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Exploring the nature of vocabulary support in online earth science courses for secondary students with reading disabilities

Purpose

This study had two purposes. The first was to determine what type of vocabulary were identified by curriculum developers of secondary earth science online courses as needing support. The second purpose was to classify that support against what is known about vocabulary support for students with disabilities. In order to attend to these purposes, a directed content analysis of supported words from earth science courses in three different online learning environments was performed.

Theoretical Perspectives

Fang (2005) summarized key linguistic features of academic text. Those features are abstraction, information density (Eggins, 1994), nominalization (Christie, 2001), authoritativeness (Schleppegrell, 2001), and technical terms. The first three features have vocabulary components, but these are also bound up in syntactic structures. Technical terms are easier to isolate from their surrounding grammatical context, although they are still tied to the pragmatic context. A technical term is any word that has a discipline-specific meaning (Wignell, Martin, & Eggins, 1993). In addition, technical terms usually have meanings derived from Greek and Latin roots (microorganism, phenotype), but there are also words with non-vernacular uses. These words not only have meaning in science, but they also have meanings outside of science text (Fang, 2006).

There is a number of issues students face when trying to comprehend academic texts. The first is the distance in the definitions that can exist between common and technical terms. The second is the interdependence of the words on each other. The third is the polysemantic features of some words that make precise understandings difficult. For students with disabilities, it is no wonder that learning technical terms can be an aggravating and frustrating process. Their already weak vocabularies and processing difficulties are exacerbated by the definitional distance and the interdependence and if they have inefficient memories (which many students with disabilities do) learning all the different definitions and deciding when to apply which definition could be a harrowing task (Jitendra, Edwards, Sacks, & Jacobson, 2004). These realities underscore the need for vocabulary support in online learning environments, a learning context that is already demanding in terms of its reliance on independence (Barbour & Reeves, 2009).

While researchers have realized that students with disabilities need support for learning words, only recently has there been an interest in the specific words that students need to learn that will be the most helpful to students, including those with disabilities as they work to comprehend text. Scholars such as Beck, McKeown, & Kucan (2013) and Zwiers (2008) have advocated that teachers engage in word strategic sorting processes to determine which words to teach as part of their curriculum.

Beck, McKeown, and Kucan (2013) advocate for a three-tiered approach where Tier 1 words are regarded as common words that can be learned with little or no instruction and Tier 3 words are

terms reserved to specific content areas. Tier 2 words are where most instruction ought to be directed in this model. These words have value in their importance in multiple subjects in multiple years of schooling. They are also words that students are less likely to know without instruction, although a word can be a Tier 2 word even if the students know it. Since these words have both interdisciplinary and enduring value over time, they need to be taught using effective methods and taught by multiple teachers in multiple subject areas at multiple grade levels. The notion of word tiers does not mandate to teachers which words should be taught; judgment about whether a given Tier 2 word is important to a text at hand and whether the students already know the word should also be considered by the teachers.

The support strategies that have been documented to be helpful for students with disabilities are (a) keyword (mnemonic) strategy instruction (b) cognitive strategy instruction, (c) activity-based methods, (d) constant time delay (CTD) (e) direct instruction, and (f) computer assisted instruction (CAI) strategies (Jitendra, Edwards, Sacks, & Jacobson, 2004). These strategies have all been tested in general education classrooms and special education classrooms in brick and mortar schools. They have not been tested in online courses. It is worth noting that most any instructional strategy a teacher uses has the potential to help students with disabilities learn vocabulary, but some are stronger than others. In their review Jitendra and her colleagues (2004) identified only two strategies as being counterproductive to vocabulary learning. These were looking up definitions in the dictionary and using word lists.

While there is no magic number in the research on vocabulary for the quantity of words that should be taught in a given instructional unit to students in general or with reading difficulties, it has been suggested that curriculum makers ought to consider three things about a word before deciding to teach it: (1) importance and utility, (2) instructional potential and (3) whether and how the word builds on students' previous conceptual understandings (Beck, McKeown, & Kucan, 2013). In most cases, this means that vocabulary instruction should focus on developing robust understandings of fewer words rather than superficial understandings of many words.

Method

This study employed a directed approach content analysis. In general terms, this type of content analysis is considered highly structured (Hickey & Kipping, 1996). Using existing theory or prior research, researchers identify key concepts or variables as initial coding categories (Potter & Levine-Donnerstein, 1999). Next, operational definitions for each category are determined using the theory. These initial codes and definitions are used as a starting point for conducting the analysis. Sometimes these initial codes are developed based on existing literature may change based on the data collected, but they might also remain the same.

In this study, the initial coding categories used were the first five strategies Jitendra and her colleagues (2004) identified as being successful for students with disabilities. The operational definitions came from studies reviewed in their study as well. The CAI code was not used because all strategies are used in CAI, the content understudy came from online courses.

The main strength of a directed approach to content analysis is that existing theory can be supported and extended. However, one of the main limitations of the directed approach is that

researchers approach the data with an informed, but strong bias. Therefore, researchers might be more likely to find evidence that is supportive rather than non-supportive of a theory.

Since the purpose of this study was not to defend vocabulary support strategies, but rather to classify them in an attempt to describe certain features of online courses, the directed approach was an appropriate option. However, it was also important during the coding process to be open to finding types of vocabulary support that did not fit the existing categories based on Jitendra and her colleagues' (2004) work as well. Two of these were discovered—narrative and metaphor—which are revealed in the findings section and elaborated on in the discussion section.

Data Sources and Techniques

The vocabulary words were extracted from earth science courses in two of the most widely used online learning environments and one earth science course from an environment generated by and supported by teachers who were currently teaching in a rural school district. These online learning environments have been given pseudonyms of Acme, LearningCo., and Student Connections. While these online learning environments do not represent every online environment available, their wide availability makes them more likely to be used in general, which includes used by students with disabilities. Words were extracted from 30 earth science course lessons in each online environment. Members of the research team extracted a word if it was denoted in the course as a keyword by (1) its appearance on a word list anywhere in the lesson (2) its demarcation with bolded lettering, italicization, or highlighting, and/or (3) its appearance as an answer to a quiz question in the lesson. Quizzes and other formal assessments in the lessons were not considered vocabulary support. It is the words extracted from these sample lessons that the coders searched for and catalogued the vocabulary support. These extracted words were visited in their contexts while the types of support were coded.

Two coders conducted the analysis. The coders participated in approximately two hours of collaborative training about where to locate the words for extraction, as well as tiered classification and understanding various strategies for providing vocabulary support. A coding manual was developed consisting of category names, definitions, or rules for assigning codes, and examples (Weber, 1990). Additional fields in the manual were added for taking notes as the coding proceeded. The manual evolved throughout the process of data analysis, and was augmented with interpretive memos. The initial codes were derived from the review of literature on vocabulary support. Since research has identified both technical terms and connective structures that can be divided into tiers, as well as both strong and weak instructional supports, we were interested in all vocabulary support for technical terms in the science courses regardless of classification or efficacy.

In order to ascertain inter-rater reliability, the coders first applied their coding scheme to extracted words from a sample of lessons from that were not included in the final set. A conference followed the coding in order to compare findings and attain agreement. Then extracted words from a set of lessons were coded. Another conference followed. After this second conference, 98 percent agreement had been accomplished. The two coders then proceeded to apply the codes to words extracted from the lessons that were included in the research study. Each researcher coded extracted words from half of the lessons from both of the

environments. A total of 974 words were supported in all three environments. Not all of these words were unique. In fact, many overlapped completely letter-for-letter and most overlapped at the word family level. For example, the terms *sample*, *sampled*, *sampling*, and *samples* would all be considered to be in the same word family. There were also many words that shared roots and word parts. Words like *hydroelectric* and *hydrostatic* are examples of words with different meanings but share a common root and have a similar structure.

To increase the trustworthiness of the study, a corpus of 164 words was developed from the database of 974 extracted words. These words were selected to represent all of the word families found across all three environments and the various roots and word parts from the supported words. This list was given to a third researcher with expertise in assigning words to tiers of vocabulary. After the expert assigned the words to Tiers 1, 2, or 3, results were compared with the first two raters. The agreement between the expert and first rater was 94 percent. The agreement between the expert rater and the second researcher was 92 percent. Table 4 contains a sampling of the words and their agreed-upon classifications into tiers.

Initial coding started with a theory or relevant research findings. In this case, those findings were related to the vocabulary support strategies in table 2 (keyword/mnemonic, cognitive strategy, activities, constant time delay, and direct instruction) that demonstrated promise in helping students with disabilities develop vocabulary skills. Then, during data analysis, the researchers immersed themselves in the data and allowed additional themes to emerge. This approach was used to extend the existing empirical basis for vocabulary support for students with disabilities. Data that could not be identified were analyzed later to determine if they represented a new category or subcategory of an existing code. When words were supported using multiple strategies, each strategy was counted. Thus a supported word was only added to a tier once, no matter how many strategies were used, but each strategy for a word was counted as a unique event.

Findings

The findings of this coding revealed that there is indeed vocabulary support occurring in the three learning environments. Table 1 reports the distribution of the words that were supported into Beck, McKeown, and Kucan’s (2013) tiers.

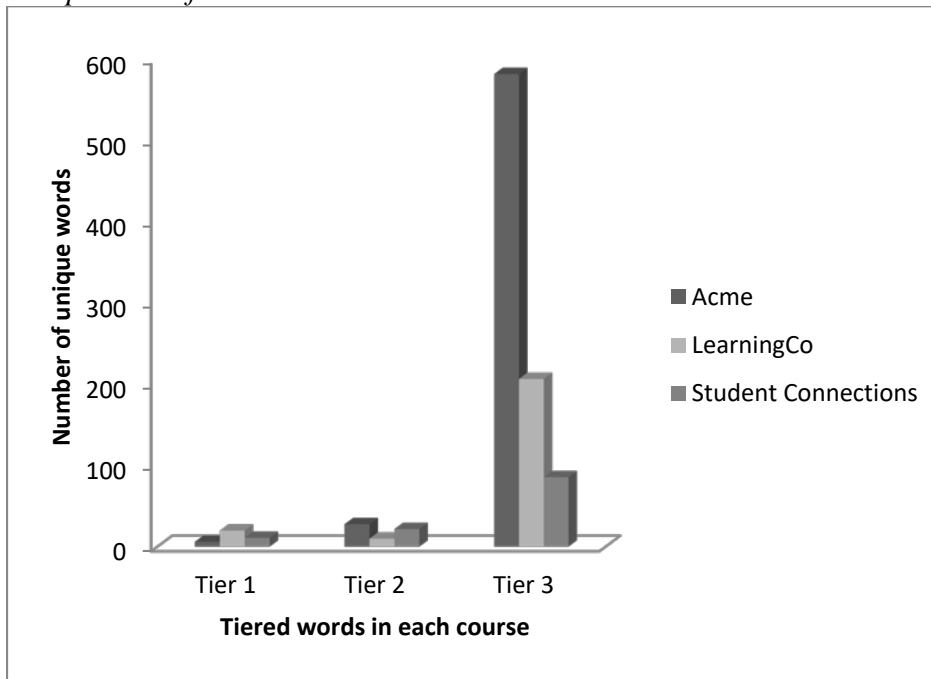
Table 1
Tiered distribution in online earth science courses

	Tier 1	Tier 2	Tier 3
Acme	6	28	582
LearningCo.	20	10	208
Student Connections	11	22	87
Total	37	60	877

Although 30 lessons were used from each earth science course, the number of words supported in each of the tiers varies. Figure 1 provides a side-by-side comparison of each of the tiers for each of the courses.

Figure 1

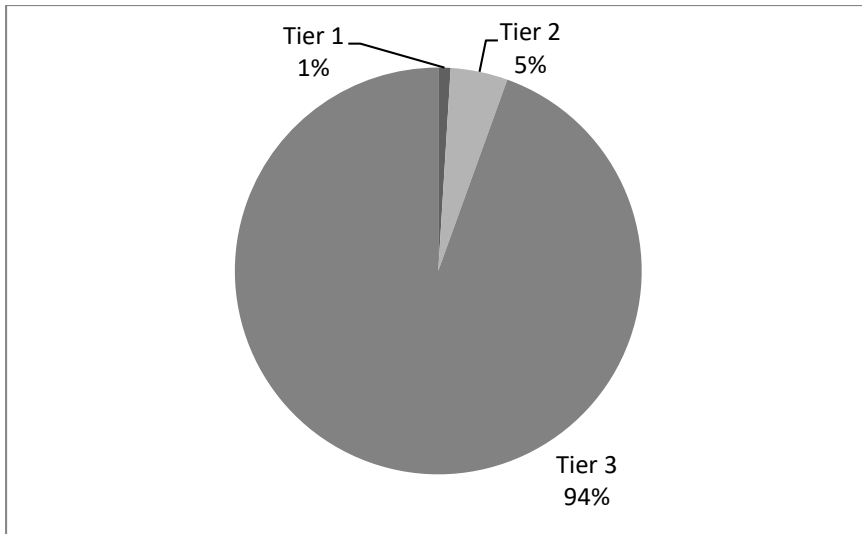
Comparison of tiered words in three online earth science courses



The Acme earth science course supported the most words, by far. The vast majority of these supported words were tier 3 words. LearningCo supported substantially less in all three categories, as did Student Connections. The next set of figures (2-4) provides percentages of tiered words in each course.

Figure 2

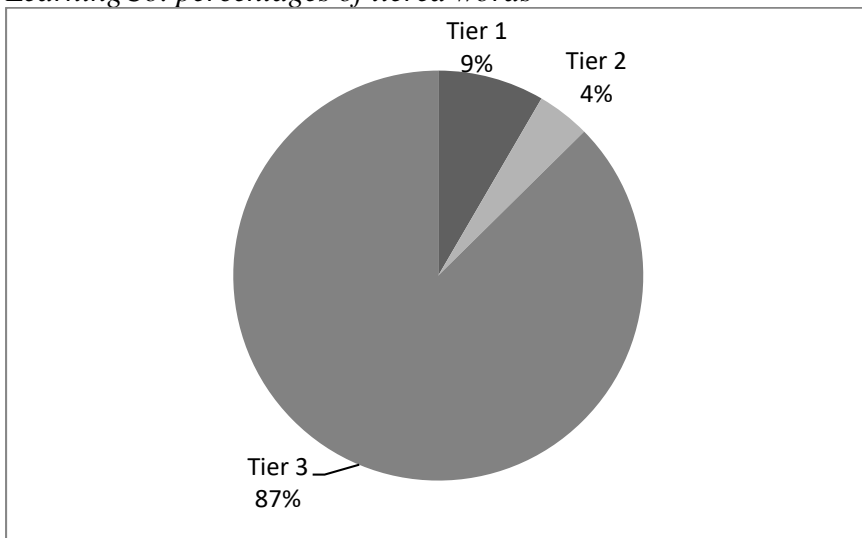
Acme percentages of tiered words



As the graph shows, 94 percent of the words supported in the Acme earth science course are tier 3 words. Only 5 percent are tier 2. One percent are tier 1.

Figure 3

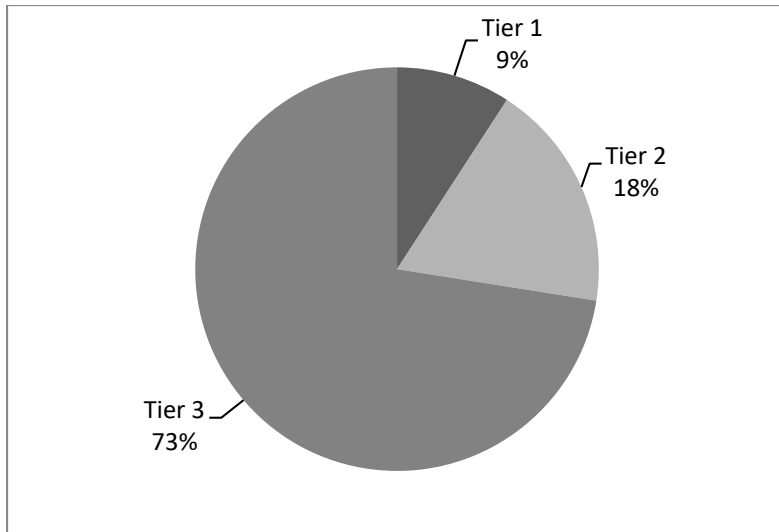
LearningCo. percentages of tiered words



In the Learning Co earth science course, 87 percent of the supported words are tier 3 words. Four percent are in tier 2. Nine percent are in tier 1, the tier that should have the least supported words in curriculum.

Figure 4

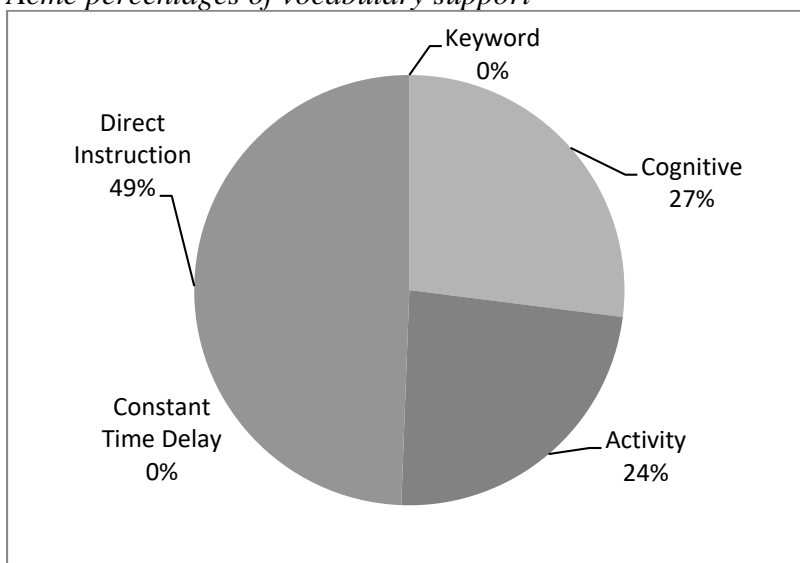
Students connect percentages of tiered words



The Student Connections earth science course also supported a majority of tier 3 words, with 73 percent. This course had the greatest percentage of tier 2 words, with 18 percent of words falling into that tier. Nine percent of the words supported came from the first tier.

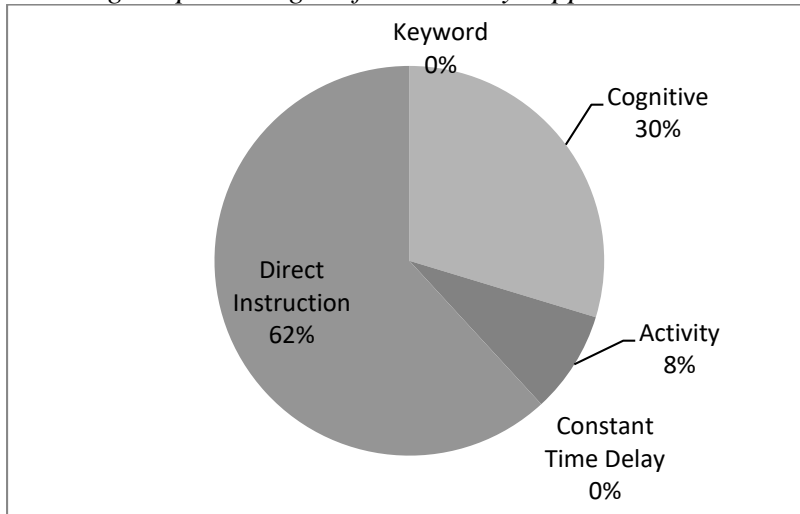
The next set of figures (5-7) reports on the types of support in each of the environments. The average number of times a word was supported in all three environments was 1.3. Typically the words that were supported more than once were defined (direct instruction) and then students performed a task with the words (activity) or were shown the words in relationship to one another on a table or graph (cognitive strategy). The mean score of 1.3 support strategies indicates that most words were supported only once. There were very few words supported twice or with more than two types of support. No words were supported more than three times with more than three types of support.

Figure 5
Acme percentages of vocabulary support



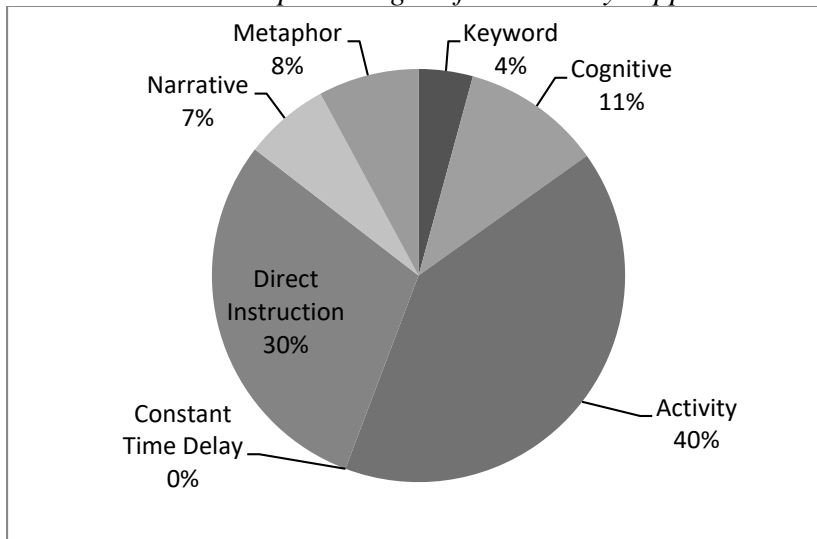
The Acme earth science course vocabulary support consists mostly of direct instruction, with 49 percent of the support coming in that form. The next highest category was cognitive support, with 27 percent. The third highest was activity with 24 percent. There was no vocabulary support in keyword or constant time delay form.

Figure 6
LearningCo. percentages of vocabulary support



Learning Co's earth science course also relied heavily on direct instruction, with 62 percent of support falling into that category. Thirty percent of the support was cognitive. Only 8 percent was driven by activity. As in Acme, keyword and constant time delay strategies were not employed.

Figure 7
Student Connections percentages of vocabulary support



Unlike the other two courses, Student Connections' earth science course had the majority of the support in activities, with 40 percent. Direct instruction was still a major source of support with

30 percent. Only 11 percent of the support was based on cognitive strategies. Student connections' course utilized keyword strategies for 4 percent of the support, constant time delay was not used at all. In addition, there were two new strategies used. One strategy was to tell a story about the word. This was coded as Narrative support. Seven percent of the words were supported in this way. Another strategy used 8 percent of the time was to embed the words into a metaphor and then explore the words and the metaphor together. One example of this happened when the course materials likened the solar system to a running track.

Scholarly Significance

The findings of this study highlight the abundance of words receiving attention in the online earth science courses. While it could be argued that it is unlikely students will be able to make meaningful use of the sheer number of words that have been selected and supported in these courses, what is additionally troubling is the fact that the number and types of words chosen do not seem to have been strategically selected to facilitate a broad command of academic language based on the notion of tiered vocabulary instruction. Instead, a limited number of words should be chosen that are important to the text, the topic at hand, and generally appear at high frequencies (Beck, McKeown, & Kukan, 2013).

Another major finding was that direct instruction was the dominant mode of support, even though it is not necessarily the most helpful for students with disabilities (Jitendra, Edwards, Sacks, & Jacobson, 2004). Others have noted that direct instruction is helpful for disabilities, but only in concert with repeated exposures across multiple contexts using multiple strategies to help students develop deep word consciousness (Bryant, Goodwin, Bryant, & Higgins, 2003). The average number of times a vocabulary word was supported (1.3 for all environments) demonstrates that this repetition was not occurring and the fact that many of the words are tier 3 words suggests that the words that should have multiple exposures, do not.

Taken together, these findings suggest that students with disabilities who are enrolled in online courses may not have access to the type of vocabulary and the strategies for support that will help them cross the lexical bar (Corson, 1984). Although online instruction has the potential for easy modification of content, the environments in this study did not allow online teachers or learning coaches, who are often parents, to change the number or types of words that receive attention or how those words are supported. Advocates, and other overseers of students, particularly those with reading difficulties, will likely need to provide additional support in sorting the vocabulary words and selecting strategies that move beyond definitions and pictures that facilitate learning. Although the names of the companies supporting these online courses have been changed to pseudonyms, this study derives value from bringing attention to the fact that vocabulary identification and support will need to be vetted by parents and educators looking for online courses for students with disabilities.

Some of the new questions that emerge include inquiring into the ways in which the students experience the vocabulary support, determining to degree to which they notice and attempt to use the support, monitoring which words are learned, and how long that learning is retained, and designing and piloting vocabulary instructional materials that can be embedded in online course material (as opposed to supplementary drills) that support students with reading difficulties, but also attend to a broader range of diverse learners. An area of promise for researchers also

emerged in the Student Connections earth science course with its use of narrative and metaphor as vocabulary support strategies. New studies into vocabulary instruction might look at whether teachers in face-to-face contexts are also providing support using these strategies and to what extent. Research may also look into whether these strategies are more/less effective than other forms.

References

- Barbour, M. K., & Reeves, T.C. (2009). The reality of virtual schools: A review of the literature. *Computers & Education* 52 (2): 402–416.
- Beck, I. L., McKeown, M. G., & Kucan, L. (2013). *Bringing words to life: Robust vocabulary instruction*. New York, NY: Guilford Press.
- Boettcher, J.V. (1983). Computer-based instruction: Classroom application and benefits for the learning-disabled student. *Annals of Dyslexia*, 33, 203-219.
- Bryant, D. P., Goodwin, M., Bryant, B. R., & Higgins, K. (2003). Vocabulary instruction for students with learning disabilities: A review of the research. *Learning Disability Quarterly*, 117-128.
- Christie, F. (2001). The development of abstraction in adolescence in subject English. In M. Schleppegrell & M. C. Colombi (Eds.), *Developing advanced literacy in first and second language: Meaning with power* (pp. 45 – 66). Mahwah, NJ: Erlbaum.
- Corson, D. (1984). The Lexical Bar: lexical change from 12 to 15 years measured by social class, region and ethnicity. *British Educational Research Journal*, 10(2), 115-133.
- Fang, Z. (2005). Scientific literacy: A systemic functional linguistics perspective. *Science Education*, 89(2), 335-347.
- Fang, Z. (2006). The language demands of science reading in middle school. *International Journal of Science Education*, 28(5), 491-520.
- Gast, D.L., Wolery, M., Morris, L.L., Doyle, P.M., & Meyer, S. (1990). Teaching sight word reading in a group instructional arrangement using constant time delay. *Exceptionality*, 1, 81-96.
- Jitendra, A. K., Edwards, L. L., Sacks, G., & Jacobson, L. A. (2004). What research says about vocabulary instruction for students with learning disabilities. *Exceptional Children*, 70(3), 299-322.
- Orthner, D. K., Jones-Sanpei, H., Akos, P., & Rose, R. A. (2013). Improving middle school student engagement through career-relevant instruction in the core curriculum. *The Journal of Educational Research*, 106(1), 27-38.
- Potter, W. J., & Levine-Donnerstein, D. (1999). Rethinking validity and reliability in content analysis. *Journal of Applied Communication Research*, 27, 258-284.
- Schleppegrell, M. (2001). Linguistic features of the language of schooling. *Linguistics and Education*, 12(4), 431– 459.
- Weber, R.P. (1990). *Basic content analysis (2nd ed.)*. Newbery Park, CA: Sage Publications.

Wignell, P., Martin, J. R., & Eiggins, S. (1993). The discourse of geography: Ordering and explaining the experiential world. In M. A. K. Halliday & J. R. Martin (Eds.), *Writing science: Literacy and discursive power* (pp. 136– 165). Pittsburgh, PA: University of Pittsburgh Press.

Zwiers, J. (2008). *Building academic language: Essential practices for content classrooms, grades 5-12*. San Francisco, CA: John Wiley & Sons.