

Abstract Title Page

Title: Accelerating Vocabulary Development and Reading Comprehension
in Grades 3-4-5 through an Inductive Vocabulary Model

Authors and Affiliations:

Michael R. Vitale, East Carolina University

Nancy R. Romance, Florida Atlantic University

Abstract Body.

Background / Context:

A variety of research has pointed to the interdependent linkage among vocabulary knowledge, reading comprehension, and level of literacy (e.g., Baker, Simmons, & Kameenui, 1998; Becker, 1977; Biemiller & Slonim, 2001; Snow, 2002; Wager, 2005). 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 expand 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 in a manner that enhanced 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 in this study 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.

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.

In addressing 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 underlying semantic dimensions as identified by Latent Semantic Analysis (see Landauer et al. 2007) represent the relatedness among words, phrases, and prose that 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

Purpose / Objective / Research Question / Focus of Study:

The specific research questions in this study 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 vocabulary intervention result in a transfer effect to student reading comprehension as measured by the nationally-normed ITBS Reading subtest?

Setting:

The study was implemented in a large (185,000 students), highly diverse (African American: 29%, Hispanic: 19%, Other: 5%, Free Lunch: 40%) school system in southeastern Florida

Population / Participants / Subjects:

The grade 3-4-5 student participants were all enrolled in schools whose demographics closely matched that of the district.

Intervention / Program / Practice:

Pre-planning identified 4-word semantic word families for each of 3 key vocabulary words in each of 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.

Research Design:

The instructional intervention was implemented on a school-wide basis in grades 3-4-5 during an 18 week period in the school year. ITBS Vocabulary and Reading subtests were administered in Experimental and Control classrooms during a two-week period prior to the beginning and after the end of the 18-week intervention. 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 specified 18-weeks in which the inductive vocabulary model was to be applied. with two days of “follow-up” during the initial 9 weeks of the intervention. In addition, researcher provided informal support as necessary. Researchers informally monitored all participating classrooms on a regular/continuing basis through direct observation and through inspection of teaching plans.

Data Collection and Analysis:

ITBS pre-post tests were administered by classroom teachers under the supervision of researchers. Story pre-post tests were scored by researchers. Researchers obtained fidelity data directly through classroom observations. 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 each 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. Analyses were conducted using HLM 7.

Findings / 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. As Table 1 shows, 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 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 data, 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.

--- Insert Table 1 Here ---

Pre-Post Story-Based Test Findings. Table 2 and Figure 1 show 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.

--- Insert Table 2, Figure 1 Here ---

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 (pre-test) 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.

Table 3 shows the HLM Model analysis 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, and Grade. 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.

--- Insert Table 3 Here ---

A parallel HLM analysis shown in Table 4 with ITBS Reading as the achievement outcome 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), and Grade. The covariate White-Asian-Mixed vs. Black-Hispanic-Indian was not significant. As in the preceding 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.

- - - Insert Table 4 Here - - -

In order to further interpret the combined Treatment and cross-level Treatment x Grade interactions, 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.

- - - Insert Figure 2 Here - - -

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 effect 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 Reading test served as an achievement transfer measure.

From an applied 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.

Appendices

Appendix A. References

- American Federation of Teachers (AFT). (1997). *Making standards matter 1997. An annual fifty state report on efforts to raise academic standards*. Washington, DC: AFT.
- Anderson, R. C. & Nagy, W. (1992). The vocabulary conundrum. *American Educator*, 16, 14-18, 44-47.
- Anglin, J. M. (1993). Vocabulary development: A morphological analysis. *Monographs for the Society of Research in Child Development*, Serial No. 238, Vol. 58, No. 10.
- August, D., C., M., Dressler, C., & Snow, C. (2005). The critical role of vocabulary development for English language learners. *The Division for Learning Disabilities of the Council for Exceptional Children*, 20(1), 50-57.
- Baker, S. K., Simmons, D. C., & Kameenui, E. J. (1998). Vocabulary acquisition: Research bases. In D. C. Simmons and E. J. Kameenui (Eds.), *What reading research tells us about children with diverse learning needs*. Mahwah, NJ: Erlbaum.
- Beck, I., & McKeown, M. (1991). Conditions of vocabulary acquisition. In R. Barr, M. Kamil, P. Mosenthal, & P. D. Pearson (Eds.), *Handbook of reading research* (Vol. 2, pp. 789-814). New York: Longman.
- Becker, W. C. (1977). Teaching reading and language to the disadvantaged - What we have learned from field research. *Harvard Educational Review*, 47, 518-543.
- Biemiller, A., & Boote, C. (2006). An effective model for building meaning vocabulary in primary grades. *Journal of Educational Psychology*, 98(1), 44-62.
- Biemiller, A., & Slonim, N. (2001). Estimating root word vocabulary growth in normative and advantaged populations: Evidence for a common sequence of vocabulary acquisition. *Journal of Educational Psychology*, 93 (3), 498-520.
- Blachowicz, C., & Fisher, P. (2000). Vocabulary instruction. In M. L. Kamil, P. B. Mosenthal, P. D. Pearson, & R. Barr (Eds.). *Handbook of reading research*. (Vol. 3 pp. 503-523). Mahwah, NJ: Erlbaum.
- Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (2000). *How people learn*. Washington, DC: National Academy Press.
- Carver, R. (1994). Percentage of unknown vocabulary words in text as a function of the relative difficulty of the text: Implications for instruction. *Journal of Reading Behavior*, 26(4), 413-437.
- Coyne, M. D., McCoach, D. B., & Kapp, S. (2005). *Teaching vocabulary to kindergarten students during shared storybook readings: A comparison of rich instruction, basic instruction, and incidental exposure*. Paper presented to the USDOE Institute of Educational Sciences Reading Comprehension Principal Investigator Group Meeting, Washington, DC.
- Feldman, S. (2000). Standards are working: But states and districts need to make some mid-course corrections. *American Educator*, 24(3), 5-7.
- Johnson, G., Gersten, R., & Carnine, D. (1988). Effects of instructional design variables on vocabulary acquisition of learning disabilities students: A study of computer-assisted instruction. *Journal of Learning Disabilities*, 20 (4), 206-213.
- Kintsch, W. (1994). Text comprehension, memory, and learning. *American Psychologist*, 49(4), 294-303.
- Kintsch, W. (1998a). *Comprehension: a paradigm for cognition*. Cambridge, United Kingdom: Cambridge University Press.
- Kintsch, W. (1998b). The role of knowledge in discourse comprehension: a construction-integration model. *Psychological Review*, 95(2), 163-182.
- Kintsch, W. (2002). On the notions of theme and topic in psychological process models of text comprehension. In M. Louwerse & W. van Peer (Eds.) *Thematics: Interdisciplinary*

- Studies*, 157-170.
- Kintsch, W. (2004) The Construction-Integration model of text comprehension and its implications for instruction. In R. Ruddell & N. Unrau (Eds.) *Theoretical Models and Processes of Reading*. 5th Edition, International Reading Association.
- Kintsch, W. (2005). An overview of top-down and bottom-up effects in comprehension: The CI Perspective. *Discourse Processes*, 39 (2&3), 125-128.
- Kintsch, W. (2012). What kinds of language statistics must be in long-term memory to make language understanding possible. In M. A. Britt, S. R. Goldman, & J. Rouet (Eds.). *Reading- From words to multiple texts* (pp. 92-100). NY: Routledge.
- Landauer, T. K., (2002). On the computational basis of learning and cognition: Arguments form LSA. *Psychology of Learning and Motivation*, 41, 43-84.
- Landauer, T. K., & Dumais, S. T. (1996). How come you know so much? From practical problem to new memory theory. In D. Herrmann, C. McEnvoy, C. Hertzog, & M. Johnson (Eds.) *Basic and Applied Memory Research Theory in Context*. 1(7), 105-126.
- Landauer, T. K., & Dumais, S. T. (1997). A solution to Plato's problem: The latent semantic analysis theory of acquisition, induction, and representation of knowledge. *Psychological Review*, 104 (2), 211-240.
- Landauer, T. K., Foltz, P. W., & Laham, D. (1998). An introduction to latent semantic analysis. *Discourse Processes*, 25, 259-284.
- Landauer, T. K., McNamara, D. S., Dennis, S., & Kintsch, W. (2007). *Handbook of latent semantic analysis*. Psychology Press.
- Nagy, W., & Scott, J. A. (2000). Vocabulary Processes. *Handbook of Reading Research*, 3(18), 269-284.
- Romance, N. R. & Vitale, M. R. (2012). *Effects of inductive vocabulary development in grades 3-4-5 on achievement in vocabulary and reading comprehension*. Presented at the Annual Meeting of the American Educational Research Association, Vancouver, Canada.
- Snow, C. E. (2002). *Reading for understanding. Toward an R&D program in reading comprehension*. Santa Monica, CA: RAND.
- Vitale, M. R., & Romance, N. R. (2007). A knowledge-based framework for unifying content-area reading comprehension and reading comprehension strategies. In D. McNamara (Ed.). *Reading Comprehension Strategies: Theory, Interventions, and Technologies*. NJ: Erlbaum.
- Vitale, M. R., & Romance, N. R. (2008). *A multi-part instructional strategy for accelerating vocabulary acquisition as an inductive process*. Paper presented at the Annual Meeting of the American Educational Research Association, New York.
- Wager, R. (2005). *Causal relations between the development of vocabulary and reading comprehension*. Paper presented at the Annual Meeting of the American Educational Research Association, Montreal, Canada.

Appendix B. Tables and Figures

Table 1. Mean Stories Taught and Mean Fidelity Scores

Grade	N Tch.	N. Stories	Fidelity ^a
3	9	7.0	91
4	7	6.4	82
5	6	6.2	92

^a Expressed on a 0-100 scale, 3.4 visits/tch.

Table 2. Mean Percent Correct on Story-Based Pre- and Post-Tests by Grade

Grade	Word Meaning			Sentence Writing		
	Pre-Test	Post-Test	Pre-Post Dif.	Pre-Test	Post-Test	Pre-Post Dif.
3	51	77	26	30	53	24
4	48	75	27	30	56	26
5	63	85	22	48	77	30

Table 3.
HLM Analysis of the 2-Level Model for ITBS Vocabulary

Fixed Effect			Coef.	Stand. Error	Approx. T-ratio	d.f.	P-value
For	INTRCPT1, B0						
	INTRCPT2, G00		0.115	0.457	0.25	65	0.801
	TRT_E1_C0, G01		-4.223	0.552	-0.76	65	0.446
For	GRADE slope, B1						
	INTRCPT2, G10		0.547	0.112	4.88	1348	0.000
	ITRT_E1_C0, G11		0.261	0.113	1.99	1348	0.046
For	PRE_VGE slope, B2						
	INTRCPT2, G20		0.592	0.035	16.94	1348	0.000
For	WMA1_BHI0 slope, B3						
	INTRCPT2, G30		0.397	0.107	3.73	1348	0.000
For	FRL0_NO1 slope, B4						
	INTRCPT2, G40		0.424	0.121	3.51	1348	0.001

Note- TRT_E1_C0= TREATMENT (1,0), PRE_VGE= PRE-ITBS GRADE EQUIVALENT, WMA1_BHI0= WHITE-MIXED-ASIAN VS BLACK-HISPANIC-INDIAN (1,0), FRL0_NO1= FREE LUNCH (0), NOT ONFREE LUNCH (0)

Table 4.
HLM Analysis of the 2-Level Model for ITBS Reading

Fixed Effect			Coef.	Stand. Error	Approx. T-ratio	d.f.	P-value
For	INTRCPT1, B0						
	INTRCPT2, G00		1.571	0.337	4.62	66	0.000
	TRT_E1_C0, G01		-1.014	0.406	-2.49	66	0.015
For	GRADE slope, B1						
	INTRCPT2, G10		0.037	0.087	0.42	1431	0.674
	ITRT_E1_C0, G11		0.304	0.102	2.99	1431	0.003
For	PRE_VGE slope, B2						
	INTRCPT2, G20		0.706	0.024	28.85	1431	0.000
For	WMA1_BHI0 slope, B3						
	INTRCPT2, G30		0.164	0.093	1.77	1431	0.077
For	FRL0_NO1 slope, B4						
	INTRCPT2, G40		0.433	0.108	4.03	1431	0.001

Note- TRT_E1_C0= TREATMENT (1,0), PRE_VGE= PRE-ITBS GRADE EQUIVALENT, WMA1_BHI0= WHITE-MIXED-ASIAN VS BLACK-HISPANIC-INDIAN (1,0), FRL0_NO1= FREE LUNCH (0), NOT ONFREE LUNCH (0)

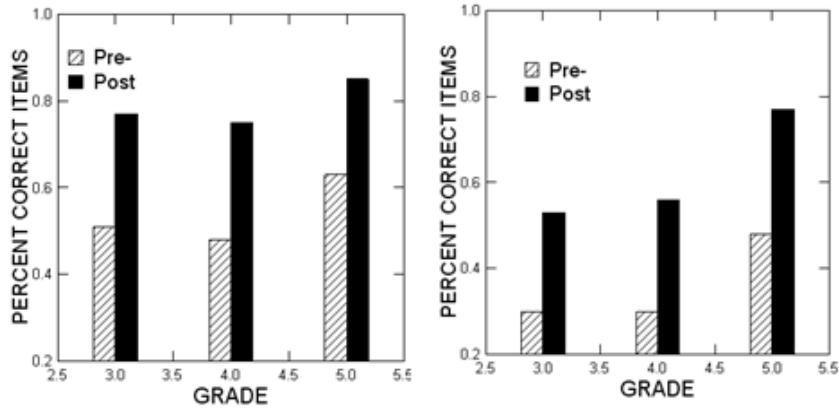


Figure 1. Mean pre- and post-test scores for Word Meaning and Sentence Writing on the story lessons in grades 3, 4, and 5.

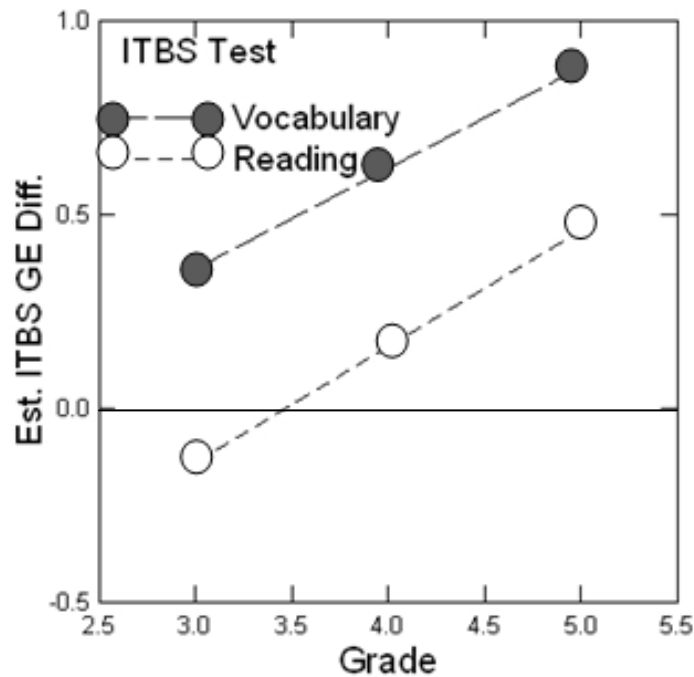


Figure 2. Differences in Estimated ITBS GE achievement between adjusted means of Experimental and Control students by grade. Differences greater than zero show higher achievement for Experimental students. For Reading, Control students outperformed Experimental students in grade 3; however the achievement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