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Understanding the Role of Academic Vocabulary in Content Acquisition for Middle School Students With and Without Disabilities

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Abstract

Vocabulary is a prominent contributor to reading comprehension. However, little is known about how students with disabilities with lower vocabulary performance respond to Tier 1 instruction, or how their vocabulary knowledge relates to their content acquisition. To examine the differential impact of Tier 1 instruction for U.S. middle school students with disabilities and to investigate the relations among academic vocabulary, content knowledge, and reading comprehension, this study analyzed data collected in previous randomized controlled trials. Findings suggest that evidence-based Tier 1 instruction targeting academic vocabulary can help eighth graders with disabilities grow as much as students without disabilities on academic vocabulary and content reading comprehension. In addition to students' baseline performance, learning gains in academic vocabulary significantly predicted the growth of content acquisition among students with disabilities.

Keywords

students with disabilities, academic vocabulary, content knowledge, reading comprehension, social studies

Reading comprehension is critical for not only school success but also lifelong learning. Better understanding the reading comprehension needs of students with reading difficulties will improve the design of interventions. Several reading models have recognized vocabulary as a critical component of reading comprehension (Ahmed et al., 2016; Cromley & Azevedo, 2007; Cromley et al., 2010; Perfetti & Stafura, 2014).

Within the reading systems framework, Perfetti and Stafura (2014) noted that vocabulary is the "pressure point" of reading comprehension because of its dual roles. As children learn to read new word forms, they simultaneously learn word meanings. In this way, vocabulary serves as the output of word reading during the reading process. At the same time, vocabulary serves as an input because understanding word meanings and word-to-text integration is fundamental to text comprehension. In fact, the reading systems framework postulates that vocabulary directly affects reading comprehension based on the across-language evidence that the relation between vocabulary and reading comprehension was greater than the relation between listening comprehension and reading comprehension (e.g., Braze et al., 2007). With broader and deeper vocabulary knowledge, a reader is more likely to better comprehend a text.

Another model that illustrates the effects of vocabulary on reading comprehension among older students is the direct and inferential mediation model (DIME; Cromley & Azevedo, 2007). To discover which components make the largest contributions to comprehension, Cromley and Azevedo (2007) conducted an extensive literature review to inform DIME and then tested its validity among ninth-grade students. Among vocabulary, background knowledge, inference, and reading strategies, vocabulary was the greatest contributor to reading comprehension. With every 1 *SD* increase in vocabulary, a 0.41 *SD* increase in reading comprehension could be expected for a high school student. Similar findings were observed across larger, diverse samples (Ahmed et al., 2016; Cromley et al., 2010). Ahmed et al. (2016) investigated the DIME model among middle and high school students, reporting that vocabulary had the largest total effect on reading comprehension for seventh

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and eighth graders. Although the effect of inference making increased and became the greatest contributor for 9th to 12th graders, vocabulary still had significant effect on reading comprehension and also the largest effect on inference making. In addition, vocabulary is theorized as part of a larger knowledge structure, and studies have indicated that vocabulary is important to content knowledge gains (Nagy, 2005). This theory is supported by a strong correlation between vocabulary and knowledge (Ahmed et al., 2016; Cromley & Azevedo, 2007), suggesting that when readers have more established vocabulary knowledge, they are more likely to have better content knowledge, to make better inferences, and to construct better situational representations as they read text.

Increasingly over the past 10 years, multicomponent interventions that leverage middle school content area instruction have included a vocabulary component (e.g., Lawrence et al., 2014; Lesaux et al., 2010; Vaughn et al., 2013, 2015). One such intervention is Promoting Adolescents' Comprehension of Text (PACT; Vaughn et al., 2013, 2015). PACT is implemented in middle school social studies classes and includes instructional practices that target academic vocabulary, content reading comprehension, and content knowledge. Results from previous randomized controlled trials (Vaughn et al., 2013, 2015) indicate that students who received the PACT instruction outperformed students in the business-as-usual (BAU) condition at statistically significant levels on measures of content knowledge (ES from 0.17 to 0.40) and reading comprehension (ES from 0.20 to 0.29). In two related quasi-experimental studies, students with disabilities (SWD) who received the PACT intervention outperformed SWD assigned to the BAU comparison condition on measures of content knowledge (ES from 0.26 to 0.51) and reading comprehension (ES from 0.04 to 0.34; Swanson et al., 2015; Wanzek et al., 2016). Findings across randomized controlled trials and quasi-experimental trials indicate that middle school students with and without disabilities benefit from content area reading instruction that focuses on academic vocabulary, content knowledge, and reading comprehension.

These findings are important for several reasons. First, findings across examinations of the reading systems framework and DIME suggest robust relations between vocabulary, general knowledge, and reading comprehension. Longitudinal data also indicates that language comprehension skills contribute more to reading comprehension than word-level skills for adolescent readers (Catts et al., 2005). The reciprocal relation between vocabulary and reading comprehension indicates that with expanded vocabulary, students are better able to comprehend what they read and thus are more likely to read increasing their text exposure (Stahl & Nagy, 2006; Stanovich & Cunningham, 1993). Conversely, students who read text gain vocabulary knowledge. However, middle school SWD often struggle with reading and vocabulary (Cromley & Azevedo, 2007; Hock et al., 2009; Lesaux & Kieffer, 2010). For example, Hock et al. (2009) found that 82% of eighth- and ninth-grade struggling readers had significant vocabulary deficits, and Lesaux and Kieffer (2010) reported that 100% of sixth-grade students with reading difficulties demonstrated low vocabulary skills. Because high-quality instruction that leverages both text reading and vocabulary may be particularly beneficial for SWD, we should examine how SWD respond to this kind of instruction.

Second, vocabulary demands increase significantly after fourth grade (Nagy & Townsend, 2012). A complex array of content-specific and academic vocabulary may pose a unique challenge to learners as they move into middle school. Middle school students should also be able to use textual clues to determine the meanings of content vocabulary. Increased expectations for student learning through text reading is one reason why content area reading is challenging for adolescent readers—particularly those who struggle with reading. As a result, the effectiveness of content area instruction has drawn attention in the research field.

Third, the content acquisition of middle school SWD cannot be detached from the context of general education classrooms. Service delivery model based on student response to intervention (RTI) have been widely considered as advantageous for preventing and remediating academic difficulties within the school framework (Fletcher & Vaughn, 2009). Previous studies suggest that SWD can benefit from resource-intensive vocabulary interventions (e.g., Bos & Anders, 1990). However, although SWD often attend special education classes for some part of the school day, they are usually included in general education social studies classes (Swanson et al., 2015). In addition, embedding reading instruction throughout the content areas and beyond the primary grades is imperative because all students progress as readers and learners through schooling. In this way, content area teachers providing Tier 1 evidence-based instruction would benefit the content acquisition and reading comprehension of SWD and all other secondary students (Foorman & Wanzek, 2016).

Based on the relation between vocabulary, knowledge, and reading comprehension among students without disabilities (SWOD; e.g., Ahmed et al., 2016), it is reasonable to investigate how vocabulary relates to content knowledge and reading comprehension among adolescent SWD. Research evidence indicates that PACT—an intervention focused on these components—is beneficial for SWD (Swanson et al., 2015; Wanzek et al., 2016) and SWOD (Vaughn et al., 2013, 2015). However, few studies to date have examined the differential intervention effects between SWD and SWOD and the relation between the disability status, response to Tier 1 instruction on critical components, and content acquisition.

Table 1. Descriptive Information for Grade 8 Student Participants in Promoting Adolescents' Comprehension of Text (PACT)

	Students with disabilities		Students without disabilities	
Variable	*n*	%	*n*	%
Gender				
Male	339	47.3	32	54.2
Female	349	48.7	27	45.8
Missing	28	3.9	0	0.0
Ethnicity				
White	367	51.3	31	52.5
African American	120	16.8	22	37.3
Hispanic	44	6.1	1	1.7
American Indian	3	0.4	0	0.0
Pacific Islander	1	0.1	0	0.0
Asian	10	1.4	0	0.0
Two or more races	142	19.8	5	8.5
Missing	29	4.1	0	0.0
Free or reduced-price lunch				
Received	253	35.3	32	54.2
Not received	362	50.6	20	33.9
Missing	101	14.1	7	11.9

Therefore, the purpose of this study was to (a) examine the differential impact of Tier 1 PACT instruction for middle school SWD and SWOD and (b) investigate the relation between student status and the growth of academic vocabulary, content knowledge, and reading comprehension. Two research questions were addressed:

1. Do middle school SWD respond differently to PACT compared to SWOD on measures of academic vocabulary, content knowledge, and reading comprehension?
2. What is the relation between student status and the growth of academic vocabulary, content knowledge, and reading comprehension among middle school students?

Method

The present study represents a secondary analysis of data collected in previous studies (Vaughn et al., 2013, 2015). Using a correlational research design, analysis focused on examining the differential impact of PACT among SWD and SWOD and exploring the relation between academic vocabulary, content knowledge, and reading comprehension in social studies among the two groups of U.S. students.

The PACT Instruction

PACT includes three 10-day units that align with district and state standards, yielding 30 sessions in total. Students received 50- to 55-min teaching per day or 90 min of teaching every other day for 6 to 10 weeks.

PACT includes five instructional components. Each component emphasizes (a) building background knowledge and offering a motivating and overarching guide for learning, (b) introducing and reviewing a set of high-utility academic vocabulary that addresses overarching ideas related to the content, (c) engaging students to acquire content knowledge through critical text reading, and (d) engaging students through team-based learning to construct knowledge and apply learned content in activities. Fidelity observations that included implementation adherence, delivery quality, and program differentiation between the PACT and BAU conditions were reported in previous studies (Vaughn et al., 2013, 2015).

Participants

Eighth-grade students participated in PACT during 2012 to 2013. The original study received institutional review board approval, and parents provided consent for all students who participated. Students also assented to their own participation. A total of 818 students participated in the PACT program. However, because the present study focuses on SWD and acquiring a second language may present unique relations between vocabulary and reading comprehension in English, 43 students who participated in limited English proficiency program were excluded from data analysis of the current study, yielding the total sample of 775 students.

Demographic information is presented in Table 1 for SWD and SWOD. Among 775 students, 59 (7.6%) were identified as SWD and 716 were SWOD. Of the 59 SWD, 54.2% were male and 45.8% were female. Of the 716 SWOD, 47.3% were male and 48.7% were female. A greater

proportion of SWD (54.2%) than SWOD (35.3%) received free or reduced-price lunch. Roughly half of SWD (52.5%) and SWOD (51.3%) were White. African American students were more prevalent in SWD (37.3%) than SWOD (16.8%). Hispanic students were less prevalent in SWD (1.7%) than in SWOD (6.1%). Among 147 multiple-race students, 111 students reported themselves as Hispanic with other races (14.3%). Multiple-race students were less prevalent in SWD (8.5%) than in SWOD (19.8%).

Measures

Students were administered the Assessment of Social Studies Knowledge (ASK; Vaughn et al., 2013), before the intervention and again within 2 weeks after the intervention. The ASK assessment is a researcher-developed measure that includes two subtests, the ASK multiple-choice subtest and the ASK reading comprehension subtest.

ASK multiple-choice subtest. The ASK multiple-choice subtest is a 42-item, four-option, untimed multiple-choice test that measures academic vocabulary and content knowledge. The alpha coefficient was .89 in a larger sample of students (Vaughn et al., 2013). To examine the relation between academic vocabulary and content knowledge, we retrieved 14 items from the multiple-choice subtest to form the academic vocabulary component, and the remaining 28 items formed the content knowledge component. For the academic vocabulary measure, each item consisted of a target academic word that was taught during the lessons (e.g., "A colony can best be described as") and four choices for the best definition of the word. The content knowledge measure was developed to measure participants' content acquisition based on the main concepts of the lessons. For example, given four choices, participants needed to answer the reason why the economic activity in the New England colonies relied heavily on trade. The alpha coefficient was .65 for academic vocabulary and .78 for content knowledge.

ASK reading comprehension subtest. The ASK reading comprehension subtest is a 21-item, four-option, untimed multiple-choice test that measures reading comprehension. The assessment consists of three reading passages (Lexile range = 1,090–1,140; word count range = 312–349), each related to content covered in PACT. Students read each passage and answer seven multiple-choice questions about the passage. Reading comprehension items were researcher developed and measured students' ability to identify main ideas, understand vocabulary in context, identify cause and effect, and summarize. The alpha coefficient was .85 in a larger sample of students (Vaughn et al., 2013).

Data Analysis

We used SPSS 23.0 throughout the data analysis. First, descriptive statistics were calculated to determine means and standard deviations for the student assessment data. Second, a series of three-level hierarchical linear models (HLMs) were conducted to investigate the effects of time, student status, and class. Level 1 of the model represents the within-individual change trajectory: $Y_{tij} = \pi_{0ij} + \pi_{1ij} Time_{tij} + \varepsilon_{tij}$, in which the outcome (Y_{tij}) for each individual *i* in each class is predicted by a baseline score (π_{0ij}) plus the linear rate of change (π_{1ij}), plus individual error (ε_{tij}) that represents the extent to which an individual's predicted values on the trajectory differ from the observed scores. At Level 2, the between-individuals predictor (referring to SWD and SWOD status) was added, and at Level 3, the between-group predictor, class, was added to explain variation in individuals' intercepts and growth. The intraclass correlation coefficients at the classroom level were .40, .43, and .41 for academic vocabulary, content knowledge, and reading comprehension outcomes, respectively.

To further evaluate the relation among the disability status, and the growth of academic vocabulary, content knowledge, and reading comprehension, two sets of HLM controlling for class-level variations were conducted separately. The slopes of the outcome measures were considered as the growth after the PACT instruction and were calculated according to the fixed predicted value of previous three-level HLM. The first two models (Models 1A and 1B) predict students' content knowledge growth. The last three models (Models 2A, 2B, and 2C) predict students' reading comprehension growth. The first model in each set is the most basic: It predicts students' growth by controlling the baseline of academic vocabulary, content knowledge, and reading comprehension at the student and the class levels. The second model in each set further includes the slope of academic vocabulary to examine how the academic vocabulary growth during the instruction predicts content knowledge growth and reading comprehension. The last model (Model 2C) is conducted only to predict the reading comprehension growth by including the slope of academic vocabulary and content knowledge at the same time.

Results

Response to PACT Instruction of Disabled and non-Disabled Groups

Table 2 summarizes the descriptive statistics on academic vocabulary, content knowledge, and reading comprehension measures for SWD and SWOD. SWD started behind SWOD on all three measures. SWD and SWOD both performed better at all posttest after PACT instruction.

Table 2. Descriptive Statistics on All Outcome Measures.

	Students with disabilities			Students without disabilities		
Measure	*n*	*M*	*SD*	*n*	*M*	*SD*
Academic vocabulary						
Pretest	627	7.28	2.53	52	5.27	2.49
Posttest	646	10.32	2.94	51	7.71	3.46
Content knowledge						
Pretest	598	13.88	4.93	47	10.45	3.83
Posttest	624	17.84	5.90	50	12.92	5.45
Reading comprehension						
Pretest	681	11.33	4.31	52	7.40	3.08
Posttest	647	12.40	4.61	55	8.64	3.97

Table 3. Conditional Growth Model With Between-Individual (Level 2) Random Slope and Between-Group (Level 3) Predictors.

Parameter	Academic vocabulary ($n = 755$)	Content knowledge ($n = 746$)	Reading comprehension ($n = 767$)
Intercept, β_{00j}	5.700*** (0.369)	11.790*** (0.725)	8.611*** (0.612)
Time, β_{01j}	2.478*** (0.357)	2.284*** (0.602)	1.286** (0.457)
Status, β_{10j}	1.279*** (0.325)	1.414* (0.631)	2.335*** (0.533)
Status × Time, β_{11j}	0.592 (0.370)	1.823** (0.624)	−0.217 (0.474)
Variance components			
Level 1 Variance, ε_{tij}	2.045*** (0.235)	3.838*** (0.724)	4.321*** (0.489)
Level 2 Intercept, γ_{0ij}	3.352[a] (0.000)	13.129[a] (0.000)	9.967[a] (0.000)
Level 2 Slope, γ_{1ij}	1.983*** (0.416)	7.874*** (1.426)	1.808* (0.859)
Level 3 Intercept, u_{00j}	1.833*** (0.440)	7.418*** (1.790)	5.253*** (1.247)
Model fit			
−2 Log likelihood	6,225.546	7,526.957	7,617.437
Parameters estimated	9	9	9

Note. Standard errors are in parentheses. All *p* values in this table area two-tailed.
*$p < .05$. **$p < .01$. ***$p < .001$.
[a]The covariance parameter is redundant.

Table 3 presents the HLM conditional growth model, which established that the linear time effect varies randomly across individuals. The significant random effect suggested that the slope varies across individuals, especially on academic vocabulary and content knowledge. As we would expect, the significant effect of student status indicated that SWOD started considerably ahead of SWD on all measures. The significant effect of time indicated significant growth on three outcome measures after PACT instruction for both groups. Interaction between student status and time was observed only on the content knowledge outcome, not on the academic vocabulary and reading comprehension outcomes, suggesting that both groups of students made gains of similar magnitude on the academic vocabulary and reading comprehension outcomes. However, as shown in Figure 1, the gap on content knowledge between SWD and SWOD increased after the PACT instruction, indicating that the amount of content knowledge that SWD obtained was less than SWOD.

Relation Among Academic Vocabulary, Content Knowledge, and Reading Comprehension

As shown in Table 4, the results of Models 1A and 2A indicated that students' disability status had no effect on the growth of content knowledge and reading comprehension. SWOD and SWD grew similarly on content knowledge and reading comprehension when baseline reading skills were considered.

Model 1A indicated that on average, an eighth grader who joined PACT instruction would have an expected content knowledge growth score of 3.069. Model 1A also revealed that initial scores of academic vocabulary (.404, $p < .001$) and reading comprehension (.368, $p < .001$)

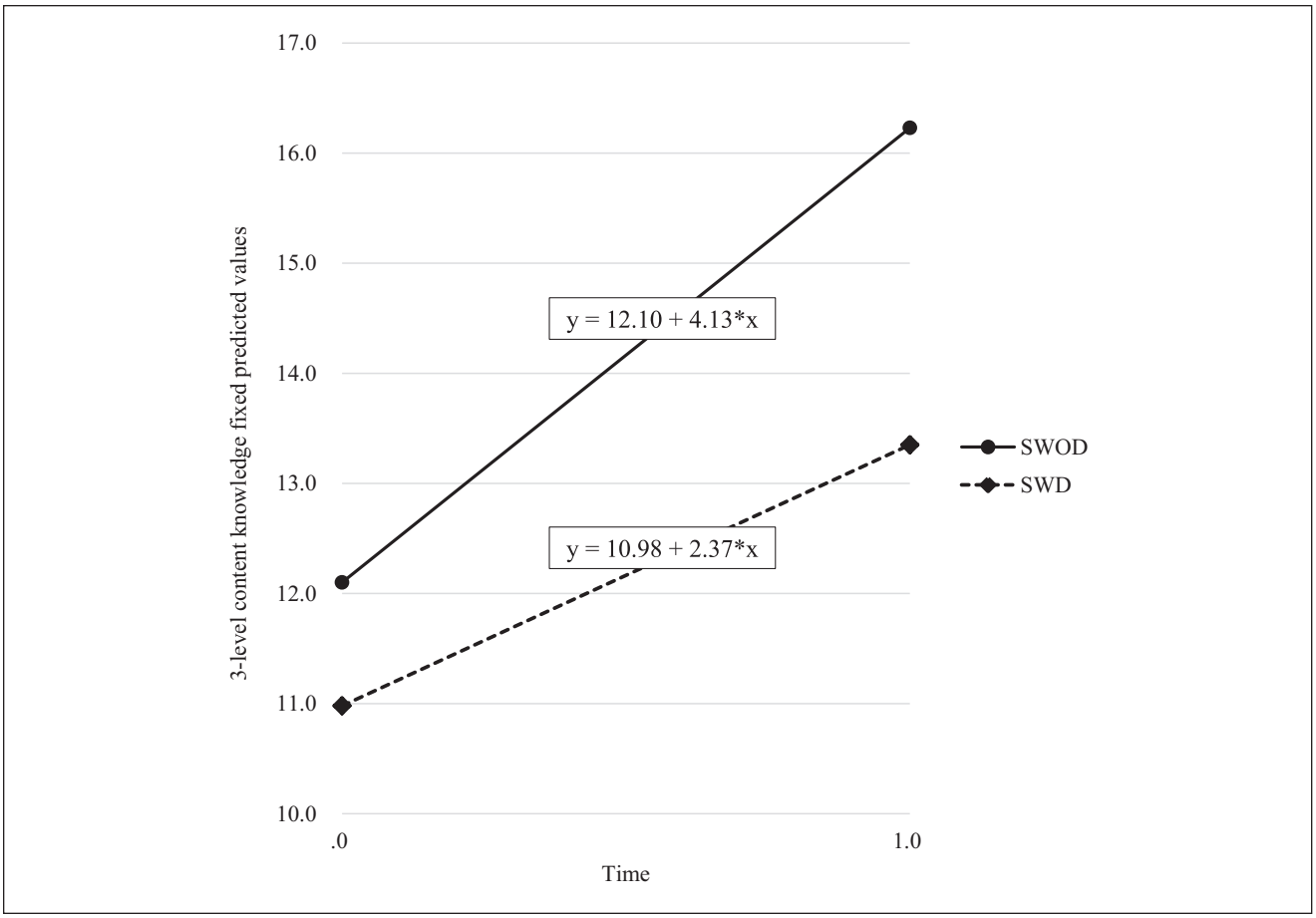

Figure 1. The interaction between student disability status and time on the content knowledge measure.
Note. The figure was made according to the fixed predicted values of the three-level hierarchical linear model (HLM) model. SWOD = students without disabilities; SWD = students with disabilities.

positively predicted the growth of content knowledge. However, with the academic vocabulary slope added in Model 1B, results revealed that the academic vocabulary slope significantly predicted the growth of content knowledge (.920, $p < .001$), and the variance of initial reading comprehension score decreased (.238, $p < .001$). In addition, the variance of academic vocabulary intercept inflated and remained significant in Model 1B (.974, $p < .001$).

The results of Model 2A revealed that on average, an eighth grader would have an expected reading comprehension growth score of 1.486 ($p < .01$) after the PACT instruction. The initial academic vocabulary score (.139, $p < .05$) and initial content knowledge score (.269, $p < .001$) positively predicted the growth of RC. With the academic vocabulary slope added in Model 2B, results revealed that the academic vocabulary slope significantly predicted the growth of content knowledge (.547, $p < .001$), and the variance of initial content knowledge score decreased (.164, $p < .001$). In addition, the variance of academic vocabulary intercept inflated and remained significant in Model 2B (.526, $p < .001$). Finally, with the academic vocabulary slope and content knowledge slope added in Model 2C, results revealed that although the variance of academic vocabulary slope decreased, it remained significantly predictive of the growth of reading comprehension (.313, $p < .001$) even after the pretests and the growth of content knowledge were controlled.

Discussion

Academic vocabulary, content knowledge, and reading comprehension are critical skills for success in middle school. Based on a search of the literature, to our knowledge, few studies to date have examined the response to Tier 1 content area instruction among adolescent SWD. Although previous quasi-experimental studies have reported that SWD who received PACT outperformed SWD who received BAU on content knowledge and reading comprehension outcomes (Swanson et al., 2015; Wanzek et al., 2016), few studies have examined how the academic vocabulary growth during

Table 4. Conditional Model With Between-Individual (Level 1) and Between-Group (Level 2) Predictors.

	CK growth		RC growth		
Parameter	Model 1A	Model 1B	Model 2A	Model 2B	Model 2C
Intercept	3.069*** (0.756)	−0.069 (0.627)	1.486** (0.561)	0.042 (0.575)	−0.181 (0.536)
Status	0.665 (0.625)	0.156 (0.547)	0.376 (0.492)	−0.112 (0.462)	−0.106 (0.449)
AV intercept	0.404*** (0.087)	0.974*** (0.085)	0.139* (0.069)	0.526*** (0.073)	0.283*** (0.079)
CK intercept	−0.492*** (0.049)	−0.625*** (0.044)	0.269*** (0.038)	0.164*** (0.037)	0.330*** (0.043)
RC intercept	0.368*** (0.054)	0.238*** (0.047)	−0.491*** (0.042)	−0.589*** (0.040)	−0.633*** (0.040)
AV slope		0.920*** (0.063)		0.547*** (0.053)	0.313*** (0.062)
CK slope					0.253*** (0.036)
Variance component					
Residual	11.853*** (0.787)	9.472*** (0.585)	2.804*** (0.499)	2.455*** (0.393)	6.239*** (0.402)
Level 1 Intercept	0.000[a] (0.000)	0.000[a] (0.000)	5.350[a] (0.000)	4.024 (0.000)	0.000[a] (0.000)
Level 2 Intercept	1.718* (0.705)	0.000[a] (0.000)	0.000[a] (0.000)	1.799 (0.173)	0.241 (0.173)
Class AV	0.000[a] (0.000)	0.000[a] (0.000)	0.000[a] (0.000)	0.001 (0.000)	0.000[a] (0.000)
Class CK	0.000[a] (0.000)	0.000[a] (0.000)	0.002 (0.002)	0.239 (0.000)	0.000[a] (0.000)
Class RC	0.000[a] (0.000)	0.000[a] (0.000)	0.001[a] (0.000)	0.010 (0.122)	0.000[a] (0.000)
Model fit					
−2 Log likelihood	2,871.157	2,713.202	2,861.902	2,647.999	2,513.840
Parameters estimated	11	12	11	12	13

Note. Standard errors are in parentheses. All *p* values in this table area two-tailed. CK = content knowledge; RC = reading comprehension; AV = academic vocabulary.

[a]The covariance parameter is redundant.

*$p < .05$. **$p < .01$. ***$p < .001$.

the content area reading instruction relate to content acquisition and reading comprehension among SWD. In a recent systematic review, Elleman et al. (2019) identified 17 experimental studies that explored the impact of vocabulary instruction on the vocabulary and reading comprehension development of middle school students, but only two of the studies included SWD (Bos & Anders, 1990; Lawrence et al., 2014).

In general, academic vocabulary, content knowledge, and reading comprehension scores for SWD at pretest and posttest were lower than those for SWOD in this study, aligning with previous studies (Cain & Oakhill, 2011; Lawrence et al., 2014). However, findings from this study indicate that although SWD had significantly lower reading-related baseline across all outcomes, the disability status did not predict differential benefits of the Tier 1 content area reading instruction on academic vocabulary and reading comprehension measures. Results suggesting that SWD and SWOD benefited similarly from PACT on academic vocabulary and reading comprehension outcomes is hopeful. Prior studies provide evidence that PACT is efficacious among SWD (Swanson et al., 2015; Wanzek et al., 2016). However, these studies compared outcomes among SWD who received PACT and SWD who received BAU instruction.

The current study extends prior work by examining differential effects among SWD and SWOD. Not only do SWD benefit from PACT, but they do so to the same extent as SWOD on measures of academic vocabulary and reading comprehension, replicating similar findings of Lawrence et al. (2014) that participating in their Tier 1 vocabulary program was just as effective for SWD as for SWOD on academic vocabulary outcome. In addition, the current study found that the average academic vocabulary growth in PACT instruction was twice as much as the prediction estimate of disability status, suggesting that the effect of participating in PACT on the vocabulary outcome was greater than students' disability status.

In addition, this finding highlights the importance of evidence-based instruction implementation in general education classes and also shows that evidence-based instruction can benefit all students (Foorman & Wanzek, 2016). However, the current study also noticed the difference between the effects on academic vocabulary and reading comprehension. The average reading comprehension growth in the instruction was half of the prediction estimate of disability status, indicating that the effect of PACT on reading comprehension was not as strong as the effect on academic vocabulary. Reading comprehension was still strongly influenced by students' disability status although SWD and SWOD benefited similarly from the instruction. This finding aligns with prior research and found that the evidence-based instruction that targets vocabulary is more effective for building vocabulary than for developing reading comprehension in content area learning (Lesaux et al., 2010; Vaughn et al., 2013, 2015).

Additional results revealed that although SWD gained content knowledge from PACT instruction, their growth magnitude was significantly smaller than that of SWOD. These findings corroborate findings from prior studies indicating that SWD can learn content from text. However, these findings may also indicate that to make gains in catching up with SWOD, SWD may require extra supports. For instance, Compton et al. (2014) noted that poor readers tend to possess less knowledge (i.e., general world knowledge, passage specific knowledge, and vocabulary knowledge) than good readers, and tend to not apply the requisite knowledge during reading tasks, even if they possess this knowledge. Uccelli et al. (2015) pointed out that the core academic-language skills, such as unpacking dense information and identifying academic definitions, is significantly predictive of reading comprehension in addition to academic vocabulary. These aspects are probably what educators should take into consideration to improve the content area learning of SWD, as content knowledge is mainly acquired via reading for middle school students.

Results of analyses examining the relations between academic vocabulary, content knowledge, and reading comprehension indicate that both content knowledge growth and reading comprehension growth are significantly correlated with the academic vocabulary gains for both SWD and SWOD. Although the interaction between student status and time on the content knowledge measure (as shown in Table 3) indicated that SWD made relatively smaller content knowledge gains than SWOD, disability status did not influence students' growth of content knowledge and reading comprehension after reading-related baselines were controlled.

The examination including academic vocabulary slope gives us an opportunity to explore how the growth of academic vocabulary obtained from the PACT instruction predicts students' improvements on content area learning outcomes. Results revealed that the academic vocabulary growth significantly predicted students' content knowledge growth. With every 1 score increase in academic vocabulary growth, a .92 score increase in content knowledge growth could be expected for an eighth grader. The academic vocabulary growth also significantly predicted students' growth of reading comprehension even when the knowledge growth was controlled. With every 1 score increase in vocabulary growth, a .31 score increase in comprehension growth could be expected for an eighth grader. These findings suggest that academic vocabulary may play a critical role in content area acquisition for middle school students, which aligns with prior studies and theories (Cromley & Azevedo, 2007; Perfetti & Stafura, 2014). The more students gained on academic vocabulary, the more they would obtain on content knowledge and reading comprehension.

In addition, prior studies provided relations among states of students' vocabulary, general knowledge, and reading comprehension, but the present study highlighted what and how students learned in the Tier 1 intervention by analyzing the gains of related variables. For example, the estimates that academic vocabulary intercept and slope predicts for content knowledge growth were .97 and .92, respectively, indicating that what and how students obtained from PACT was as predictive as students' baseline performance. Similar findings were found for reading comprehension growth as well.

Implications for Practice

This study has several implications for classroom practice. First, although SWD are disadvantaged on all reading baselines, evidence-based instruction such as PACT delivered in a Tier 1 setting can help SWD grow as much as SWOD. Evidence-based instruction can play an important role in the overall education of SWD. Combining high-quality Tier 1 instruction within the content areas may have a synergistic effect on improving reading outcomes such as academic vocabulary and reading comprehension for SWD.

Second, previous studies indicate that academic vocabulary plays a key role in content reading. Although students' baseline performance predicts the growth of content acquisition outcomes, the growth of academic vocabulary during the instruction significantly predicts students' content acquisition growth, especially on the content knowledge outcome. This finding is promising because it suggests that the improvement of academic vocabulary may be as important as the baseline performance.

Third, the instructional practices in PACT have been shown to improve multiple outcomes for SWD and SWOD (e.g., Vaughn et al., 2013), including academic vocabulary, which represents and connects core concepts in the content. However, general education teachers tend to be less familiar with these practices and seldom use them (Swanson et al., 2016). Therefore, we encourage social studies teachers to infuse their instruction with several practices. For example, teachers can introduce academic vocabulary in multiple ways, including using a simplified definition, visual representation, related words, sentences, and brief discussion of the word meaning in context. In addition, multiple exposures to targeted academic vocabulary are provided during not only the text reading but also other activities throughout the unit.

Limitations and Future Research

We acknowledge that several limitations to the study led to a limited generalizability. First, a full array of measures of components that have been demonstrated to influence reading comprehension (e.g., word reading) was not included in this study due to school constraints. Such information would allow for a more comprehensive understanding of the relations between academic vocabulary, content knowledge, and

reading comprehension. However, previous studies have revealed that comprehension skills, such as vocabulary, contribute more to reading comprehension than word reading for adolescents (Ahmed et al., 2016; Catts et al., 2005). Although results from the current study align with prior examinations, we acknowledge that nuanced findings might emerge by including a more comprehensive set of measures.

Second, only researcher-developed measures were used in this study because previous PACT trials showed stable effects on researcher-developed measures of content acquisition but not on the broader measure of reading comprehension (Vaughn et al., 2013, 2015). A previous meta-analysis of vocabulary instruction (Elleman et al., 2009) also showed significant effects on researcher-developed measures but not on broader measures of reading comprehension. Due to the research objectives and these previous studies, it may have been appropriate to focus on the researcher-developed measures rather than on the broad measures of reading comprehension. However, we acknowledge that the findings of this study may be just part of a larger picture.

Finally, to investigate the role of academic vocabulary in content acquisition, we divided the original measure into two components. We acknowledge that compromising test reliability is not ideal and that the assessment variation cannot be ruled out due to this circumstance.

Researchers may consider developing more reliable academic vocabulary assessments at various aspects and examining the relation between academic vocabulary and content acquisition among SWD by including other reading skills and standardized measures. Furthermore, our study and previous research (e.g., Uccelli et al., 2015) indicate that SWD might need extra support for knowledge building and application. Therefore, future research could examine special education supports to further enhance students' content knowledge. Finally, examination of Tier 1 evidence-based instruction across multiple content areas along with pertinent special education supports could provide further information for improving the learning of adolescents with disabilities who are included in general education context.

Conclusion

Academic vocabulary plays a critical role in the content acquisition of middle school students. Through examining the impact of PACT, this study suggested that evidence-based instruction delivered in Tier 1 social studies classes would benefit SWD and all other students' content acquisition. The vocabulary growth that students obtained from the Tier 1 instruction significantly predicted their content acquisition outcome, in addition to their baseline performance. This finding is encouraging for both teachers and students—particularly for SWD because they tend to have less developed vocabulary and related reading skills.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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