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Direct Vocabulary Instruction: An Idea Whose Time Has Come

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One of the perceived "truisms" in education has been that a student's intelligence or aptitude accounts for the lion's share of the variation in student achievement. For example, the strong relationship between intelligence and achievement was one of the more salient findings in the seminal research of Coleman and colleagues (1966) and Jencks and colleagues (1972). More recently, Jensen (1980) and Herrnstein and Murray (1994) have argued that aptitude is not only the strongest predictor of academic achievement, but that it is a genetically determined, immutable characteristic. Of course, if one accepts this position, it paints a bleak picture for certain students and even certain socioeconomic groups.

In contrast, the basic premise of this chapter is that what was previously thought to be unchangeable is, in fact, quite malleable. When one carefully examines the research on intelligence or aptitude, the conclusion can be drawn that at least some of those aspects of intelligence that are most closely associated with academic achievement can, in fact, be altered by direct interventions taken by schools. In addition, these interventions have been known for years, although they have been severely underutilized, particularly in the last two decades.

A first step is to consider the research linking aptitude to achievement. Some discussions of this issue make a distinction between intelligence and aptitude (Anastasi, 1982; Snow & Lohman, 1989). However useful, the distinction is a fairly technical one and does not serve the purposes of this discussion. Consequently, throughout this chapter the terms intelligence and aptitude are used interchangeably.

Intelligence and Academic Achievement

The relationship between intelligence and academic achievement has an intuitively valid ring to it. The more intelligence one has, the easier it is

to learn, and school is certainly about learning. Indeed, numerous stu(have documented a statistically significant relationship between int gence and academic achievement (Bloom, 1984a, 1984b; Dochy, Seger: Buehl, 1999; Fraser, Walberg, Welch, & Hattie, 1987; Walberg, 1984] one assumes, as do Jensen, Herrnstein, and Murray, that intelligence fixed, immutable characteristic, then there is little hope that schools alter the impact of aptitude on achievement. However, an examinatio the nature of aptitude provides a quite different perspective. Specific if one makes a distinction between two types of intelligence, then the tential intervening role for schools becomes evident.

A basic distinction between two types of intelligence was first propo by Cattell (1971/1987) and further developed by Ackerman (1996). Wit this theory base, intelligence is seen as consisting of two constructs: telligence as knowledge, or *crystallized intelligence*, and intelligence cognitive processes, or *fluid intelligence*. Crystallized intelligence is ex plified by the ability to recognize or recall facts, generalizations, and p ciples, along with the ability to learn and execute domain-specific sk and processes, such as multiplying and dividing. Fluid intelligence is emplified by procedures such as abstract reasoning ability, working m ory capacity, and working memory efficiency. Where fluid intelligenc assumed to be innate and not subject to alteration from environment tors, crystallized intelligence is thought to be learned. It is also assun that fluid intelligence is instrumental in the development of crystalli intelligence. That is, the more efficient a person is at the cognitive cesses involved in fluid intelligence, the more easily he will acquire c tallized intelligence as he interacts with the world.

A question pertinent to the present discussion is which type of int gence—crystallized or fluid—is more strongly related to academic achie ment? Rolfhus and Ackerman (1999) conducted one of the most extens studies of the relationship among crystallized intelligence, fluid int gence, and academic achievement. They administered intelligence test 141 adults, along with tests of knowledge in 20 different subject are They then examined the relationship between scores on the tests of s ject matter knowledge and fluid versus crystallized intelligence. T found little relationship between academic knowledge and fluid int gence but noted a strong relationship between academic knowledge crystallized intelligence. As Rolfhus and Ackerman (1999) state, th findings suggest that academic "knowledge is more highly associated w [crystallized] abilities than with [fluid] abilities" (p. 520). These findi are quite consistent with those reported by Madaus, Kellaghan, Rak and King (1979), who found that the correlation between measures fluid intelligence and achievement was relatively small when control for the home environment of students and characteristics of the schoo

The strong correlation between crystallized intelligence and achievement goes a long way in explaining the strong relationship between prior knowledge and achievement. In fact, the research finding that prior knowledge is strongly correlated with academic achievement is as ubiquitous as the research finding that aptitude is strongly correlated with academic achievement (Alexander & Judy, 1988; Alexander, Kulikowich, & Schulze, 1994; Bloom, 1976; Boulanger, 1981; Dochy et al., 1999; Schiefele & Krapp, 1996; Tamir, 1996; Tobias, 1994). One of the most extensive investigations of the relationship between prior knowledge and academic achievement was conducted by Dochy and colleagues (1999). In their analysis of 183 studies, they found that 91.5 percent of the studies demonstrated positive effects of prior knowledge on learning, and those that did not measured prior knowledge in ways that were indirect, questionable, or even invalid.

If one considers the research on intelligence and academic achievement and the research on prior knowledge and academic achievement as a set, some clear generalizations emerge. First, the research supports the notion that crystallized intelligence or learned intelligence, as opposed to fluid or innate intelligence, is the stronger correlate of academic achievement. Second, it is a small step to go from crystallized intelligence to prior knowledge. In fact, for all practical purposes, they might be considered identical. Crystallized intelligence is learned knowledge about the world; prior knowledge is learned knowledge about a specific domain. One might say, then, that enhancing a student's background knowledge is akin to enhancing his crystallized intelligence, which is one of the strongest determiners of academic achievement. This fact strongly suggests that schools can directly influence the type of intelligence most closely associated with academic achievement. The task for schools is simply that of enhancing the background knowledge of students.

The most direct way of enhancing student background knowledge is to increase their access to a wide variety of experiences such as cultural field trips, prolonged contact with families who have a wide variety of resources, and the like. Programs that take this approach have great potential (Scheerens & Bosker, 1997; Teddlie & Reynolds, 2000). However, such programs require extraordinary resources in terms of time, energy, and finances. Fortunately, an indirect way of enhancing the general background knowledge of students is through direct vocabulary instruction. In short, the central thesis of this chapter is that direct vocabulary instruction is a time-honored but underutilized technique for enhancing the background knowledge and, consequently, crystallized intelligence of students and can be particularly useful with those students who have limited access to a broad experiential base.

Before an examination of the rationale for and validity of direct vo ulary instruction, it is useful to clarify the relationships among fluid ir ligence, crystallized intelligence, and achievement. It is certainly true students who have high fluid intelligence *and* access to a variety of e riences will quite naturally acquire substantial crystallized intelligenc is not the case, however, that an individual with low crystallized int gence has low fluid intelligence. Indeed, a person with high fluid int gence who does not have access to a variety of experiences will also h low crystallized intelligence simply because of lack of opportunity to quire it. The person with low fluid intelligence and limited access t wide experiential base is in a double bind. Such a person not only suf from reduced ability to acquire crystallized intelligence but also has l ited access to the experiential base to build that type of intelligence. rect vocabulary instruction, then, can greatly serve any students whc not have access to a wide experiential base, whether they have mode to high fluid intelligence or low fluid intelligence.

Crystallized Intelligence and Vocabulary Learning

Although crystallized intelligence is not synonymous with vocabul development, a large vocabulary is one of the best general indicators of telligence (Chall, 1987). Indeed, Coleman and colleagues (1966) used bal ability measured primarily by vocabulary knowledge as their prim dependent measure (Madaus et al., 1979). Not surprisingly, the relati ship between vocabulary knowledge and academic achievement is a well-established. For example, as early as 1941, researchers estimated t for students in grades 4 through 12, there was about a 6,000-word between students at the 25th and 50th percentiles on standardized t (Nagy & Herman, 1984). Using a more advanced method of calcula vocabulary size, Nagy and Herman (1984) estimated the difference to anywhere between 4,500 and 5,400 words for low- versus high-achiev students.

What is there about vocabulary that makes it such a strong proxy m sure for crystallized intelligence and such a strong correlate of acade achievement? There are at least two perspectives that provide an ans to this question: (1) the nature of memory, and (2) the relationship tween language and thought.

The Nature of Memory

Permanent memory is the repository for everything learned—all kno edge and skill. A common model for the manner in which informatio represented in permanent memory is that it is organized in modular form. Anderson (1995) refers to these modules as memory "records." Tulving (1972) further explains that memory records come in two basic forms: episodic and semantic. Episodic memory records are of actual experiences. For example, if a foreign student who has never seen a football game attends the Super Bowl, she will store that event in permanent memory as an episodic record. Semantic records are derived from episodic records. They contain decontextualized information. In the case of our foreign student, she would organize information about football games (in general) from her episodic record of direct experience. It is our semantic records that allow us to make inferences about new knowledge and link new knowledge to old knowledge.

In terms of the discussion in this chapter, a key feature of semantic records is that they have a "label" or a "tag" associated with them. In the case of our foreign student, that label or tag would probably be *football games*. In fact, a vocabulary term can be defined as a word or phrase that is used as a "tag" for a given semantic memory record. This sheds light on the strong link between vocabulary knowledge and crystallized intelligence. As students have new experiences, they store these experiences as memory records. Fully formed memory records have an associated tag or label. The more records one has with their accompanying tags, the more crystallized intelligence.

This also explains the strong relationship between vocabulary knowledge and socioeconomic status (SES). For example, Nagy and Herman (1984) found a consistent difference in vocabulary development between groups at different SES. They estimated a 4,700-word difference in vocabulary knowledge between high- and low-SES students. Similarly, they estimated that mid-SES 1st graders know about 50 percent more words than do low-SES 1st graders. Graves and Slater (1987) found that 1st graders from higher-income backgrounds had about double the vocabulary size of those from lower-income backgrounds. Although different researchers use slightly different estimates, all seem to agree that there are huge variations in the size of vocabulary between students from different backgrounds.

The Relationship Between Language and Thought

It is probably safe to say that Chomsky was one of the first linguists to provide a compelling argument that language and thought are inextricably linked. This argument was made in his book *Syntactic Structures* (1957) and then expanded in *Aspects of a Theory of Syntax* (1965). Pinker has described more recent advancements in *The Language Instinct* (1994).

The initial insight Chomsky elucidated in *Syntactic Structures* was that sentences must be characterized by two structural descriptions, not one, as is the case with grammar systems designed prior to Chomsky's work (the traditional grammar that is commonly taught in school). The "deep structure" of language deals with the underlying semantic and syntactic nature of language. The "surface structure" of language deals with the actual use of language. The necessity for the two forms is most easily seen with imperatives. The surface structure *go away* is understood by ordinary speakers as a realization of the underlying form or deep structure *you will go away*. Where the surface structure of language is the observable expression of language, it is the deep structure that depicts the basic "thought" underlying language.

The actual format of deep structure language has been the subject of much discussion. The most popular model for describing the basic unit of linguistic thought is the proposition. The construct of a proposition has a rich history in both psychology and linguistics (Frederiksen, 1977; Kintsch, 1974; Norman & Rumelhart, 1975). In simple terms, "a proposition is the smallest unit about which it makes sense to make the judgment true or false" (Anderson, 1990b, p. 123). Clark and Clark (1977) have noted that there is a finite set of the types of propositions used to express linguistic thought. Some of the basic types of propositions are exemplified by the following:

- Birds fly.
- Birds are pretty.
- Birds eat fruit.
- Birds live in trees.
- Birds have a purpose in the ecosystem.

What we call thinking—particularly abstract thinking—is a matter of stringing together basic propositions like those above into complex semantic networks (Kintsch, 1974, 1979). The ability of a person to think in complex ways, then, is a function of his ability to express experiences in propositional format. This illuminates the importance of vocabulary. Where the proposition is the basic unit of linguistic thought, vocabulary terms are the building blocks of propositions. In other words, without knowledge of the vocabulary terms that describe an experience, an individual has no way to express the experience semantically. A limited vocabulary inhibits one's ability to store experiences in abstract ways—as semantic records. Enhancing vocabulary knowledge, then, might be viewed as a direct path to enhancing students' language competence and their ability to think in abstract ways.

Myths and Realities of Vocabulary Instruction

The research on direct vocabulary instruction provides a final and practical validation for the arguments presented in this chapter. Indeed, this literature indicates that direct vocabulary instruction has a well-documented effect on student achievement (Stahl & Fairbanks, 1986). In fact, some researchers have concluded that employing direct vocabulary instruction is one of the most important instructional interventions, particularly with students who have little access to a rich experiential base (Becker, 1977). In spite of this, practicing direct vocabulary instruction at the school level is somewhat rare in U.S. schools (McKeown & Curtis, 1987). This unfortunate situation is due, in part, to an argument that direct vocabulary instruction is a futile or, at best, low-yield endeavor in terms of student learning. The research of Nagy and Anderson (1984) has fueled this conclusion; they have estimated that the number of words in "printed school English" (that is, those words students in grades 3 through 9 will encounter in print) is about 85,000. Obviously, it would be impossible to teach this many words one at a time. Stahl and Fairbanks (1986) summarize this position in the following way:

> *Since vocabulary teaching programs typically teach 10 to 12 words a week or about 400 words per year, of which perhaps 75 percent or 300 are learned, vocabulary instruction is not adequate to cope with the volume of new words that children need to learn and do learn without instruction.* (p. 100)

Nagy and Herman (1987) offer an alternative to direct vocabulary instruction: wide reading. Simply stated, this is the practice of encouraging students to read a variety of subjects, themes, and types of literature. They argue as follows:

> *If students were to spend 25 minutes a day reading at a rate of 200 words per minute for 200 days out of the year, they would encounter a million words of text annually. According to our estimates, with this amount of reading, children would encounter between 15,000 and 30,000 unfamiliar words. If 1 in 20 of these is learned, the yearly gain in vocabulary will be between 750 and 1,500 words.* (p. 26)

If one subscribes to this position, then direct vocabulary instruction is not only unadvisable but downright foolish. However, this argument is not entirely accurate. In fact, an analysis of the extant research provides a strong counterargument for direct vocabulary instruction.

Five Principles of Direct Vocabulary Instruction

The discussion below organizes the research on vocabulary learning around five principles. These form the basis for the design of a systematic approach to enhancing students' crystallized intelligence through direct vocabulary instruction.

Principle #1: Students must encounter words in context more than once to learn them. Nagy and Herman (1987) base their conclusion about the utility of wide reading, in part, on the assumption that students will learn some, albeit few, of the new words they encounter in their reading. Still, if students read enough (for example, 25 minutes per day, 200 days a year), then the few words they learn will add up to a substantial number (between 750 and 1,500 words per year, as noted previously). However, wide reading might not add new words to students' vocabularies as easily as the argument above implies.

A study by Jenkins, Stein, and Wysocki (1984) dramatically demonstrates this point. They found that to learn a new word in context (without instruction), students must be exposed to the word about six times before they have enough experience with it to ascertain and remember its meaning. Also interesting is that beyond six exposures to a new word, the increase in learning was negligible. These findings are consistent with those reported by Stahl and Fairbanks (1986), who found that multiple exposures to words produced a significantly better understanding of those words (although Stahl and Fairbanks did not identify an optimal number of exposures).

These conclusions seriously undermine the logic of the "wide reading" approach to vocabulary development as the sole vehicle for vocabulary development. Again, the working principle underlying the approach is that students will figure out the meaning of and remember a portion, albeit small, of the new words they encounter in their reading. However, this argument fails to acknowledge that students will encounter the vast majority of these words only a few times. Indeed, word frequency studies indicate that most words appear very infrequently in written material. More than 90 percent of the words students will encounter while reading occur less than once in a million words of text; about half occur less than once in a billion words (Nagy & Anderson, 1984). Thus, the encounters students have with new words in their reading are, for the most part, isolated, single encounters that will not produce enough exposure for them to learn the new words.

Principle #2: Direct instruction in new words enhances the learning of words in context. Perhaps one of the most useful findings from the Jenkins and colleagues study (1984) is that even superficial instruction of words greatly enhances the probability that students will learn the words from context when they encounter them in their reading. Specifically, students who had prior instruction on words they encountered in context exhibited one-third (that is, about 33 percent) more achievement relative to their understanding of the words encountered than did those students who had no prior instruction.

Perhaps most significant about these findings is that the prior instruction was minimal. In fact, it amounted simply to providing students with a sheet that contained definitions of the new words along with an example of each word used in a sentence. Students were allowed to read the sheet, but they received no help from the teacher. In addition, students had only about 40 seconds to study each word—certainly not enough time to digest the information about the new words in any depth. Yet this superficial instruction produced an average of one-third higher performance scores on a test of word knowledge after students encountered the words in context.

Principle #3: Generating imagery representations enhances recall of vocabulary. One of the best ways to stimulate recall of newly learned vocabulary terms is to have students generate imagery representations of the meaning of new words. For example, a student has been presented with the information that the term *mode*, from mathematics, refers to "the most frequent number in a set of numbers." To elaborate on this, the student might form a mental picture of a set of numbers, with one number appearing many more times than any other number. Figure 3.1 depicts this kind of set.

Numerous studies support the powerful effects on learning that the creation of mental representations or symbolic representations have for a student (Paivio, 1990). For example, in an analysis of 11 controlled studies, Powell (1980) found that instruction techniques employing the use of

FIGURE 3.1

Student's Mental Picture Depicting *Mode*

2 2 2 3 4 4 4 4 4 4 4 4 4 4 5 5 6 6 6 7 7

imagery produced achievement gains in word knowledge that were 34 percentage points higher than techniques that did not use imagery.

Principle #4: Instruction in content-specific words produces greater learning. There is a distinct difference between the effects of instruction in words from generalized vocabulary lists and words that are specific to a given topic. Many vocabulary development programs use vocabulary lists of high-frequency words—words that commonly appear in the written language (Carroll, Davies, & Richman, 1971; Harris & Jacobson, 1972). However, these high-frequency lists typically do not focus on the written material students encounter in school. When coupled with the research by Stahl and Fairbanks (1986), this fact becomes significant.

In their meta-analysis, Stahl and Fairbanks found that instruction in general words, like those found in high-frequency word lists, enhanced students' ability to understand new content by 12 percentage points. By way of illustration, assume that two students of equal ability are asked to read and understand new information. Student A is in a program that teaches about 10 to 12 words each week from one of the high-frequency word lists. Student B does not receive this instruction. Now assume that students A and B take a test on the new content, and that student B achieves a score in the 50th percentile. All else being equal, student A will receive a score at the 62nd percentile on that same test, simply from having received systematic vocabulary instruction. This is certainly a significant gain.

However, the effects of direct vocabulary instruction are even more powerful when the words taught are those that students will most likely encounter in the new content they are learning. To illustrate, again consider students A and B who have been asked to read and understand new content. Student B, who has not received direct vocabulary instruction, receives a score on the test at the 50th percentile. Student A, who has received direct instruction *on words that have been specifically selected because they are important to the new content*, will obtain a score at the 83rd percentile.

Principle #5: You do not have to know a word in depth for it to be useful. The final premise derived from the research on vocabulary instruction is that students do not have to know words in depth to find them useful. E. D. Hirsch made this point salient in his 1988 book *Cultural Literacy: What Every American Needs to Know*, wherein Hirsch identified 4,546 terms and phrases that every student should know to be "culturally literate." He referred to his list as a "national vocabulary." Although I believe Hirsch's list of terms and phrases is biased and not an accurate accounting of what students should know (for a detailed discussion of the criticisms of Hirsch's list, see Marzano, Kendall, & Gaddy, 1999), I do agree with his contention that students need not know terms in depth. A surface level knowledge of terms that form the basis for general understanding of a subject area is sufficient to provide students with a solid platform on which they can build more sophisticated understandings.

To validate his position, Hirsch elaborates on a retrieval theory he characterizes as schema theory. He notes that when one reads or hears a word, memory activates a hierarchical array of information about that term. He refers to that activated information as schema. As described by Hirsch, those pieces of information an individual associates with a word or phrase comprise that person's schema for that term. Thus, Hirsch's notion of schema is akin to the description of a memory record. A key aspect of schema is that the information is stored in a hierarchic fashion, with the more common knowledge at the upper, most accessible levels. To exemplify this idea, Hirsch relates the findings of a study by Collins and Quillian (1969). Collins and Quillian posited that an individual's schema for the word "canary" might appear in a hierarchic fashion such as the following:

canary	can sing is yellow
bird	has wings can fly has feathers
animal	has skin can move around eats breathes

If it is true that the information closest to the top of the hierarchy is the most available, then people should remember the top-level information more quickly than the bottom-level information. Collins and Quillian's study tested this hypothesis by providing subjects with sentences such as these:

- Canaries can move around.
- Canaries are yellow.
- Canaries can fly.

Collins and Quillian asked subjects to determine whether each sentence was true or false. According to schema theory, people should be able to verify the accuracy of sentences that draw upon information from the higher levels of the schema more quickly than sentences that draw upon information from the lower levels of the schema. The study findings supported the hierarchic schema hypothesis. Hirsch (1988) made the following comments about the findings:

> *Collins' and Quillian's observations suggest that the top portion of the schema is the important part to know. The schema canary can yield an indefinite number of facts and association[s] by remote inference from knowledge of the world: canaries have backbones; canaries have their own special pattern of DNA; canaries are descended from reptiles; canaries must drink water; canaries mate; canaries die. One could go on this way for a long time with specifications not only from biology, but from physical knowledge: canaries obey the law of gravity and the laws of motion, and so on. But this secondary information about canaries is not important in communicating with fellow human beings. What is functional in reading, writing, and conversation is the distinctive system of traits in the schema we use—the traits that differentiate canaries from other birds: their smallness, yellowness, ability to sing, use in human culture, being kept in cages, and so on. We need to know the primary traits commonly associated with [the schema] canary in our culture in order to deploy the associations rapidly when we encounter the word* canary *in reading.* (pp. 58–59)

Since the Collins and Quillian experiment, a number of other studies have demonstrated the hierarchic nature of human knowledge. (For reviews see Anderson, 1990a, 1990b, 1995.)

Based on research evidence that top-level schema information is necessary and sufficient for general literacy purposes, Hirsch (1988) reasoned that schools should address the learning of his national vocabulary with a great deal of latitude and should hold students accountable for only general knowledge of his 4,546 terms and phrases. As he observed:

> *The nature of this world knowledge as it exists in the minds of literate adults is typically elementary and incomplete. People reliably share just a few associations about canaries, such as yellow, sing, kept in cages, but not much more. Literate people know who Falstaff is, that he is fat, likes to eat and drink, but they can't reliably name the Shakespeare play in which he appears. They know who Eisenhower was, and might recognize "military-industrial complex," but they can't be counted on to state anything else about Eisenhower's Farewell Address. In short, the information that literate people*

dependably share is extensive, but limited—a characteristic central to this discussion. (p. 127)

To reiterate, although I find many problems with Hirsch's "national vocabulary" list, I support the notion that it is possible to approach vocabulary terms and phrases legitimately from a top-level schema perspective—that students do not have to know a word's precise meaning for the word to aid them in their learning. This is not to say that students should not learn content in depth. Indeed, knowing words at a surface level provides the basis upon which students can develop an in-depth understanding at a later time.

In summary, it is possible to organize the research on vocabulary around five principles. Taken together, these principles provide a picture of how a highly effective vocabulary development program might look. Such a program could directly impact the background knowledge or crystallized intelligence of students, as well as their language competence and their ability to generate abstract semantic memory records. Specifically, these principles imply the following:

- Students should receive direct instruction on words and phrases that are critical to their understanding of content.
- As part of this instruction, students should be exposed to new words multiple times—preferably about six times.
- Students should be encouraged to represent their understanding of new words using mental images, pictures, symbols, and the like whenever possible.
- The goal of vocabulary instruction should not necessarily be an in-depth understanding of new words, but rather an accurate, albeit surface, knowledge of new words that will form the basis for greater understanding of content.

Identifying the Critical Subject Matter Terms

The principles above imply that the beginning point in designing a vocabulary program to enhance students' crystallized intelligence or academic background knowledge is to identify those terms that are central to academic learning. As mentioned previously, word lists that have typically been used as the basis for direct instruction in vocabulary are derived from general word frequency counts of words. Consequently, they do not focus on academic content students encounter in school.

Recently, researchers at Mid-continent Research for Education and Learning (McREL) identified 6,700 terms that are critical to the understanding

of 14 different subject areas (Marzano et al., 1999). As an illustration of the nature of those words, the following are a few mathematical terms and phrases within the general category of probability that are appropriate for students in grades 6–8:

- Experiment
- Odds
- Theoretical probability
- Tree diagram
- Simulation
- Experimental probability

Based on the earlier discussion in this chapter, one can conclude that an understanding of these terms at the top schema level would provide students with a firm foundation on which to build more detailed and deeper understandings of probability.

There are at least two significant aspects of the McREL academic vocabulary list. First, the number of terms is small enough to make direct instruction feasible. If students were to receive instruction in about 18 words per week over the course of their K–12 schooling, they would be exposed to all 6,700 terms covering 14 subject areas. Of course, it would be possible to greatly reduce the number of terms directly taught to students if selected subjects are targeted (for example, mathematics, science, language arts, and social studies). Second, by definition, these terms are the ones students will most probably encounter in their subject matter classes. As already noted, Stahl and Fairbanks (1986) found that instruction in words encountered in reading produced a 33 percentage point gain in comprehension. Therefore, lists of subject matter terms, such as those produced by McREL, provide a new foundation for vocabulary development with the potential of directly affecting students' academic background knowledge.

A Process for Vocabulary Development

With a viable list of academic terms finally in place, it is possible to undertake a systematic approach to enhancing students' academic background knowledge. Specifically, schools can directly teach students the terms they will encounter in their subject areas, and they can do so easily if subject matter teachers systematically teach these terms as a regular part of classroom instruction. It is important to coordinate this effort from teacher to teacher and grade level to grade level. To ensure that students receive instruction in all the critical terms at appropriate times, the school must do cross-grade planning to determine which words are taught at specific grade levels for specific subjects.

Along with a correlated effort to directly teach the subject matter words, the research implies a sequential process for the learning of these academic terms. This process involves the following six steps:

1. Students receive a brief, informal explanation, description, or demonstration of the term.
2. Students receive an imagery-based representation of the new term.
3. Students describe or explain the term in their own words.
4. Students create their own imagery-based representations for the term.
5. Students elaborate on the term by making connections with other words.
6. Over time, teachers ask students to add new information to their understanding of terms and delete or alter erroneous information.

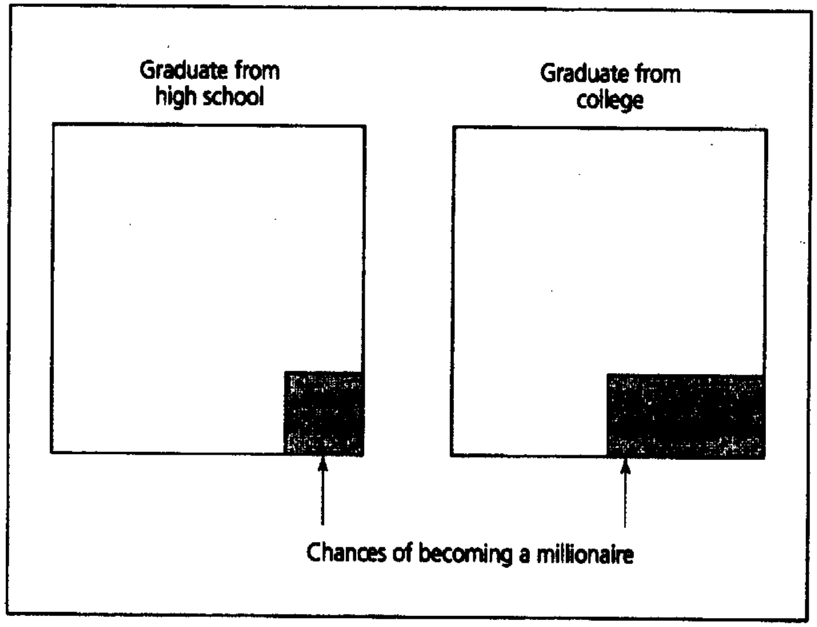
To illustrate the use of this process, consider the term *area model* from mathematics. The first step in the process involves providing students with a brief informal explanation, description, or demonstration of the target term. It is important to emphasize that a "description" or "explanation" is not the same as a definition. The intent of this process is to develop top-level schema knowledge for academic terms, not an in-depth knowledge. Given this freedom, the first step can be relatively simple and short. For example, the teacher might say, "*Area model*: A technique mathematicians use to represent the chances of something occurring. For example, I might create an area model to represent your chances of becoming a millionaire if you graduate from high school and another area model depicting your chances of becoming a millionaire if you graduate from college."

The second step in the process involves presenting students with an imagery-based representation of the term. In this case, the teacher might present students with the representation depicted in Figure 3.2.

The third step in the process is the point at which students begin to actually use the information provided in the first two steps. Here students construct their own meaning of the term by formulating a description or explanation. Again, because the goal is top-level schema development, the students' descriptions can be quite nontechnical and stated in ways that are meaningful to the student only. The basic criterion for the students' explanations is that they represent an accurate understanding of the top-level information about the term.

FIGURE 3.2

Teacher's Representation of *Area Model*



The fourth step in the process requires students to construct an imagery-based representation of the term. Again, these representations can be quite idiosyncratic to individual students as long as they convey accurate information. A student might draw a picture or symbol representing the term. The critical aspect of this step is to facilitate the translation of the information about the term into an imagery-based memory record.

The fifth step requires students to make connections. Here they might compare or contrast the new term with known terms. The emphasis in this step is on having the students elaborate on the information about the new term.

The final step in the process involves students revising their understanding of the term over time. If the students keep the terms in a vocabulary booklet, they can easily facilitate this. Occasionally, the teacher might ask students to review the words in their vocabulary notebooks with an eye toward adding new information or altering information that has proved to be less than totally accurate over time.

Conclusions

This chapter has presented the rationale and design for a systematic approach to enhancing the crystallized, learnable intelligence of students through direct vocabulary instruction. Both research and theory strongly support the viability of this endeavor. Such an approach has the potential for bringing about dramatic gains in academic achievement, particularly for those students who suffer from low crystallized intelligence for a variety of reasons. Because such students are traditionally the underserved minority, one might legitimately conclude that an implementation and trial of the approach described in this chapter is of paramount importance in K–12 education.

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