Inductive Use of Semantic Word-Families to Accelerate Vocabulary Development and Reading Comprehension in Grades 3-4-5

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Abstract

This study explored the acceleration of student vocabulary growth and reading comprehension proficiency through a multi-part instructional strategy for engendering the inductive, semantic word-family-oriented acquisition of vocabulary from context, a difficult task for elementary students. Implemented on a schoolwide basis for an academic year in grades 3-4-5, the intervention was a four-part enhancement to a traditional basal reading program that constructed and used semantic word families for designated vocabulary words within stories. Results from HLM statistical modeling using student minority status and free/reduced lunch as covariates showed that experimental students in grades 3-4-5 obtained significantly higher achievement on both ITBS Vocabulary and ITBS Reading Comprehension subtests. Implications for research and practice are discussed.

Keywords: Inductive reasoning, Vocabulary acquisition, Reading comprehension

A variety of research has pointed to the interdependent linkage among vocabulary knowledge, reading comprehension, and level of literacy (e.g., Baker et al., 1998; Becker, 1977; Biemiller & Slonim, 2001; Snow, 2002; Wager, 2005). Although substantial vocabulary growth can be attributed to student acquisition of word meaning from reading context (Baker, Simmons, & Kameenui, 1998), August, Dressler, and Snow (2005) noted that if the proportion of unknown words is too large, then text comprehension which serves as a context for vocabulary development is disrupted (see also Carver, 1994).

Despite technical details in how words (e.g., counting word roots vs. root variants) and word understanding (e.g., recognition vs. in depth understanding) are defined in the literature (e.g., Anglin, 1993; Beck & McKeown, 1991), research findings agree that children acquire vocabulary at a rate that is too rapid for all the words to be taught directly (see Baker et al., 1998) or learned incidentally through reading (Landauer, 2002; Landauer, & Dumais, 1996, 1997; Landauer, Foltz, & Laham, 1998; Landauer, McNamara, Dennis, & Kintsch, 2007). With this point in mind, the present study addressed the question of whether student vocabulary acquisition could be accelerated by using a multi-part semantic word-family-oriented learning strategy to inductively broaden vocabulary taught directly. In incorporating criteria suggested by Baker et al. (1998) and Beck and McKeown (1991), the intent of the strategy was (a) to engender an inductive broadening of the vocabulary taught directly and, in doing so, to enhance reading comprehension, and (b) to be feasible for use by classroom teachers within regular classroom settings.

Implemented as a practitioner-oriented model, the instructional intervention reflected several inter-disciplinary perspectives: (a) vocabulary research findings with both younger (e.g., Coyne, McCoach, & Kapp, 2005) and older (e.g., August et al., 2005; Baker et al., 1998; Blachowicz & Fisher, 2000; Johnson, Gersten, & Carnine, 1988) students, (b) cognitive science models (e.g., Kintsch, 1994, 1998a, 1998b, 2002, 2004, 2005; Landauer, 2002; Landauer, & Dumais, 1996, 1997; Landauer et al., 1998, 2007) that emphasize the central role of prior knowledge in comprehension and, (c) our prior research (Vitale & Romance, 2007) investigating the effect of knowledge-focused reading comprehension strategies on student learning. In the present study, different aspects of these perspectives provided a framework for engendering the semantically-oriented inductive learning of vocabulary.

The design of the present study was a significant enhancement of earlier studies (Romance & Vitale, 2012; Vitale & Romance, 2008). First, in this study, the intervention was implemented over an school year in multiple schoolwide sites. Second, teachers were asked to commit to implement the model in eight selected stories in grade 3, 4, and 5. across the school year. And third, the criterion measures (ITBS Vocabulary and Reading Subtests) were administered on a pre-post basis. The specific research questions were:

- Did the instructional intervention which incorporated words taught inferentially accelerate student the vocabulary development as measured by story-specific,

curriculum-based, pre-post tests?

- Did the instructional intervention accelerate student vocabulary development as measured by the nationally-normed ITBS Vocabulary subtest?
- Did the instructional intervention engender a transfer effect to student reading comprehension as measured by the nationally-normed ITBS Reading subtest?

Perspectives in Vocabulary Instruction

Although an increasing number of studies have identified factors important in teaching vocabulary in classroom settings (see Baker et al., 1998; Biemiller & Boote, 2006; Coyne et al., 2005; Nagy & Scott, 2000), such studies have limitations insofar as providing a comprehensive means for accelerating student vocabulary acquisition. For example, Baker et al. (1998) pointed to the fact that the size and rate of growth of the vocabulary of school age children is far too large to be addressed on a literal word-by-word basis alone, while Anderson & Nagy (1992) argued that because word meaning is learned primarily in the context of speech or text, direct instruction of vocabulary can address only a small portion of words to be learned.

The approach in the present study was a methodological enhancement of an earlier study (Vitale & Romance, 2008) that demonstrated significant effects of the inductive model used in the present study on both curriculum-based vocabulary transfer tests and on ITBS Vocabulary. Approaching the question of vocabulary acquisition from a knowledge-based instruction approach (see Bransford, Brown, & Cocking, 2000), a major tenet of this perspective is that prior knowledge is a major factor in meaningful comprehension, learning, and expert performance. Within this framework, building prior knowledge has been recognized as a major determinant of meaningful learning, general comprehension, and reading comprehension.

In applying a knowledge-based perspective to the classical problem of how persons can know more than experience could have taught (literally) within the context of vocabulary, Landauer (2002) and Landauer and Dumas (1997, 1998) drew on the idea that the underlying semantic dimensions as identified by Latent Semantic Analysis (see Landauer et al. 2007) that represent the relatedness among words, phrases, and prose provide the "learning leverage" through which words are understood. From this view, both the traditional and cognitive science research literatures are consistent in that while vocabulary words can be taught directly, the majority of vocabulary must be gained in a fashion that is inferential. Although some indirect vocabulary acquisition can be explained through reading, the rate of vocabulary acquisition exhibited by children requires a process that involves the induction of the meaning of new words (since direct teaching and incidental learning from reading contexts are inadequate to explain vocabulary growth).

Method

Participants

The study was implemented over an 18 week period on a school-wide basis in grades 3-4-5 in a large (185,000 students), highly diverse (African American: 29%, Hispanic: 19%, Other: 5%, Free Lunch: 40%) school system in southeastern Florida. Using a random selection process with constraints for demographic similarity, three of six schools were assigned the intervention and the other three demographically similar schools served as controls.

Instrumentation

Outcome measures consisted of the ITBS Vocabulary and ITBS Reading Comprehension Subtests. These tests were administered by classroom teachers with supervision from the researchers during 2-week periods prior to the beginning of the intervention and after the intervention ended.

The project intervention model also provided teachers with curriculum-based, pre-post lesson tests specific to each story taught. These tests consisted of two components: (a) a word recognition test in which students indicated whether or not they believed they know the meaning of a given word and (b) a sentence writing task in which students used a given word in a sentence. All of the words used in the tests were randomly sampled from the semantic word families associated with key words in specific stories and were not used in instruction. While there was a partial overlap of words used on the pre and post-tests, one-half of the words appearing on the post-test did not appear on the pre-test.

Experimental Intervention

Pre-planning identified 4-word semantic word families for each of 3 key vocabulary words in each of 10 regular basal reading stories for use by teachers at each grade level. In Part 1 of the multi-part intervention in each story, teachers pre-taught 3 key vocabulary words in a textbook-specified fashion. Then, as a student reading the story reached a key word, teachers queried students regarding the word meaning in context (e.g., *What does the word ____ mean in this sentence? How does this word contribute to the overall meaning of this sentence*?).

In Part 2, the same procedure was followed but with pairs of new target words similar in meaning to each of

the pre-taught key words that were pre-taught and then substituted in 3-sentence blocks from the story that contained the original key words. In Part 2, the teacher query was enhanced with an additional question: *How does the use of this new word change the meaning of the sentence or story?*

In Part 3, two new target words for each key word were not pre-taught. Rather, they were substituted in the same 3-sentence blocks in Part 2 and, again, students were queried regarding their meaning in context (an inductive process) by adding an additional question to the Part 2 query: *How did the meaning of the three sentences from the story suggest what the meaning of the new word should be?* Finally, in Part 4, as an expansion task, students presented sentences orally about their own experience using a key or target words.

For use by teachers, story-specific guidelines for each story were computer-generated in an easy-to-follow format in which the words, word definitions, relevant story sentences, and specific questions were inserted for each part of the intervention.

Design, Analysis, and Procedure

The instructional intervention was implemented on a school-wide basis in grades 3-4-5 over the school year, with the ITBS Vocabulary and Reading subtests administered during a two-week period prior to the beginning and end of the 18-week study. Both Experimental and control teachers used the same district-adopted basal reading series and followed the district curriculum plan in selecting stories for instruction. Experimental teachers were asked to commit to teaching 8 stories during the 18-weeks of the school year in which the inductive vocabulary model would be applied. The study design followed the framework appropriate for a 2-Level HLM analysis, with separate HLM analyses conducted for ITBS Vocabulary and ITBS Reading. For the HLM analyses, Level 1 student data consisted of student ITBS Vocabulary or Reading achievement outcomes, with minority (vs. non-minority) status, participation in free/reduced lunch (vs. non-eligible), grade, and the appropriate ITBS Reading or Vocabulary Subtests serving as a covariate. Level 2 classroom/teacher data (with students nested within teachers) consisted of a dummy variable representing treatment (1 = treatment, 0 = control) and grade.

Teacher Professional Development and Implementation Support

Teacher professional development consisted of 2 days prior the start of the study with two days of "follow-up" during the initial 9 weeks of the intervention. In addition, researcher provided informal support as necessary.

Monitoring of Intervention Fidelity

Researchers informally monitored all participating classrooms on a regular/continuing basis through direct observation and through inspection of teaching plans.

Results

Implementation Fidelity

The intervention involved 22 teachers across grades 3-4-5 and, because some teachers taught multiple sections, a total of 39 classrooms. The average number of stories taught using the vocabulary intervention were 7.0, 6.4, and 6.2 for grades 3, 4, and 5, respectively. Observation of classroom implementation by researchers averaging 3.4 visits per teacher found the intervention easy to implement by teachers and the project-developed story-specific vocabulary guides to be effective. Mean ratings of fidelity of implementation ranged from 82 to 92 expressed on a 100 point scale, in which a rating of 80 percent or more indicated consistent model implementation. Based on the observations in conjunction with teacher planning effectiveness, the model was judged to be implemented with fidelity. Average inter-rater reliability (agreement) on the researcher-developed classroom fidelity observation form ranged from .88 to .95.

Pre-Post Story-Based Test Findings

Figure 1 shows the pre-post lesson achievement gains across the experimental classrooms in terms of mean percent of items correct across students and stories. As Figure 1 shows, students exhibited consistent pre-post achievement growth on the curriculum-based lesson tests.

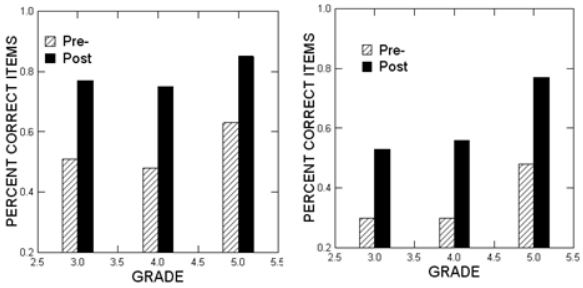

Figure 1. Mean pre- and post-test scores for Word Meaning and Sentence Writing on the story lessons in grades 3, 4, and 5.

ITBS Achievement Findings

One of the three control schools was eliminated from the analysis because of problems with the data resulting from the scanning of their Fall, 2011, prior ITBS response sheets. The results presented here are for the three

experimental and two control schools. Because preliminary HLM analyses found no interactions of treatment with minority status, or free/reduced lunch participation, these interaction components were removed from the final HLM models reported.

The HLM Model analyses with ITBS Vocabulary as the achievement outcome measure found a significant cross-level interaction between Treatment and Grade, $t(1348) = 1.99$, $p < .04$), along with each of the three covariates in the model (White-Asian-Mixed vs. Black-Hispanic-Indian, Free/Reduced Lunch vs. None, Prior-ITBS Achievement). The Treatment main effect was not significant. However, because of the significant interaction, the General Linear Hypothesis option in HLM was used to test the combined effect of Treatment and the Treatment x Grade interaction model components as a means of interpreting the overall effect of the intervention. The result of this follow-up analysis was significant, *Chi-Square* ($2df$) = 11.43, $p < .0003$ and confirmed the overall impact of the intervention on student ITBS Vocabulary achievement.

A parallel HLM analysis with ITBS Reading as the achievement outcome measure found both the Treatment main effect, $t(66) = -2.95$, $p < .01$, and the cross level-level interaction between Treatment and Grade, $t(1431) = 2.99$, $p<.003$, significant, along with two of the three covariates (Free/Reduced Lunch vs. None, Prior-ITBS Achievement). The covariate White-Asian-Mixed vs. Black-Hispanic-Indian was not significant. As in thepreceding analysis, because of the significant interaction, the General Linear Hypothesis option in HLM was used to test the combined effect of Treatment and the Treatment x Grade interaction model components as a means of interpreting the overall effect of the intervention. The result of this follow-up analysis was significant, *Chi-Square* ($2df$) = 11.90, $p < .003$, confirming the impact of the Vocabulary Intervention on student ITBS Reading achievement.

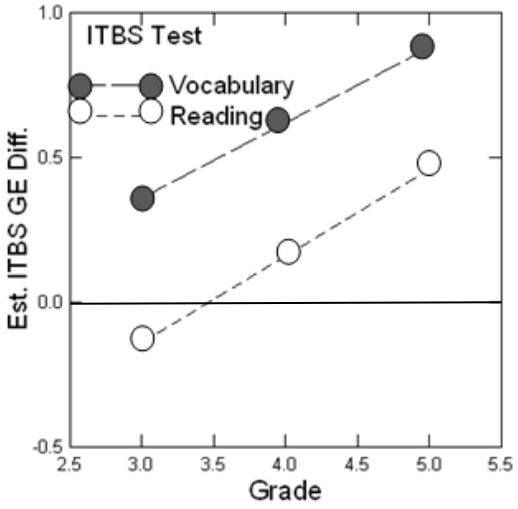

Figure 2. Differences in Estimated ITBS GE achievement between adjusted means of Experimental and Control students by grade. Differences greater than zero show higher achievement for Experimental students. For Reading, Control students outperformed Experimental students in grade 3; however the achievement difference in favor of Experimental students accelerated in grades 4 and 5.

In order to further interpret the combined Treatment main effect at Level 2 and the cross-level Treatment x Grade interaction, estimates were computed from the HLM models for ITBS Vocabulary and ITBS Reading of the differences between adjusted means for the Experimental and Control students by grade level for each ITBS achievement outcome. As shown in Figure 2, the intervention resulted in a magnified effect of the favor of Experimental students as grade level increased.

Discussion and Conclusions

In conducting studies on vocabulary acquisition, earlier (Romance & Vitale, 2012; Vitale & Romance, 2008) investigations of the inductive vocabulary model along with research cited in the literature (e.g., Kintsch, 2012; Landauer, & Dumais, 1996, 1997; Landauer et al., 1998, 2007) were suggestive that development and inductive use of general semantic (i.e., conceptual) meaning should be considered as an important focus of vocabulary learning rather than simply building understanding of specific words in a literal fashion. This perspective is supported by findings from earlier work (Vitale & Romance, 2008) which explicitly demonstrated the impact of the model on the inferential performance of students on tasks based on the semantic word families used and by the fact that the impact of the model on the ITBS Vocabulary test served as an achievement transfer measure.

From an applied research perspective, the present study replicated and extended the preceding studies (Romance and Vitale, 2012; Vitale and Romance, 2008) in terms of instructional time (duration of intervention) and increased use of the intervention across grade levels (grades 3-5). Demonstrating the effect of the intervention on reading as well as on vocabulary was an important finding of the present study because engaging students in the inductive vocabulary intervention implicitly required them to focus attention on comprehension of each story. This "side-effect" of the model serves as a potential explanation of the effect of the vocabulary intervention on reading achievement.

One important goal of future studies would be to

explore the cumulative effect of the present intervention on both the vocabulary development and reading proficiency of low-SES students when implemented on a multi-year basis. For practitioners, the present study is suggestive of how student vocabulary acquisition and reading proficiency can be accelerated through the enhancement of their regular reading programs. Considered together, the present findings are consistent with traditional and cognitive science research in that while recognizing vocabulary words can be taught directly, it is feasible for schools to accelerate student vocabulary growth in an inductive fashion that also improves student reading comprehension.

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