effective vocabulary instruction*. Students who benefited most from vocabulary instruction had teachers who knew how to pre-teach, teach, and reinforce vocabulary knowledge through effective techniques (Carr, 1985; Chall & Snow, 1988; Harmon, Katims & Whittington, 1999; Merkley & Jefferies, 2000/2001). It is essential that schools provide teachers with a repertoire of solid, research-based strategies and a rationale for using these strategies with the diverse students and the varied subject matter they teach.

A FINAL NOTE

This research review has clearly shown that ensuring that students have a conceptual understanding of content area vocabulary is essential for success in all subjects, especially mathematics, science, and social studies. It must be noted that the suggestions derived from this research and enumerated in this article are applicable not only to readers functioning below grade level, but also to students of all ability levels. These suggestions represent "best practices for all students" and are used here in an effort to encourage the use of meaningful strategies for below grade-level students that allow deeper processing, active involvement, and hands-on experiences with vocabulary and concepts in all disciplines.

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