



School Specialty  
*Literacy and Intervention*



## Research-Based Vocabulary

### **CONTENT-AREA VOCABULARY BUILDER (CVB)**

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#### **Introduction**

*Content-Area Vocabulary Builder (CVB)* is an online content-area vocabulary development curriculum for grades 4–8. Developed especially for readers who struggle to comprehend what they read in science and social studies texts, *CVB* is also valuable for on-level readers. Many strong readers in these grades can still face difficulties when presented with the terminology in their content-area texts.

Educators increasingly recognize that vocabulary development is at the heart of literacy achievement, which in turn is central to general academic achievement. This is especially so in the intermediate and middle school years, when content-area instruction becomes central to school success. *CVB* serves to develop academic vocabulary knowledge through individualized computer-based instruction, student engagement, construction of meaningful knowledge, and online teacher-based progress monitoring.

Recent federal education policies have identified vocabulary instruction as one of the “five pillars” of reading development. Yet, for nearly twenty years previously, vocabulary instruction received little attention from national educational organizations and experts (Beck, McKeown, & Kucan, 2008). Fortunately, the publication of the report of the National Reading Panel (NRP; National Institute of Child Health and Human Development, 2000) and the subsequent use of the report as a foundation for policy in *No Child Left Behind* brought renewed attention to the importance of vocabulary instruction. The recent publication of new Common Core standards by the Council of Chief State School Officers and the National Governors Association Center for Best Practices (2010) continues efforts to place a major emphasis on vocabulary development.

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## Description of CVB

The first task in developing any vocabulary program is deciding which words should be taught. The words in CVB and the topics used in the text passages have been carefully selected using a variety of sources. These include national and state standards in the social studies and sciences, science and social studies textbooks for grades 4–8, and content-area word lists developed by vocabulary experts (Fry & Kress, 2006; Marzano, 2004). CVB provides one module of instruction in science and one module in social studies at each grade level, 4–8, for a total of ten modules. Each module has five lessons, each targeting ten content-area words. There are 100 target words per grade, with a total of 500 target words for the program.

Beck, McKeown, and Kucan's (2002; 2008) vocabulary research has been based on grouping words into three tiers (not to be confused with the unrelated tier terminology used in Response to Intervention). According to Beck *et al.*, Tier One words are those typically known by students and need no teaching. Tier Two words are those frequently used in school—academic terms that may be germane to a variety of disciplines, or content areas, such as *profit* and *native*. Some Tier Two words are unknown by most students but are encountered frequently enough to affect comprehension. Tier Three words are usually unknown by students because they are specialized terms, sometimes called “domain words,” such as *ion* and *embargo*.

CVB instruction is designed to focus on content-area vocabulary development. Therefore, the target words in CVB are primarily Tier Two and Tier Three words. Examples of Tier Two words are *rural* and *society* (Grade 4), *excavate* and *heritage* (Grade 6), and *intervention* and *minority* (Grade 8). Some CVB Tier Three words important to students' content-area reading in science and social studies are *Bill of Rights* and *prime meridian*

(Grade 4), *hieroglyph* and *pictograph* (Grade 6), and *Manifest Destiny* and *Industrial Revolution* (Grade 8).

Many of the words targeted in CVB are also parts of larger word families, as is common with content-area vocabulary. The effort expended in teaching and learning one word can have its effects multiplied as students encounter related words. Scott *et al.* (2008), for example, pointed out that the word *consume* occurs only 5 times per million words in text, but that related words (such as *consumer*, *consumers*, *consumed*, *consumption*) occur 90 times per million words. A CVB target word such as *doctrine* can help students learn other words in the future: *doctrinal*, *doctrinaire*, *doctrinally*, as well as many words connected to a related word, *doctor*.

CVB is built on a solid foundation of research-based instructional principles and technologies:

- The online instruction provides immediate feedback as students complete activities.
- Computer-based monitoring of student performance provides ongoing, frequent assessments of the kind that have become widely accepted in Response to Intervention (RTI) efforts.
- Lessons are designed according to well-researched computer-based instructional principles so that students who are struggling with particular concepts are identified and provided additional instruction and practice.
- Learning is multimodal, with audio enhancement of the on-screen materials and frequent student response throughout the lessons.
- Instruction integrates meaningful learning connections between each lesson and standards-based, grade-appropriate content-area themes.



- Thematic passages are written at readability levels easy enough so that struggling readers can concentrate on the conceptual content and the new vocabulary words. Lexile® scores for *CVB* passages are at approximately two grade levels below the nominal grade.
- *CVB* is designed to promote success. As students complete each item in an activity, they can move on only after they have corrected any wrong answers. Immediate feedback makes this possible and helps provide a sense of accomplishment.

## A *CVB* Lesson

***What Do You Know?:*** Each *CVB* lesson begins with a pretest of the ten lesson words. This helps students with the metacognitive tasks important to successful online learning (U. S. Department of Education, 2009). These include activation of prior knowledge related to the lesson’s vocabulary and consideration of task-based questions that are important to meeting the lesson’s requirements. *Which words do I know, and how well do I know them? Which words do I not know, and how much additional effort will be needed to learn them?* These metacognitive tasks also involve the active reading task of predicting content, as the student considers and makes predictions about potential thematic connections among the words. Like the rest of *CVB*, the pretest offers audio support, removing a potential decoding obstacle to understanding.

What should teachers do if particular students demonstrate on the pretest that they already know some—or most—of the words? We recommend that the *CVB* lessons are valuable, even for those students who “test out” of a lesson. First of all, the pretest gives the teacher the first glimpse into the student’s understanding of the lesson

words. It is not *expected* that the words are familiar at the point of the pretest, since in many cases they present new concepts, or at least new words for known concepts. Furthermore, there are always students who simply make good guesses and score high, when in reality they don’t really know the words. For students who are familiar with some of the words, the activities can present validation and provide more practice to deepen knowledge. In fact, prior knowledge of some of the target words may actually help their learning. Some prior knowledge helps to build a bridge from the known to the unknown. That is, learners use what they already know as the foundation for linking new vocabulary and concepts into their permanent memory. Prior knowledge/experience supports increased vocabulary knowledge (Anderson & Freebody, 1981; Marzano, 2004).

***Word List:*** Following the pretest is the Word List, comprising ten words. Students are introduced to individual words, their definitions, and their use in a context-rich sentence. A student response activity to check understanding of the word’s meaning follows. Note that the Word List, along with audio definitions and sample sentences, is available to students on most screens as a pop-up window. Wherever possible, *CVB* provides varied types and levels of scaffolding to ensure success.

The Word List is followed by four interactive practice activities, which students can choose to do in any order. (Even such small levels of student control over the progress of their online instruction—involving merely the order of activities—can have positive effects on motivation.) These four online activities are designed to provide an engaging, interactive set of learning experiences with a number of varied exposures to each word. This understanding in varied contexts is key to integration into students’ long-term memory.

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**The four exercises are:**

- **Get It Together:** Students combine sentence parts containing the vocabulary words to form meaningful sentences.
- **Say What You Mean:** Students replace an awkward definitional phrase in a sentence with one of the vocabulary words.
- **It's Your Choice:** Students choose answers to multiple-choice questions.
- **Word Smarts:** Students use word parts, such as roots, prefixes, and suffixes, to further their understanding of word meanings—a key skill, particularly in context areas, such as science. They also work with synonyms and antonyms to broaden their network of known vocabulary. Word Smarts activities use a variety of exercise types.

**Passage and Questions:** Following these activities, students move on to reading the text passage, which features all ten lesson words. Students read the passage, with or without audio support, which consists of natural, human speech. The audio of the passage is in sync with word-by-word and sentence-by-sentence tracking, so students can utilize the audio-visual match to its fullest. The passage is followed by a series of questions designed to demonstrate the student's understanding of the topic and the lesson words.

**Crossword Puzzle Review:** Before students take a post-test, they do an interactive crossword puzzle for review. This provides a fun, game-like review experience.

**What Did You Learn?:** Students then take a multiple-choice post-test, formatted exactly like the pretest. This makes comparisons easy for the teacher who is progress-monitoring and for the student who is self-monitoring. Scores are available for the teacher and the school via the learning management system. They are also reported to the students via a reporting screen.

**Practice for Success:** Any word on the post-test that has not been mastered triggers a series of supplemental Practice for Success activities. This series of activities begins much like the main lesson, with a word card that includes a definition and a new sample sentence. Additional interactive instructional activities are provided for each word. These activities depend upon the actual target words, but they may include graphic organizers, true-false or multiple-choice exercises, or an image, diagram, or mnemonic device appropriate to helping students learn the unmastered word or words. A Quick Check assessment activity concludes the section, assessing whether the Practice for Success work has been successful. Once students have completed the words they missed, a printable certificate screen affirms their accomplishment. Students can then move on to the next assigned lesson.

**Teacher Support:**

Teachers are provided support in the online Teacher Resource Area (TRA). Materials in this area include professional development articles on the role and function of vocabulary instruction, vocabulary strategies, and several downloadable PDFs that teachers can use with students. These include word cards, graphic organizers, enrichments, and extensions for the Word Smarts activities, as well as word lists.

Teachers may assign lessons in several ways and for a variety of purposes through CVB's learning management system. Since the words and topics are drawn from grade-level texts and standards, there is every expectation that during a school year, classroom curriculum will be in sync with at least some of the topics. However, because this sequence of study varies, teachers have the option to assign CVB lessons in whichever order they feel best for their students. While some may choose to assign a lesson on the solar system, for instance, as that topic is being covered in class, others may feel that assigning the solar system



lesson before the class works with it will provide a leg up for struggling students.

## Research Basis for CVB

Though given short shrift for many years, vocabulary knowledge has long been recognized as an important factor in reading comprehension. Vocabulary knowledge has a high correlation with performance on reading comprehension tests (Cutting & Scarborough, 2006). Carver's (2000) cognitive model of reading included verbal knowledge, along with word identification, as the two major aspects of reading development that can most effectively be improved through instruction.

Jeanne Chall, well-known Harvard researcher and theorist, described the fourth grade as a major transition point in schooling (1996). In their earlier years, children "learn to read." The fourth to eighth grade stage was described by Chall as the "reading to learn" stage of literacy development. Starting in the fourth grade, emphasis shifts from learning to read to using reading as a tool to further enhance content-area studies. CVB is designed to support the vocabulary learning of struggling students through that transition and during the critical grade 4–8 years.

One of the leading researchers on vocabulary development, William Nagy, described the need for increased attention to these grades in a 2005 research survey. He noted that schools emphasize learning of sight words in the primary grades. Years later, as high school graduation approaches, schools restart vocabulary instruction in preparation for college entrance examinations. But he warned that the critical middle grades are too often left out of the overall K–12 vocabulary development plan. These grades are critical times in vocabulary development for future student success in literacy and in schoolwork in general. According to research, effective vocabulary

instruction should be designed in line with these principles:

- **Direct, explicit instruction** in vocabulary plays a central role in increasing students' vocabulary size.
- In the upper-elementary and middle grades, students move into the "reading to learn" stage of literacy development, with **content-area vocabulary** learning increasingly at the heart of literacy achievement.
- Effective vocabulary instruction provides for satisfactory **depth of learning** new words that ensures long-term retention.
- **Strategic learning** of vocabulary provides students with the tools to generalize their word study to encounters with many other new words they will find in their readings and studies.

## Direct, Systematic Instruction

The publication of the National Reading Panel's (NRP) research survey in 2000 was a turning point in schools' increasing recognition of the effectiveness of direct, explicit, and systematic instruction in reading. One of the NRP's "five pillars" of reading instruction was vocabulary. The report underscored the importance of vocabulary development, noting that many studies demonstrated that "comprehension gains and improvement on semantic tasks are results of vocabulary learning" (p. 4–20). The NRP found that indirect learning of vocabulary through such activities as book reading *did* play an important role in increasing student readers' vocabulary size, but that indirect learning alone was insufficient (p. 4–24).

For example, Swanborn and deGlopper (1999) designed a meta-analysis of twenty studies of word learning during normal reading (often called incidental vocabulary learning). They found

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that, on average, students learn about 15% of the unfamiliar words encountered during reading. But a close analysis of their statistical results indicated real concerns about incidental vocabulary learning, especially for struggling readers such as those for whom *CVB* is designed. High ability readers demonstrated a 19% probability of learning an unfamiliar word in text. Low ability readers, however, demonstrated only a 7% probability. In their analysis, Swanborn and deGlopper also found that density of unfamiliar words was a factor. If only 1 in every 150 words is unknown (that is, very easy text), the probability of readers learning an unfamiliar word is 30%. For text in which 1 out of 10 words is unfamiliar, the probability is only 7%. Since struggling readers spend so much of their reading time in school dealing with frustration-level texts, the likelihood that they will learn new words from casual reading is much reduced.

Baumann and Kame'enui's (2004) text, *Vocabulary Instruction: Research to Practice*, divided its definition of comprehensive vocabulary instruction into three major components: teaching specific words; fostering word consciousness, that is, being aware of and interested in word meanings; and teaching strategies for learning words independently. The instruction in *CVB* plays an important role in each of these. It provides systematic attention to the learning of specific words that are of importance in the content-areas. It communicates powerfully to students that vocabulary growth is important, an aspect of word consciousness. Students also practice a variety of strategies during direct instruction that can then be transferred to their own independent reading situations.

### Content-area Vocabulary Learning

Beginning vocabulary knowledge is understood best as part of readers' general knowledge of their world (Carver, 2000). "The research and theory strongly suggest that teaching vocabulary

is synonymous with teaching background knowledge. The packets of information that constitute our background knowledge all have labels associated with them" (Marzano, 2004, p. 35). So once students transition from the "learning to read" stage to a stage in which content-area reading and learning plays the central role, the "reading to learn" stage (Chall, 1996), texts change from familiar situations—realistic fiction, for example—to more abstract exposition for which students may have inadequate background knowledge. At this stage, poor vocabulary skills increasingly affect further academic development, and students can spiral down in failure at school (Snowling, 2002), an effect often referred to as the Matthew Effect (Stanovich, 1986). Students with superior vocabulary find more success in reading. Therefore, they read more and achieve better in school. Students with poor vocabulary struggle with reading, read less, and do poorly in school, falling further and further behind their peers.

### Depth of Learning

In his survey of research on vocabulary instruction, Nagy pointed out that schools' goals should not be simply to expose students to a lot of vocabulary words. Instead, schools need to bear in mind that improved reading comprehension is the goal. "For vocabulary instruction to increase the comprehension of texts that contain the instructed words, it must be fairly intensive" (Nagy, 2005, p. 28). He estimated that, for most students, between seven and twelve instructional encounters with a word are necessary for it to be learned in sufficient depth. The National Reading Panel report (2000) also validated the importance of repeated exposures to new vocabulary words and called for "extended and rich instruction in vocabulary" (p. 4–22).

Repetition is important, in part, because knowledge of a word's meaning is not an "all or nothing" affair. Learning a new word usually



occurs gradually, along a continuum, as learners are repeatedly exposed to that word. Nagy and Scott (2000) called this aspect of vocabulary *learning incrementality*. One of the pioneers of vocabulary study, Edgar Dale (Dale & O'Rourke, 1986), suggested that there are four levels of word knowledge, varying from "I never saw it before" to "I know it":

1. The student has never seen the word.
2. The student has seen the word but cannot verbalize its meaning.
3. The student can recognize the word in some contexts and has partial knowledge of its meaning.
4. The student has full knowledge of the word, can explain its meaning(s), and understands its use in varied contexts.

Part of the purpose of repetition has to do simply with the power of repeated practice in learning, but a great deal of repetition in *CVB* lessons is focused on moving a student toward a Level 4 understanding by use of the word in varied contexts.

In non-academic accounts of vocabulary instruction, much attention is paid to the breadth of vocabulary knowledge, that is, to the sheer number of words "known" by readers. Less attention has been paid to the *depth* of vocabulary knowledge. Scott and Nagy (1997) noted that to know a word means more than simply knowing its definition. Similarly, Proctor *et al.* (2009) found that depth of vocabulary knowledge is important to students'—including bilingual students'—comprehension. Proctor's research was based on an understanding of word depth that included the different domains involved in knowing words, such as their pronunciation (phonology); spelling (orthography); meaningful parts (morphology); part(s) of speech (syntactic constructions); meaningful use in sentences (semantic representations); appropriate use in

sentences (pragmatics); and history and derivation (etymology).

So, simply presenting lists of words and their definitions does not sufficiently improve vocabulary knowledge. Growth comes as learners make connections between new words and concepts and the words and concepts from their own experience. Traditional strategies of vocabulary instruction, such as having students look up definitions in the dictionary, copy them, and copy sample sentences from the board in preparation for a weekly quiz, are too frequently used in classrooms (Rupley & Nichols, 2005).

Nagy and Scott (2000) suggested that these traditional strategies need to be modified as follows: Target vocabulary words must be integrated with content-area learning or with students' background knowledge. Instruction and practice with target words needs to be repeated so that students know the words thoroughly. Traditional rote practice with target words should be replaced by active student involvement in the process of learning.

*CVB* follows these recommendations: Students read content-area text passages using the target words. Different types of activities provide repetition of target words in varying contexts. Students read words in context and actively respond in a variety of meaning-based practice activities, and they are given immediate feedback to their responses.

### **Strategic Learning**

Knowledge of vocabulary that can be used for the learning of new words is sometimes called generative word knowledge (Nagy, 2005), or simply strategic learning. One important aspect of vocabulary development is the learning of information about the meanings of specific words, as discussed in previous sections of this paper. In this section, another aspect of vocabulary study, strategic learning, is discussed. This gives students

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Strategic learning includes using context, understanding word parts, and differentiating among multiple meanings. *CVB* teaches these strategies as an integral part of its vocabulary instruction, so students are better able to learn words that are not taught directly.

the ability to apply specific word knowledge to new words they encounter in their independent reading and study of texts.

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*CVB* lessons incorporate a wide variety of vocabulary learning strategies. Students see these strategies modeled, and they develop an ability to use them independently. (See Table 1.)

Strategies using word parts have been found to be particularly helpful to middle grade students' ability to learn new words encountered in reading and studying (Baumann *et al.*, 2002; Baumann *et al.*, 2003). Direct, systematic instruction in word parts improves vocabulary knowledge (Baumann, 2005; Baumann, *et al.*, 2003). It also improves students' ability to infer the meanings of new words (Blachowicz, Fisher, Ogle, and Watts-Taffe, 2006). The use of meaningful word parts includes knowledge of prefixes, suffixes, and root words. (This skill is sometimes called structural analysis, morphemic analysis, or morphology.) Bromley (2007) estimated that the meanings of 60 percent

Strategy	CVB Activity	Example from CVB				
<b>Use context</b>	Students see contextual use of words throughout the lesson activities and in the passage.	During <b>condensation</b> , water changes from a liquid to a gas.				
<b>Use word parts (Morphology)</b>	In Word Smarts, students use meaningful word parts as clues to meanings of words.	The root <i>spir</i> means "breathe." <b>Respiration</b> is the act of breathing in and out.				
<b>Relate words in families</b>	In the Word List, students see related forms and parts of speech of target words.	<b>circulation</b> <i>n.</i> The movement of gas or liquid in a circular or looped path. <b>circulate</b> <i>v.</i> To follow a circular or looped path.				
<b>Use graphic organizers</b>	In Practice for Success, students use graphic organizers to achieve a deeper understanding of words—for example, categorizing and giving examples/non-examples.	<table border="1"> <tr> <td>Circulation</td> <td>Not Circulation</td> </tr> <tr> <td>Water moving through the water cycle</td> <td>A rock falling off a cliff</td> </tr> </table>	Circulation	Not Circulation	Water moving through the water cycle	A rock falling off a cliff
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<b>Use mnemonics</b>	In Practice for Success, students learn how mnemonics can help them remember a word's meaning; they associate a word they are learning with a known word or concept. Animation provides a clear presentation of this device.	To remember the word <b>caravan</b> , picture a car followed by a van. Together, these vehicles form a caravan. A caravan is a group of vehicles (or people and animals) that travel together as a unit.				
<b>Use self-monitoring</b>	Throughout <i>CVB</i> , students are guided to assess their own understanding of a word's meaning. Immediate feedback validates or corrects their choices. Unmastered words trigger Practice for Success activities.	When water <b>circulates</b> , it dries up and is gone forever. True False Feedback: When water circulates, it follows a path like a circle that keeps repeating. If water dries up, it goes into the sky and then returns as rain.				

Table 1



of words can be inferred from their word parts. In the expository texts that increasingly replace narrative text in the upper grades, words that contain word part clues to meaning occur twice as often (Ebbers, 2008).

### Other Key Research Issues

The four key research-based vocabulary-learning principles described above serve as foundations for CVB instruction. Teachers and schools using CVB may, however, have questions about the research basis pertaining to other aspects of CVB instruction. For example:

- Can CVB be effectively used with **English Language Learners**?
- What role does the **audio support** in CVB play in instruction?
- Is there research that supports using **computer-based instruction** to scaffold vocabulary learning?
- What function does the **learning management system** play in increasing the effectiveness of vocabulary instruction?

### English Language Learners

Children who speak a language other than English at home tend to have smaller vocabularies than the general student population (August & Shanahan, 2006; Proctor *et al.*, 2009). Poor vocabulary is one cause of poor reading comprehension for English Language Learners, or ELLs (Garcia, 1991; Verhoeven, 1990). The instruction in content-area vocabulary provided by CVB is appropriate for many ELL students.

Research on teaching academic vocabulary to ELLs has dramatically increased in the last several years as these students' needs have become more apparent (Townsend, 2009). The National Reading Panel's (2000) survey of instructional effectiveness found that strategies effective with

first-language learners are also effective with second-language learners.

Calderón and her colleagues (2005), for example, found that a direct instructional approach—the approach at the foundation of CVB instruction—is effective for second-language learners. This study included instructional components that are an important part of CVB, such as repetition, contextual use of target words, and word parts. A similar study by Carlo, August, and Snow (2005) with fifth grade ELL students also found that these three instructional components were key to student success.

The transition of ELL students into mainstream, English-only classrooms is a critical point where second-language learners need appropriate instructional support. Calderón, Hertz-Lazarowitz, and Slavin (1998) and Saunders and Goldenberg (2001) have provided research evidence that extra support in vocabulary learning will be an effective part of this transition.

The Report of the National Literacy Panel on Language-Minority Children and Youth (August & Shanahan, 2006) reviewed existing research on language-minority students. The report did note that the effect sizes of instructional interventions are lower than with students from English-speaking homes, indicating that additional and more intensive instruction is necessary. The report also noted that respect for cultural diversity and English instruction are important, in addition to the strategy instruction.

### Audio Support

CVB lessons are entirely scaffolded by the use of audio technology. The reading aloud of definitions, examples, questions, and passages is done using natural, digitized speech by human readers. This natural, digitized speech is understood better than, and preferred to, the artificial, robotic, phonemically synthesized speech sometimes found in computer-based instruction.

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With the increasing availability of technology in classrooms, researchers have directed a good deal of attention to the use of audio support for reading (Balajthy, 2007). Audio support is effective in improving comprehension with a wide variety of types of learners, including students with attentional difficulties (Hecker *et al.*, 2002), younger struggling readers (Leong, 1995; Montali & Lewandowski, 1996), older struggling readers (Elkind, 1998; Wattenberg, 2004), and students with disabilities (Wise & Olson, 1994).

Audio support can be helpful for proficient readers, but it is even more helpful for the struggling readers for whom *CVB* is designed (Disseldorp & Chambers, 2002). Wolf (2007) verified established findings that audio support during reading improves the comprehension of struggling readers, but this study also found that readers' phonemic awareness and listening comprehension were improved. Montali and Lewandowski (1996) indicated that struggling readers performed as well as average readers when text was presented in this bimodal condition of audio support with visual reading.

Mayer and Moreno (1998) compared the use of text and audio narration on learning of computer-based content-area lessons. They found that on their computer-based lesson presentations, learners did best when they were able to integrate material from the screen with audio support. They called this result the split-attention effect, in that learners were able to learn best when their attention could be directed in an integrated way both to the screen and to audio support. Similar findings supporting the use of speech prompts in computer-based instruction were reported in a study by Davidson, Elcock, and Noyes (1996).

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rigors of reading—a skill at which these students are challenged—not interfere with that vocabulary learning (a concept sometimes called cognitive interference or cognitive overload). Balajthy (1989), in his chapter on "Voice Synthesis," written when classroom computers were only beginning to use voice to scaffold reading, described its benefits: "Speech is a preeminently natural form of communication. Listening is practically automatic and requires little conscious attention, so that other learning tasks can be carried on at the same time" (p. 116). The lower readability levels of *CVB* passages (two grade levels in readability easier than typical text at the students' grade level) helps avoid this overload. The audio support provides an additional scaffold to help students appropriately focus on learning the new vocabulary words.

### Computer-Based Instruction

The explosive growth in online learning over the past few years has been described as signaling a "revolution in the educational sector" (Natriello, 2005, p. 1892). The potential of computers for providing direct teaching in vocabulary was recognized from the early days in which the primitive microcomputers of the 1980s were being introduced to classrooms. Research quickly established that vocabulary instruction using computers can be more effective than traditional methods (Balajthy, Bacon, & Hasby, 1987). Teachers face difficulty in finding classroom time for vocabulary instruction. Only about one percent of student time is spent in developing content-area vocabulary in traditional upper-elementary classrooms (Scott, Jamieson-Noel, & Asselin, 2003). The ability to use online instruction to increase student time-on-task is one of the greatest benefits of this technology.

Early surveys of research on online learning found that it is just as effective as traditional, face-to-face instruction (Russell, 1999). Time



and experience have resulted in instructional improvements in delivery media and in more sophisticated support systems. Newer approaches, such as those employed in *CVB*, offer promise of even better results (Zhao *et al.*, 2005). In a 2009 U.S. Department of Education study on the effectiveness of online learning, the authors cited a need for more research on K–12 online learning, but the statistical results from general research supported its potential: “Students who took all or part of their class online performed better, on average, than those taking the same course through traditional face-to-face instruction” (p. xiv). The report noted that much of the improved results could be attributed to the greater time-on-task that online learning often makes possible.

The Carnegie Foundation’s Reading Next report on adolescent literacy development called for increased use of classroom technology: “As a tool, technology can help teachers provide needed supports for struggling readers, including instructional reinforcement and opportunities for guided practice” in vocabulary instruction (Biancarosa & Snow, 2004, p. 19). Research also suggests that such affective factors as motivation and self-esteem are increased by computer use (Cosden, 1988). In a discussion of vocabulary development software, Balajthy and Lipa-Wade (2003) described how this affective impact works: “Computers confer status to the users, suggesting that they are engaged in cutting-edge learning. That status can work to overcome the negative image often associated with receiving instruction as a struggling reader” (p. 99).

In 2000, the National Reading Panel’s comprehensive survey of reading research included attention to computer-based learning. The report cited a variety of newer studies finding that “computer technology... may be a powerful way of increasing vocabulary” (p. 4–26). The authors of the report suggested that computers could be used as tools to provide more time-on-task in practicing vocabulary, without additional

burden on classroom teachers. They also found that computer-based instruction made use of multiple modalities of learning for increased effectiveness, including speech support such as that provided in *CVB*.

One key strength of *CVB* is that it uses a direct instructional approach, as opposed to an arcade game drill-and-practice format. In large measure, that is due to the nature of *CVB* instruction as tutorial rather than simple drill-and-practice. Tutorial software presents information and guides learning in a way that imitates the interaction between an individual student and a human tutor. As with a human tutor, tutorial software provides motivation and uses the quality of the student responses to determine what to do next (Grabe & Grabe, 2007). Instruction in *CVB* vocabulary tutorials, involving the development of sophisticated understandings of word meanings and uses, is a good deal more complex than that offered by standard drill-and-practice software.

Educational arcade drill-and-practice games may be of use, especially in home situations. However, the “edutainment” nature of such activities has long been a concern to researchers. In their review of technology applications in special education, Woodward and Rieth (1997) noted that “arcade games compete for time and attention in the context of drill and practice... Arcade games seem to detract from high amounts of practice required of students with disabilities, if they are to master target skill areas” (p. 514). Direct instructional format computer-based instruction, such as that in *CVB*, maximizes time-on-task in learning and more closely matches teaching methods preferred and used by classroom teachers.

### **Learning Management System**

The management system provides a variety of reports for monitoring student progress for teachers and administrators. The system allows

**As a tool, technology can help teachers provide needed supports for struggling readers, including instructional reinforcement and opportunities for guided practice” in vocabulary instruction (Biancarosa & Snow, 2004, p. 19).**



The major tenet of the Response to Intervention (RTI) reform efforts, as with all formative measures, is that assessment is useful only if it is used to plan and adapt instruction. *CVB* provides additional practice where it is needed.

ongoing monitoring of performance at several levels: the individual student, the classroom, and the school. Frequent assessment of student progress is crucial to achievement. The major tenet of the Response to Intervention (RTI) reform efforts, as with all formative measures, is that assessment is useful only if it is used to plan and adapt instruction. *CVB* provides additional practice where it is needed.

Much reading instructional software on the market today is “designed on what is now considered to be decade old technology” due to insufficient progress monitoring (Lovell & Phillips, 2009/2010). *CVB* provides the kind of assessment called for by such reform efforts as RTI. Gehring noted the increasing recognition on the part of schools of the importance of “technologies that help educators analyze student-achievement data and then adjust their teaching based on what those results show” (2005, p. 38).

Classroom teachers involved in Tier 1 RTI instruction are able to monitor the performance of each student, of groups within the class, and of the class as a whole. They can identify which content themes appear to present the most challenges, as well as which kinds of activities. At the end of each lesson, they can identify which target words presented the most difficulty to the class and plan for extra attention to those words.

Teachers and specialists involved in Tier 2 and Tier 3 RTI instruction have the ability to “drill down” through the *CVB* reports to examine very specific data. For example, teachers are able to examine individual student performance on each of the major activities, including the practice activities and the pretest and post-test. They can also monitor student and class time-on-task to determine which students are struggling to complete the online activities. This can be of special help to teachers and specialists who want to provide additional intervention to meet a specific student’s individual needs. Assessment

is frequently administered and closely monitored so that adjustments can be made in instruction to ensure that students are on target to achieving mastery. It is one of the 15 elements of the Carnegie Foundation’s Reading Next report on improving literacy instruction: “Data should be cataloged on a computer system that would allow teachers, administrators, and evaluators to inspect students’ progress individually and by class” (Biancarosa & Snow, 2004, p. 19).

This computer-based progress monitoring also mirrors the nature of assessments called for by RTI. RTI programs include careful monitoring of the intervention’s success through the use of frequent curriculum-based measurements (CBMs; Fuchs & Fuchs, 2007). The assessments in *CVB* are tightly connected to the vocabulary objectives of each lesson, rather than to the general student progress in reading measured by CBMs. But the research-validated connection between vocabulary growth and reading achievement suggests that assessed success in *CVB* vocabulary learning would be reflected in overall growth in general reading ability.

One important aspect of the reports has to do with integration of instruction. From the early days of computer-based instruction in the classroom, it was clear that technology was most effective when it was integrated in a seamless manner to support and extend classroom instruction (Dias, 1999). *CVB*’s reports serve not only to indicate student performance, but also as reminders of the vocabulary words to which students are currently being exposed in *CVB*. This provides teachers with the cues to point out use of the current vocabulary words as they occur in classroom discussion or in traditional text readings, and to encourage their use in student writing. This combination of traditional face-to-face teaching and online instruction (often called blended learning or hybrid learning) offers advantages over purely online instruction (U. S. Department of Education, 2009).



## Conclusion

*Content-Area Vocabulary Builder* (CVB) is designed to engage struggling readers in grades 4–8 in learning to improve literacy achievement through the online, intensive development of vocabulary. It focuses on vocabulary learning that is particularly appropriate during the “reading to learn” years, the kind of vocabulary that students encounter on a day-to-day basis in their content-area reading and studies. Target vocabulary words are carefully chosen and placed in the context of expository passages similar to those students will encounter in their science and social studies readings. Passages are written to be at appropriate difficulty levels for students who are struggling with reading, but CVB instruction can be helpful to on-level students as well.

Student learning is supported by CVB’s well-designed, computer-based instructional organization that individualizes instruction according to student performance and that is based on key research principles of vocabulary teaching and learning. Students who struggle with a lesson’s vocabulary words are guided into additional online activities that reinforce learning.

Online lessons focus on providing students with the depth of understanding and the number of engaged exposures to new words that are crucial for long-term retention. Students’ performance in each lesson is monitored and used to modify instruction as needed. Results are easy to access in the online management system.

CVB instruction in vocabulary is based on key research principles supporting direct instruction, content-area vocabulary learning, depth of vocabulary learning, and the strengthening of strategic learning for independent student reading situations. Research shows clearly that vocabulary learning is at the heart of reading comprehension improvement. The results of vocabulary growth through students’ use of CVB will have a positive impact on their literacy achievement.

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From the early days of computer-based instruction in the classroom, it was clear that technology was most effective when it was integrated in a seamless manner to support and extend classroom instruction (Dias, 1999).

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