


# Examining the Role of Pre-Instruction Academic Performance Within A Text-based Approach to Improving Student Content Knowledge and Understanding

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## Abstract

Students with disabilities are often included in general education social studies classes, but these classes can differ in the achievement level of the overall class, including wide variation in content-related background knowledge, reading achievement, or both. The purpose of this study was to examine how background knowledge and reading achievement moderate the effects of a previously validated intervention, Promoting Adolescents' Comprehension of Text (PACT). We examined data from a prior randomized control trial of 1,487 eighth-grade students in 85 classes that were randomly assigned at the class level to receive either PACT instructional practices or typical instructional practices using the same social studies content. Results of the current study reveal no moderating effect at the class level of either initial background knowledge or reading achievement on student content knowledge acquisition or content reading comprehension outcomes. Classes with varying levels of background knowledge and reading achievement performed similarly in PACT instruction, with benefits of the PACT instruction found on content knowledge acquisition.

Most students with disabilities receive some of their instruction in the general education classroom. In fact, 81% of students with disabilities receive more than 40% of their instruction in general education settings (National Center for Education Statistics, 2017).

Social studies has been one of the most common content areas for inclusion of students with disabilities (Newman, 2006; Wagner, Marder, & Chorost, 2004). Middle school teachers in these general education content area classrooms serve a wide range of learners across the school day, yet expectations are that they will provide instruction that facilitates all learners meeting or exceeding grade-level standards.

One way in which learners can vary is their background or prior knowledge on the topics

addressed in their classes. Students with disabilities often demonstrate deficiencies in background knowledge (Compton, Miller, Elleman, & Steacy, 2014). Students with low knowledge tend to play a more passive role within their class and rely on better students to respond and answer questions (Hall, 2012). However, classes may differ in the average amount of background knowledge they bring to the topic. Differences in background knowledge that relate to the topics

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being learned can uniquely predict students' comprehension of new material (Cromley & Azevedo, 2007; Taboada, Tonks, Wigfield, & Guthrie, 2009). In this sense, existing knowledge can help students with disabilities make more connections to process and retain information. In fact, a student's background knowledge can account for 30% to 60% of the variance in learning new content (Dochy, Segers, & Buehl, 1999).

*Social studies has been one of the most common content areas for inclusion of students with disabilities.*

Learners participating in content area instruction can also differ in their reading achievement, which can then affect their learning of new content through text. Reading is an essential component of social studies, with current standards requiring students to evaluate and analyze primary and secondary text sources (National Council for the Social Studies, 2014; National Governors Association & Council of Chief School Officers, 2010). In a recent study, our data suggested that a typical middle school social studies teacher instructed classes throughout the day at the same grade level and same topic area but with a wide range of average reading achievement across classes. Teachers, on average, had differences in class means of about 13 standard score points (nearly 1 standard deviation) in reading achievement across their classes, with some teachers seeing even wider ranges of achievement (Vaughn, Martinez, Wanzek, Roberts, Swanson, & Fall, 2017). In some classes, even the lowest student in the class had an average reading level, while other classes served many students that were 1 to 2 standard deviations below average. These data suggest that middle school teachers can face a range of student abilities not only within their classes but across the classes they instruct in a given day. Students with disabilities were a part of all of these classes but were generally among the lowest readers in the class. The correlation between class reading achievement and class social studies knowledge was .63,

meaning that classes with higher reading achievement were more likely to also have greater average social studies knowledge. Meeting content standards across classes of students with wide-ranging reading abilities, including students with disabilities, presents a significant challenge for social studies teachers, many of whom have limited background on how to promote text reading for students with reading difficulties or disabilities within the content instruction (Hall, 2005; Ness, 2007; O'Brien, Moje, & Stewart, 2001).

Promoting Adolescents' Comprehension of Text (PACT) was designed to address the needs of content area teachers to increase content learning for diverse students. Typical secondary content area classrooms pose challenges for students with disabilities as instruction is often marked by passive reading of textbooks, lecture, and worksheet-based activities (Bulgren, Deshler, & Lenz, 2007; Paxton, 1999; Scruggs & Mastropieri, 2003). In fact, social studies teachers report that lecture is their most effective teaching strategy, followed by individual projects and worksheets (Bolinger & Warren 2007). Mastropieri and Scruggs (2001) pointed out that these expectations for independent learning are often mismatched to the learning needs of students with disabilities. Effective instructional practices for students with disabilities in social studies content include engaging students in the content and meaningful learning, explicit instruction in vocabulary and comprehension strategies for the material, assistance with organizing and retaining information, and facilitating active thinking and application of the content (Gajria, Jitendra, Sood, & Sacks, 2007; Scruggs & Mastropieri, 2003; Swanson et al., 2016). Yet instructional strategies for content area text reading, engaging students in discussion, and facilitating content application are the least reported activities in social studies classes (Bolinger & Warren, 2007; Swanson et al., 2016).

Building on the research related to current practice and the needs of students with disabilities, PACT provides a set of instructional practices intended to be integrated within social studies content units to increase engagement of

all students in supported text-based learning, discourse-based processes, and application of newly learned content (Vaughn, Swanson, Roberts, Wanzek, Stillman-Spisak, Solis, & Simmons, 2013). The components include: (a) a unit introduction to activate background knowledge and engage students in the content, (b) introduction of vocabulary students will need to support learning the new content as well as (c) review of the words through application activities, (d) critical reading of text with teacher support for comprehension and organizing newly learned content, (e) individual and collaborative team checks of content understanding, and (f) team-based application activities for integrating the content learned in the unit.

Previous research on the efficacy of PACT has reported positive effects on content knowledge acquisition for students participating in PACT instruction (Vaughn, Roberts, Swanson, Wanzek, Fall, & Stillman-Spisak, 2015; Vaughn et al., 2017). For example, in a study of almost 1,500 students in 85 general education social studies classrooms, students in the classes randomly assigned to receive the PACT instruction outperformed students in the classes receiving typical instruction on a measure of social studies knowledge acquisition (effect size [ES] = 0.32), but no differences were noted in students' reading comprehension (Vaughn et al., 2015). Similarly, Vaughn et al. (2017) noted students in classes receiving the PACT instruction significantly outperformed their peers in typical classes on knowledge acquisition (ES = 0.40).

*PACT provides a set of instructional practices intended to be integrated within social studies content units to increase engagement of all students in supported text-based learning, discourse-based processes, and application of newly learned content.*

To begin to address PACT's effectiveness with diverse students in general education classrooms, two additional studies examined

the treatment effects specifically for the subset of students with disabilities in the general education classrooms (Swanson, Wanzek, Vaughn, Roberts, & Fall, 2015; Wanzek, Swanson, Vaughn, Roberts, & Fall, 2016). The sample of students had lower average reading comprehension and social studies prior knowledge at the beginning of the school year than the full sample of all students in the general education classes. Notably, students with disabilities in the general education social studies classes using PACT instruction outperformed students with disabilities in the general education social studies classes using typical instruction on both social studies knowledge acquisition (ES = 0.26) and social studies content reading comprehension (ES = 0.34; Swanson et al., 2015). English learner and non-English learner students with disabilities in general education social studies classes receiving the PACT instruction also outperformed their peers in typical instruction classes on social studies knowledge acquisition (ES = 0.51; Wanzek et al., 2016) but not on social studies content reading comprehension. Both of these studies suggest the benefits of the PACT instructional practices for the subsamples of students with disabilities. However, these studies examine a subsample of students from larger classes randomized to condition, making it difficult to directly compare the findings to the full class of students and determine whether there were any differences in response to the instruction. We were interested in examining the impact of differences in students' initial achievement levels, specifically, content background knowledge and reading achievement, at the class level—the level of randomization.

The purpose of this study was to examine further the effects of the PACT treatment on the student outcomes of content knowledge acquisition and content reading comprehension based on differences in class-level content background knowledge and reading achievement prior to treatment. To accomplish this purpose, we explored a previous study of the PACT instructional practices conducted with a large sample of eighth-grade students in general education social studies

classes. Specifically, we addressed the following research questions:

1. Are there differences in treatment effect on social studies knowledge acquisition or content reading comprehension based on class initial background knowledge in the content?
2. Are there differences in treatment effect on social studies knowledge acquisition or content reading comprehension based on class initial reading achievement?

Given the previous research demonstrating connections between incoming knowledge and comprehension of new material, we hypothesized that students in classes with higher levels of background knowledge would benefit more from the PACT intervention than students in classes with lower levels of background knowledge. Similarly, given the correlation between reading achievement and social studies knowledge as well as the use of text to comprehend and learn social studies content in the PACT intervention, we hypothesized that students in classes with higher levels of reading achievement would benefit more from the PACT intervention.

## Method

### *Context and Participants*

The original study was a randomized control trial, approved by the Institutional Review Board at The University of Texas and Florida State University, conducted with randomization of all social studies classes to either treatment (PACT) or comparison (typical instruction) condition, blocking on teacher (Vaughn et al., 2015). Both conditions received instruction in the same social studies content by the same teacher. Teachers employed the PACT instructional practices only in the treatment classes, but they used their typical instructional practices in the comparison classes.

The study was implemented in seven diverse middle schools located in five large school districts in the Southeast and Southwest

United States. Nineteen participating eighth-grade U.S. history teachers each taught between two and six classes of U.S. history for a total of 85 class sections in the study. When teachers had an odd number of classes, the additional class was assigned to the treatment condition. This resulted in a total of 47 treatment classes and 38 comparison classes. There were no significant differences between study conditions on any of the study measures.

A total of 19 teachers participated (male = 9). Teaching experience ranged from 2 to 38 years ( $M = 15.47$  years;  $SD = 13.1$ ). All teachers possessed a bachelor's degree; six of the teachers also held a master's degree. Teachers reported their ethnicity as either Hispanic (10.5%) or White (89.5%).

A total of 1,487 (male = 712) students consented to participate in the study. Approximately 8% of the students were identified with a disability, 5% were classified as limited English proficient (LEP), and 39% qualified for free or reduced lunch. Students' special education identification labels included learning disabilities, speech and language impairments, intellectual disabilities, and autism, with the majority of students identified with learning disabilities. The majority of students were White (61.1%), followed by African American (18.2%), Hispanic (23.5%), Asian (3.7%), Native American (9.4%), or two or more races specified (3.9%). There were no significant differences between study groups on any demographic characteristics.

### *Professional Development and Teacher Support*

Teachers participated in a one-day (eight-hour) professional development workshop prior to instruction. The workshop focused on implementation of each PACT component and procedures to facilitate student use of discourse and text evidence to support claims within the components. Additionally, there was an emphasis on fidelity of implementation and maintaining a firewall between treatment and comparison conditions to ensure treatment instruction was not implemented in the comparison classes.

Once instruction began, coaches were assigned to teachers to give support during implementation of each of the three PACT units. Coaches worked with teachers at least once per week (more frequently as needed). Coaching included modeling, co-teaching, monitoring student work during teacher-led instruction, observation and feedback, and support in lesson planning.

### *Description of Treatment Instruction*

All students received instruction during their regularly scheduled eighth-grade social studies classes. Classes met daily for 50 to 55 minutes or every other day for 90-minute class periods. Teachers delivered three distinct units to both treatment and comparison classes, each lasting 10 days (Colonial America, the Road to Revolution, and the Revolutionary War). Teachers implemented the 30 classes over 6 to 10 weeks. Content in both the treatment and comparison classes aligned with standards identified by the school districts and was covered over the same period in both treatment and comparison conditions.

The PACT program consisted of five inter-related components embedded in the teachers' content instruction: comprehension canopy, essential words, knowledge acquisition, team-based learning comprehension checks, and team-based learning knowledge application. Teachers were provided with semi-scripted lesson plans as well as a daily schedule identifying when components were to be delivered within the 10-day unit. We provided the teachers with all the materials needed for implementation.

*Comprehension canopy.* The comprehension canopy opened every unit and was designed to engage students in new content, connect to prior learning, and present an overarching question to guide learning as students progressed through the unit. On the first day of the unit, students viewed a short high-interest video related to the upcoming content. Teachers first provided a reason for viewing (e.g., "As you watch the video, write two reasons why the colonists called the First Continental Congress."). After viewing

the clip, students had small group or class-wide discussions about the purpose of the video as well as the questions posed prior to viewing. They were then presented with the overarching question for the unit (e.g., "Was the American Revolution inevitable? Why or why not?").

The comprehension question was reviewed at the beginning of class on each of the remaining nine days of the unit. On each day, teachers facilitated a brief discussion of what content they had learned thus far to address the comprehension question as well as what information they may still need to address fully the question. At the end of the 10-day unit, students were expected to draft a full answer to the comprehension canopy question.

*Essential words.* On the first day of the unit, students were introduced to four or five high-utility, high-frequency concepts related to the content and the comprehension questions (e.g., revolution, independence, tyranny). These were concepts to which new knowledge could be attached and served to scaffold comprehension of the content. The words were presented in a variety of ways to ensure student understanding, including providing visual representations, simplified definitions, sample sentences, and turn-and-talk discussions of the word in context. The remaining nine days of the unit began with a quick review of one or more of the essential words. Additionally, they were integrated into texts, team-based learning comprehension checks, and team-based learning knowledge application activities. Students were also provided with an essential words log in which they wrote connections they made to the essential words across all of the components.

*Knowledge acquisition through text reading.* Throughout the 10-day unit, students were provided with three opportunities to focus on reading primary and secondary texts, through the knowledge acquisition component. Students spent about 20 minutes reading texts that covered key content aligned with district standards. They read in whole group, small

group, pairs, or individually. During the reading, teachers facilitated student discussions of how the text related back to the comprehension canopy question, clarified unfamiliar vocabulary, and pointed out essential words. Students also stopped to write and discuss what they learned in different sections of the text.

*Team-based learning comprehension checks.* On the fourth and sixth days of the 10-day units, students completed short comprehension checks, first individually, and then with their assigned heterogeneous groups. These checks were designed to assess students' knowledge of key content. The checks consisted of five multiple-choice questions and one open-ended writing question. Students first completed the check independently, allowing for individual accountability of knowledge. Then, they joined their assigned groups and completed the question a second time. They were allowed to use notes and texts to achieve consensus on the correct answers and provide text evidence for their choice. The team was provided with a scratch off answer sheet, and once an answer was chosen, they scratched off their choice. If the answer was correct, a star would appear, and the group moved on to the next question. If an incorrect answer was chosen, there was no star, they had to refer back to their notes and texts, discuss other options, and try again. The scratch-off answer sheets allowed the students immediate feedback and allowed the teacher to monitor how groups were progressing.

While students worked in groups, the teacher monitored their progress, facilitated productive discussion, ensured all students were participating, and prompted students to provide adequate text evidence. During monitoring, teachers noted content with which students were struggling. At the end of the comprehension check, teachers spent approximately 10 minutes reteaching the content students did not understand.

*Team-based learning knowledge application.* On the ninth day of the unit, students worked in their assigned heterogeneous groups on an activity designed to extend their think-

ing and understanding as well as apply their knowledge to a complex historical question that related directly to the comprehension canopy question that they had been discussing throughout the unit. Students began by reading a short text. They were then given an assignment that related to the reading, the content they had previously studied, and the comprehension canopy question used throughout the unit. For example, students read William Penn's "Letter to the Free Society of Traders" and listed the reasons Penn gave for settling in the new colony. Students provided reasons related to government, economic opportunities, native populations, and geography/climate. Students were then tasked with selecting a colony and, using their notes and texts, developing statements that would convince settlers to choose their colony.

As students worked through the activity, the teacher monitored students to ensure all students were participating, prompted students to deepen their thinking and refine their answers with probing questions, and encouraged students to provide text evidence for their answers. Once the groups finished constructing their answers, they presented them to the class. During the presentations, other student groups as well as the teacher asked questions to assist in extending everyone's thinking and understanding. Once all the groups presented their answers to the questions posed by the activity, they discussed the comprehension canopy question and decided on an answer to the question as a class.

### *Observation of Fidelity of Treatment and Typical Classes*

One treatment class and one comparison class per teacher were randomly selected to be audio recorded throughout the units for measuring fidelity of treatment implementation. For each teacher's treatment class, two recordings of each PACT component were randomly selected for fidelity coding, resulting in a set of 10 treatment audio recordings for each teacher, evenly distributed over the three units of instruction. For each teacher's comparison

class, 10 consecutive classes were selected for fidelity coding.

Coders who were blind to treatment and comparison conditions assigned a fidelity rating for each PACT component. A Likert-type scale ranging from 1 (low; *component not observed*) to 4 (high; *completes all of nearly all of the elements for the PACT component*) was used. Four coders trained on the PACT practices independently coded a pre-identified audio-recorded lesson to establish reliability of coding. Their codes were compared with a gold standard that had been established on the same recording by two senior researchers on the team (Gwet, 2001). Each coder had to reach an agreement of 90% or higher to the gold standard.

Results of fidelity data suggest that in treatment classes, the PACT instruction was implemented with at least medium-high levels (rating of 3; *majority of the elements of the component implemented*). The team-based learning comprehension checks and essential words had the highest level of fidelity, with ratings of 3 or 4 in approximately 76% of the observations. The comprehension canopy was rated at 3 or 4 for about 66% of the treatment observations. The knowledge acquisition and team-based learning knowledge application portions of the instruction were the areas in which teachers had the most difficulty, with more than 50% of the observations in these two areas receiving a rating of 2 (mid-low implementation; *some elements of the component implemented*). Teachers typically struggled to implement the elements of extending student thinking, facilitating discussion and note-taking, and making connections to essential words.

By contrast, there were no ratings above 1 (component not observed) for any of the PACT components in the typical instructional classes. In these classes, there was instruction related to unit introduction (comprehension canopy), vocabulary (essential words), and text reading (knowledge acquisition) in 2% to 10% of observed lessons, but virtually no elements of the PACT instructional procedures were observed.

## Measures

The Assessment of Social Studies Knowledge (ASK; Vaughn et al., 2013) measure was administered to students in both the treatment and comparison conditions prior to and immediately following treatment to examine students' knowledge acquisition across the three units. In addition, the Gates-MacGinitie reading comprehension subtest was administered at pretest to examine students' initial reading achievement. The assessments were administered by trained research personnel who were blind to the condition (treatment or comparison) to which students were assigned.

**ASK.** The ASK (Vaughn et al., 2013) assessment is a researcher-developed measure consisting of two subtests. The first subtest, content knowledge acquisition, is an untimed multiple-choice test containing 42 items. The test measures content knowledge in the three units included in the treatment (Colonial America, Road to Revolution, Revolutionary War). Test items were collected, with permission, from released Massachusetts state social studies tests (Massachusetts Comprehensive Assessment System), released Texas state social studies tests (Texas Assessment of Knowledge and Skills), and released advanced placement tests in social studies for the College Board. Additionally, researcher-developed vocabulary items were included.

The second subtest, content reading comprehension, is an untimed multiple-choice test with 21 items that measures content reading comprehension. It includes three passages (Lexile range = 1,090–1,140; word count range = 312–349). Each of the passages is related to the content covered in the three 10-day units. Students were required to read each passage silently and answer seven questions about each passage. These items were researcher developed and measured students' ability to understand vocabulary in context, identify main ideas, summarize, and identify cause and effect.

Item difficulties across the 62 items range from  $-2.12$  to  $2.67$ , suggesting that the item set as a whole is useful in estimating proficiency

among individuals across the knowledge acquisition and comprehension continua. Item discrimination indices, sometimes called slope because they indicate the rate at which the probability of correct responses changes as proficiency increases, ranged from 0.05 to 2.13, indicating desirable variation in items' utility in discriminating between proficient and less proficient respondents. In item response theory (IRT) models, reliability, or measurement precision, is described as a continuous function conditional on values of the measured construct ( $\theta$ ). Reliability was above 0.80 for values of about  $-1.6$  to  $+1.2$ , suggesting adequate to high reliability across the range of performance levels. The information function indicates the contribution that can be made by the test to assess ability. Across the range of ability from  $-1.0$  to  $+1.0$ , the test information index was greater than 4, which is high. For the ability range bounded by  $-2.0$  to  $+2.0$ , the information function was greater than 3, also well within the acceptable range. Alpha coefficients for the ASK were 0.93 and 0.89 for ASK Content and Comprehension, respectively.

*Gates-MacGinitie reading comprehension subtest (fourth edition)*. The Gates-MacGinitie reading comprehension subtest (MacGinitie, MacGinitie, Maria, Dreyer, & Hughes, 2006) is a timed (35 minutes), group-administered reading comprehension assessment. It includes narrative and expository passages ranging in length from 3 to 15 sentences. Students silently read each passage and answer three to six multiple-choice questions. Items increase in difficulty as the student progresses through the assessment. Internal consistency reliability ranges from 0.91 to 0.93, and alternate for reliability is reported as 0.80 to 0.87.

### Data Analysis

We address the research questions in the context of multilevel latent moderated structural equation modeling (LMS; Preacher, Zhang, & Zyphur, 2016). Many current models for

estimating moderated effects in multilevel data are problematic because they fail to specify all possible moderation effects and because they do not separate effects into their between and within components, thereby conflating effects across levels of analysis. By using observed cluster averages rather than random intercepts, estimated as latent variables, to represent higher-level constructs (Preacher, Zyphur, & Zhang, 2010), traditional approaches often yield biased tests of multilevel moderation. LMS, a subcomponent of Preacher et al.'s (2016) more comprehensive multilevel structural equation model (MSEM), addresses these existing shortcomings by estimating cluster means as latent, which allows interaction of latent constructs at higher levels of the multilevel model (Klein & Moosbrugger, 2000) and, consequently, full specification of all possible interaction effects. This represents the "latent" feature of the model. However, unlike traditional structural models, where observed indicators are predicted by a latent construct (i.e., in a measurement model), LMS directly models latent interactions in the structural model, making it possible to explicitly specify the conditional slopes that are of interest in a moderation context.

We estimate PACT's effect on content knowledge acquisition and content area reading comprehension for different pretreatment levels of content knowledge and reading comprehension at the class level. We fit structural equation models in Mplus 8, with students nested in classes and classes blocked on teachers. We model two levels (student and class) of clustering. We treat outcomes ( $Y$ ), moderators ( $Z$ ), and other covariates ( $W$ ) as latent, using the full information latent approach described by Preacher et al. (2016). We model  $Y$  as a student-level posttest score and  $Z$  as a student-level moderator. In the subset of models where the moderator is not a measure of the outcome, we include  $W$  as a student-level covariate for the outcome. We decompose observed Level 1 variables into their latent  $B$  and  $W$  components, estimate cluster-level means as latent, and fully specify all possible moderating effects, including latent by latent effects created at Level 2 of the model, resulting in unbiased and unconfounded



estimates of student- and class-level effects of Time 1 status on reading-related outcomes (Preacher et al., 2016).

The relationship of  $Z$  and  $Y$  (and  $Z$ ,  $W$ ,  $Y$ ) can be described as

$$y_{ij} = \gamma_{00} + \gamma_{10}z_i + (\gamma_{20}w_i) + \gamma_{01}z_{.j} \\ + (\gamma_{02}w_{.j}) + \mu_{0j} + \mu_{1j}z_i \\ + (\mu_{2j}w_i) + \varepsilon_{ij},$$

where  $\gamma_{10}$  is the effect of  $z_i$  on  $y_{ij}$ , and  $z_i$  describes individuals' status on  $z$  relative to the cluster mean for  $j$ , the classroom from which  $z_i$  is collected. As indicated, we include  $w$ -related parameters ( $\gamma_{20}w_i$ ,  $\gamma_{02}w_{.j}$ ,  $\mu_{1j}w_i$ ,  $\mu_{2j}w_{.j}$ ) in parentheses to represent the subset of models (Models 2, 3, and 4) where the moderator differs from the pretest of the outcome; if  $z$  is a construct other than  $y$ ,  $w$  is modeled at both levels as the pretest measure of the outcome. In contrast,  $\gamma_{01}$  describes the effect for the *latent* mean for cluster  $j$ . The  $.j$  subscript represents clusters' latent standing along a Level 1 (student) variable. In sum, the coefficients  $\gamma_{10}$  (and  $\gamma_{20}$ ) and  $\gamma_{01}$  (and  $\gamma_{02}$ ) represent the within- and between-clusters effects of the covariates on the outcomes, respectively. The  $\mu_{0j} + \mu_{1j}z_i + \mu_{2j}w_i + \mu_{3j}z_{.j} + \mu_{4j}w_{.j} + \varepsilon_{ij}$  term describes the random part of the model.

Assignment to condition,  $X$ , is a between-groups (Level 2) manifest factor, which we model as the focal predictor at Level 2. Added to the above, the reduced-form equation is

$$y_{ij} = \gamma_{00} + \gamma_{10}z_i + (\gamma_{20}w_i) + \gamma_{01}z_{.j} \\ + (\gamma_{02}w_{.j}) + \gamma_{03}x_j + \gamma_{04}z_{.j}x_j + \mu_{0j} \\ + \mu_{1j}z_i + (\mu_{2j}w_i) + \varepsilon_{ij},$$

where  $\gamma_{04}z_{.j}x_j$  describes the interaction of treatment ( $X$ ) and the between-groups part of the moderator,  $Z$ . It is estimated as a latent interaction between the B part of a Level 1 variable and a Level 2 variable modeled at the between-groups level (Preacher et al., 2016). For each research question, we estimate  $\gamma_{04}z_{.j}x_j$  for the following models:

Research Question 1: Are there differences in treatment effect on social studies knowledge acquisition or content reading comprehension based on students' initial background knowledge in the content?

- Model 1: the moderating effect of content knowledge at pretest ( $Z$ ), as measured by the ASK content knowledge acquisition, on treatment's effect ( $X$ ) on ASK content knowledge acquisition ( $Y$ ) at posttest.
- Model 2: the moderating effect of content knowledge at pretest ( $Z$ ), as measured by the ASK content knowledge acquisition, on treatment's effect ( $X$ ) on content reading comprehension ( $Y$ ) at posttest, as measured by the ASK content reading comprehension, when controlling for ASK content reading comprehension at pretest ( $W$ ).

Research Question 2: Are there differences in treatment effect on social studies knowledge acquisition or content reading comprehension based on students' initial reading achievement?

- Model 3: the moderating effect of distal reading comprehension at pretest ( $Z$ ), as measured by the Gates-MacGinitie reading comprehension, on treatment's effect ( $X$ ) on content knowledge ( $Y$ ) at posttest when controlling for ASK content knowledge at pretest ( $W$ ).
- Model 4: the moderating effect of distal reading comprehension ( $Z$ ), as measured by the Gates-MacGinitie reading comprehension, on treatment's effect ( $X$ ) on content reading comprehension ( $Y$ ) at posttest when controlling for ASK content reading comprehension at pretest ( $W$ ).

We created interaction terms using the latent moderated SEM approach described by Preacher et al. (2016), using a robust maximum likelihood estimator (MLR) that combines ML and a mixture of normal distributions to approximate the nonnormality of latent product terms. To aid model convergence, we

**Table 1.** Observed Means and Standard Deviations by Condition.

| Measure | Treatment (n = 816)           |                               | Comparison (n = 668)          |                               |
|---------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|
|         | Pretest                       | Posttest                      | Pretest                       | Posttest                      |
| ASKC    | 19.70/7.21<br>2–40            | 26.70/8.92<br>5–41            | 20.52/7.49<br>1–40            | 24.75/8.39<br>4–41            |
| ASKRC   | 10.78/4.37<br>1–21            | 11.80/4.72<br>1–21            | 10.81/4.28<br>2–21            | 11.70/4.62<br>2–21            |
| GM      | 539.25/38.60<br>386.00–643.00 | 542.70/37.40<br>386.00–643.00 | 542.60/37.80<br>386.00–643.00 | 547.25/36.58<br>386.00–643.00 |

Note. ASKC = Assessment of Social Studies Knowledge-Content Acquisition Subtest; ASKRC = Assessment of Social Studies Knowledge-Reading Comprehension Subtest; GM = Gates-MacGinitie Reading Comprehension Subtest.

use starting values derived from manifest-only MSEM analogs of the latent moderated models reported here. We evaluate moderation at the mean for each moderator. In addition, we test values of the moderator that correspond with 2 standard deviations above and below the mean and for values 1 standard deviation above and below the mean. Finally, we report conditional effect sizes for each moderating effect ( $\gamma_{04z_jx_j}$ ). These describe the standardized differences in the posttest means for treatment and control classes when compared at the moderator’s average.

**Results**

Distributions for measures of the covariates and outcomes were normal. Descriptive statistics for each group are provided in Table 1. Earlier studies (Vaughn et al., 2013) documented the strong measurement invariance for the ASK content knowledge acquisition and ASK content reading comprehension across the treatment and comparison groups in this study. We report unstandardized coefficients for the parameters.

Research Question 1: Are there differences in treatment effect on social studies knowledge acquisition or content reading comprehension based on students’ initial background knowledge in the content?

To address this question, we first examined the extent to which PACT treatment’s effect is moderated by differing levels of pretreatment social studies knowledge. The results (Table 2) indicate that pretest status on a measure of social studies content knowledge predicts levels of posttreatment social studies knowledge, on the within-groups level of the model ( $\gamma_{10z_i}$ ) and between groups ( $\gamma_{10z_j}$ ). However, content knowledge at pretest does not predict treatment’s effect. The interaction effect ( $\gamma_{04z_jx_j}$ ) is .17 ( $p = .11$ ), which indicates that treatment’s effect on social studies content knowledge does not vary across different levels of pretreatment content knowledge when the interaction is between the B part of Z and when X is a Level 2 variable. The corresponding effect size is .02. This model does not include a covariate (W). Moderation at values other than the moderator’s mean were also not statistically significant.

We then examined the moderating effect of content knowledge at pretest (Z) on treatment’s effect (X) for content reading comprehension (Y) at posttest when controlling for content reading comprehension at pretest (W). Table 3 presents the model results. The interaction term,  $\gamma_{04z_jx_j}$ , does not differ statistically from 0 ( $p = .54$ ). Because PACT does not have a main effect on content reading comprehension (Vaughn et al., 2015), the absence of a moderating effect represents a less promising finding than that for content

**Table 2.** Moderation of Background Knowledge for Content Knowledge Acquisition.

| Parameter  | Estimate | S.E.  | Est./S.E. | p-value |
|--|----------|-------|-----------|---------|
| ASKC(B) <sub>posttest</sub> on ASKC(B) <sub>pretest</sub> ( $\gamma_{01z_j}$ )                     | 1.04     | 0.069 | 15.06     | <.0001  |
| ASKC(B) <sub>posttest</sub> on Assignment (X) ( $\gamma_{03x_j}$ )                                 | 0.427    | 2.14  | 0.200     | .842    |
| ASKC(B) <sub>posttest</sub> on ASKC(B) <sub>pretest</sub> x Assignment (X) ( $\gamma_{04z_jx_j}$ ) | 0.165    | 0.102 | 1.608     | .108    |
| ASKC(W) <sub>posttest</sub> on ASKC(W) <sub>pretest</sub> ( $\gamma_{10z_i}$ )                     | 0.790    | 0.033 | 24.05     | <.0001  |
| <b>Means/Intercepts</b>  |          |       |           |         |
| ASKC(B) <sub>pretest</sub>   | 19.69    | 0.477 | 41.31     | <.0001  |
| ASKC(B) <sub>posttest</sub>  | 3.402    | 1.34  | 2.54      | .011    |
| <b>Variances/Residual Variances</b>  |          |       |           |         |
| ASKC(W) <sub>pretest</sub>   | 35.22    | 1.42  | 24.81     | <.0001  |
| ASKC(W) <sub>posttest</sub>  | 28.63    | 1.75  | 16.36     | <.0001  |
| ASKC(B) <sub>pretest</sub>   | 17.43    | 2.77  | 6.29      | <.0001  |
| ASKC(B) <sub>posttest</sub>  | 2.025    | 0.918 | 2.205     | .027    |

Note. ASKC = Assessment of Social Studies Knowledge-Content Acquisition Subtest; B = between level; X = assignment; W = within level.

knowledge acquisition. Follow-up tests for values of the moderator other than its mean also found no subgroup differences.

Research Question 2: Are there differences in treatment effect on social studies knowledge acquisition or content reading comprehension based on students' initial reading achievement?

Model 3 considers the moderating effect of general reading comprehension measured by the Gates-MacGinitie when the outcome is social studies content knowledge. The pretest measure of content knowledge is included as a latent covariate on both levels of the model. We do *not* model its interaction with Z; however, to the extent that Z and W are correlated, the moderating effect of Z is conditional on the main effect of W. As indicated in Table 4, the covariance of Gates-MacGinitie and ASK content knowledge is considerable. Accordingly, the interaction of treatment and the pretest Gates-MacGinitie ( $\gamma_{04z_jx_j} = .072$ ;  $p = .17$ ) represents the moderating effect of general reading comprehension on posttest content knowledge when controlling for pretreatment levels of content knowledge. The effect was also relatively constant (and nonsignificant)

across values of the moderator (i.e., 1 and 2 standard deviations above and below the mean). The standardized difference in conditional posttest means is .002.

Model 4 also evaluates effects related to content reading comprehension, with reading achievement serving as the moderator. The pretest values for content reading comprehension are modeled as latent covariates on both levels of the model. Table 5 presents the model results. The interaction of the B part of general reading comprehension and treatment X is nonsignificant ( $p = .708$ ;  $ES = .006$ ), as were the follow-up tests at different values of the moderator.

## Discussion

The PACT set of instructional practices were designed to increase student engagement in text-based learning and the application of content through discourse-based activities to support acquisition of social studies content knowledge. In 2015, we examined the average effects of PACT instruction in eighth-grade general education classes with a wide range of learners, including students with disabilities (Vaughn et al., 2015). Teachers taught the same content to classes that were randomly

**Table 3.** Moderation of Background Knowledge for Content Reading Comprehension.

| Parameter  | Estimate | S.E.  | Est./S.E. | p-value |
|--|----------|-------|-----------|---------|
| ASKRC(B) <sub>posttest</sub> on ASKC(B) <sub>pretest</sub> ( $\gamma_{01z_j}$ )                      | 0.006    | 0.191 | 0.029     | .98     |
| ASKRC(B) <sub>posttest</sub> on ASKRC(B) <sub>pretest</sub> ( $\gamma_{02w_j}$ )                     | 1.07     | 0.353 | 3.03      | .002    |
| ASKRC(B) <sub>posttest</sub> on Assignment (X) ( $\gamma_{03x_j}$ )                                  | -0.214   | 0.878 | -0.244    | .81     |
| ASKRC(B) <sub>posttest</sub> on ASKRC(B) <sub>pretest</sub> × Assignment (X) ( $\gamma_{04z_jx_j}$ ) | 0.026    | 0.043 | 0.607     | .54     |
| ASKRC(W) <sub>posttest</sub> on ASKC(W) <sub>pretest</sub> ( $\gamma_{10z_i}$ )                      | 0.173    | 0.021 | 8.17      | <.0001  |
| ASKRC(W) <sub>posttest</sub> on ASKRC(W) <sub>pretest</sub> ( $\gamma_{20w_i}$ )                     | 0.532    | 0.028 | 19.34     | <.0001  |
| <b>Means/Intercepts</b>  |          |       |           |         |
| ASKC(B) <sub>pretest</sub>   | 19.75    | 0.48  | 41.54     | <.0001  |
| ASKRC(B) <sub>pretest</sub>  | 10.62    | 0.26  | 40.60     | <.0001  |
| ASKRC(B) <sub>posttest</sub>   | -0.066   | 0.73  | -0.091    | .927    |
| <b>Variances/Residual Variances</b>  |          |       |           |         |
| ASKC(W) <sub>pretest</sub>   | 35.33    | 1.43  | 24.63     | <.0001  |
| ASKRC(W) <sub>pretest</sub>  | 13.45    | 0.491 | 27.42     | <.0001  |
| ASKRC(W) <sub>posttest</sub>   | 8.05     | 0.338 | 23.78     | <.0001  |
| ASKC(B) <sub>pretest</sub>   | 17.31    | 2.79  | 6.20      | <.0001  |
| ASKRC(B) <sub>pretest</sub>  | 5.03     | 0.684 | 7.35      | <.0001  |
| ASKRC(B) <sub>posttest</sub>   | 0.017    | 0.077 | 0.222     | .825    |
| <b>Covariances</b>   |          |       |           |         |
| ASKRC(W) <sub>pretest</sub> with ASKC(W) <sub>pretest</sub>  | 13.74    | 0.731 | 18.77     | <.0001  |
| ASKRC(B) <sub>pretest</sub> with ASKC(B) <sub>pretest</sub>  | 9.09     | 1.33  | 6.82      | <.0001  |

Note. ASKRC = Assessment of Social Studies Knowledge-Reading Comprehension Subtest; B = between level; ASKC = Assessment of Social Studies Knowledge-Content Acquisition Subtest; X = assignment; W = within level.

assigned to receive either the content with the PACT instructional practices or the content with the teacher’s typical instruction. Fidelity of implementation observations conducted in both the treatment and comparison classes demonstrated that PACT practices were implemented at a moderate to high level in the treatment classes and with little to no implementation of PACT practices in comparison classes. The findings indicated statistically significant differences between students in classes where the teacher used PACT instructional procedures and students in classes with typical instruction of the same content (ES = 0.32). There were no average effects on a measure of content reading comprehension (ES = 0.002).

The purpose of the current study was to examine differences in response to PACT instruction when implemented across diverse classrooms by eighth-grade general education social studies teachers. We examined whether

students’ incoming background knowledge for the social studies material or incoming reading achievement moderated the effects of the treatment.

First, we investigated the moderating effects of students’ incoming background knowledge. Background knowledge has been found to be significantly related to general reading comprehension and comprehension of new content (Cromley & Azevedo, 2007; Dochy et al., 1999). The effects of the PACT instruction were not moderated by the class’s initial knowledge of the social studies content in the three units. There was no significant effect, and the effect size was trivial (ES = 0.02). In other words, students in classes with varying levels of background knowledge of the upcoming content benefitted similarly from the PACT practices. We hypothesized that students in classes with higher levels of initial background knowledge would benefit more from PACT, particularly given the peer

**Table 4.** Moderation of Reading Achievement for Content Knowledge Acquisition.

| Parameter  | Estimate | S.E.  | Est./S.E. | p-value |
|--|----------|-------|-----------|---------|
| ASKC(B) <sub>posttest</sub> on GM(B) <sub>pretest</sub> ( $\gamma_{01}Z_j$ )                               | -.38     | .46   | -.84      | .40     |
| ASKC(B) <sub>posttest</sub> on ASKC(B) <sub>pretest</sub> ( $\gamma_{02}W_j$ )                             | 1.80     | .88   | 2.04      | .04     |
| ASKC(B) <sub>posttest</sub> on Assignment (X) ( $\gamma_{03}X_j$ )   | -4.58    | 5.53  | -.83      | .41     |
| ASKC(B) <sub>posttest</sub> on GM(B) <sub>pretest</sub> $\times$<br>Assignment (X) ( $\gamma_{04}Z_jX_j$ ) | .072     | .05   | 1.36      | .17     |
| ASKC(W) <sub>posttest</sub> on GM(W) <sub>pretest</sub> ( $\gamma_{10}Z_i$ )                               | .18      | .017  | 10.65     | <.0001  |
| ASKC(W) <sub>posttest</sub> on ASKC(W) <sub>pretest</sub> ( $\gamma_{20}W_i$ )                             | .55      | .034  | 16.20     | <.0001  |
| <b>Means/Intercepts</b>  |          |       |           |         |
| GM(B) <sub>pretest</sub>   | 103.67   | .93   | 111.25    | <.0001  |
| ASKC(B) <sub>pretest</sub>   | 19.64    | .47   | 41.97     | <.0001  |
| ASKC(B) <sub>posttest</sub>  | 28.21    | 29.93 | .94       | .34     |
| <b>Variances/Residual Variances</b>  |          |       |           |         |
| GM(W) <sub>pretest</sub>   | 159.99   | 7.53  | 21.24     | <.0001  |
| ASKC(W) <sub>pretest</sub>   | 35.80    | 1.44  | 24.84     | <.0001  |
| ASKC(W) <sub>posttest</sub>  | 25.23    | 1.65  | 15.26     | <.0001  |
| GM(B) <sub>pretest</sub>   | 65.71    | 11.72 | 5.61      | <.0001  |
| ASKC(B) <sub>pretest</sub>   | 17.12    | 2.88  | 5.94      | <.0001  |
| ASKC(B) <sub>posttest</sub>  | 1.83     | 1.22  | 1.51      | .13     |
| <b>Covariances</b>   |          |       |           |         |
| ASKC(W) <sub>pretest</sub> with GM(W) <sub>pretest</sub>   | 47.28    | 2.82  | 16.75     | <.0001  |
| ASKC(B) <sub>pretest</sub> with GM(B) <sub>pretest</sub>   | 32.00    | 5.70  | 5.78      | <.0001  |

Note. ASKC = Assessment of Social Studies Knowledge-Content Acquisition Subtest; B = between level; GM = Gates-MacGinitie Reading Comprehension Subtest; X = assignment; W = within level.

collaboration that is a part of PACT. However, our findings suggest that PACT's impact was overall resilient to class differences in prior social studies knowledge. The purpose of the intervention to engage students more in learning and apply the content they are learning may have facilitated students in all levels of classes to acquire new knowledge. Thus, even though some classes began the school year with lower knowledge about the topic, the PACT practices allowed students in these classes to gain more of this knowledge than students in classes with similar background knowledge receiving typical instruction from the same teacher. However, the finding also suggests that students in classes with lower incoming background knowledge did not gain more knowledge in the PACT instruction than students in classes with higher levels of background knowledge. Less knowledgeable students in the study may have continued to be

less knowledgeable posttreatment, but improvements in their knowledge were comparable no matter the level of class where they received the instruction.

Background knowledge of the class also did not moderate student outcomes for the content area reading comprehension measure. There were no statistically significant average effects for the PACT instruction on content reading comprehension in the original study (Vaughn et al., 2015) and no moderating effects by level of incoming background knowledge for the class in the current study. Therefore, the absence of moderation on content reading comprehension suggests that PACT's lack of impact may be constant across class levels of pretreatment content knowledge. In other words, the treatment was no more effective than typical practice for improving content reading comprehension for any level of prior knowledge the class brought

**Table 5.** Moderation of Reading Achievement for Content Reading Comprehension.

| Parameter  | Estimate | S.E.  | Est./S.E. | p-value |
|--|----------|-------|-----------|---------|
| ASKRC(B) <sub>posttest</sub> on GM(B) <sub>pretest</sub><br>( $\gamma_{01}z_j$ )                     | .032     | .055  | .573      | .566    |
| ASKRC(B) <sub>posttest</sub> on ASKRC(B) <sub>pretest</sub><br>( $\gamma_{02}w_j$ )                  | .984     | .198  | 4.96      | <.0001  |
| ASKRC(B) <sub>posttest</sub> on Assignment (X)<br>( $\gamma_{03}x_j$ )                               | -.547    | 2.29  | -.238     | .812    |
| ASKRC(B) <sub>posttest</sub> on GM(B) <sub>pretest</sub> ×<br>Assignment (X) ( $\gamma_{04}z_jx_j$ ) | .008     | .022  | .375      | .708    |
| ASKRC(W) <sub>posttest</sub> on GM(W) <sub>pretest</sub><br>( $\gamma_{10}z_i$ )                     | .089     | .010  | 9.152     | <.0001  |
| ASKRC(W) <sub>posttest</sub> on<br>ASKRC(W) <sub>pretest</sub> ( $\gamma_{20}w_i$ )                  | .519     | .027  | 19.57     | <.0001  |
| <b>Means/Intercepts</b>  |          |       |           |         |
| GM(B) <sub>pretest</sub>   | 103.96   | .897  | 115.9     | <.0001  |
| ASKRC(B) <sub>pretest</sub>  | 10.62    | .257  | 41.40     | <.0001  |
| ASKRC(B) <sub>posttest</sub>   | -2.32    | 3.83  | -.607     | .544    |
| <b>Variances/Residual Variances</b>  |          |       |           |         |
| GM(W) <sub>pretest</sub>   | 160.2    | 7.536 | 21.25     | <.0001  |
| ASKRC(W) <sub>pretest</sub>  | 13.42    | .490  | 27.40     | <.0001  |
| ASKRC(W) <sub>posttest</sub>   | 7.929    | .361  | 21.99     | <.0001  |
| GM(B) <sub>pretest</sub>   | 61.45    | 10.92 | 5.628     | <.0001  |
| ASKRC(B) <sub>pretest</sub>  | 4.87     | .686  | 7.10      | <.0001  |
| ASKRC(B) <sub>posttest</sub>   |          |       |           |         |
| <b>Covariances</b>   |          |       |           |         |
| ASKRC(W) <sub>pretest</sub> with GM(W) <sub>pretest</sub>  | 28.34    | 1.623 | 17.46     | <.0001  |
| ASKRC(B) <sub>pretest</sub> with GM(B) <sub>pretest</sub>  | .020     | .078  | .261      | .774    |

Note. ASKRC = Assessment of Social Studies Knowledge-Reading Comprehension Subtest; B = between level; GM = Gates-MacGinitie Reading Comprehension Subtest; X = assignment; W = within level.

to the instruction. PACT includes text-based instructional practices, but the supports provided do not seem robust enough to increase independent content area reading beyond typical instruction. Students did grow in their ability to read this text after instruction, but they grew similarly in typical instruction and PACT instruction. This finding demonstrates that the increased social studies knowledge noted for students after the PACT instruction across classes did not similarly increase their reading comprehension of novel content area text for students no matter the level of initial background knowledge.

Second, we examined the moderating effects of students' initial reading achievement

as measured by the reading comprehension subtest of the Gates-MacGinitie (MacGinitie et al., 2006). Given that PACT is a text-based approach to content area instruction, we were interested in whether the instructional practices may be more beneficial for particular reading levels at the class level. We found that the PACT effects on student content knowledge acquisition remained robust across varying class reading levels. The moderation effect was negligible ( $ES = 0.002$ ). In addition to the PACT practices facilitating student engagement and response, and application of new learning, the teacher-supported text reading and comprehension as opposed to independent reading may have helped students

in classes with lower levels of reading continue to gain content knowledge. Thus, although PACT has a focus on text, lower and higher level classes appear to benefit similarly, obtaining higher content knowledge when their teachers implement the PACT instructional practices than when they implement their typical practices.

Class reading achievement also did not moderate effects for student's content reading comprehension ( $ES = 0.006$ ). Students in classes averaging higher or lower levels of reading achievement made similar gains in content reading comprehension whether they were in the PACT instruction or typical instruction. Again, the benefits of the PACT instructional practices on knowledge acquisition did not similarly increase the reading comprehension of content area text for any specific type of class.

*The current study provides evidence that whether students are in general education classes with peers that have lower or higher background knowledge or reading achievement, they benefit similarly from the PACT instructional practices.*

Students with disabilities often lag behind their peers without disabilities in areas such as background knowledge and reading achievement (Compton et al., 2014). The current study provides evidence that whether students are in general education classes with peers that have lower or higher background knowledge or reading achievement, they benefit similarly from the PACT instructional practices. Importantly, average peer levels of background knowledge or reading achievement did not serve to increase the benefits of the PACT instruction for students in any systematic way. Thus, there did not appear to be a specific benefit for receiving instruction in a lower or higher level class. Of course, all of the classes had a range of learners, so this finding does not suggest that tracking students in general education specifically by ability would result in the same findings.

Importantly, students with disabilities remained behind their nondisabled peers in outcomes even though they benefitted from the PACT intervention. Students with disabilities receiving the PACT treatment gained approximately 4.5 correct questions on average on the ASK content acquisition compared to about seven correct questions gained by students without disabilities receiving the PACT treatment. However, students with disabilities in the typical instruction condition gained approximately 2.5 correct questions compared to a gain of 4.5 correct questions for students without disabilities receiving typical instruction. Thus, the benefit of the PACT intervention over typical instruction was similar for students with and without disabilities, but students with disabilities remained approximately 1 standard deviation behind their nondisabled peers in content knowledge at posttest. However, students with disabilities in the PACT intervention gained 1.5 correct questions on the ASK reading comprehension while their nondisabled peers receiving the intervention gained one correct question, demonstrating more similar gains to peers. Students with disabilities receiving typical instruction did not make any gains from pretest to posttest in content reading comprehension, though nondisabled peers gained one correct question. However, students with disabilities in the treatment remained approximately four correct questions lower than nondisabled peers at posttest, again, about 1 standard deviation behind peers. Consequently, while the current study as well as previous work (Swanson et al., 2015; Wanzek et al., 2016) suggest middle school students with disabilities in general education social studies classes can make greater gains in their social studies knowledge acquisition when receiving PACT instruction, more intensive treatments are certainly needed to address knowledge and comprehension deficits and allow them to better access the general education content.

This study examined classes in five school districts that were located in either the Southwest or the Southeast regions of the United States. The results may be limited specifically

to these regions. The participating teachers were provided with not only training in the PACT instructional practices but also in-class support from the research team to assist with obtaining the fidelity levels noted in the original study. The robustness of the instruction across the class levels may be possible only when at least these fidelity levels are reached and/or this amount of support in the instruction is received. In addition, because reading comprehension is correlated with students' background knowledge (Cromley & Azevedo, 2007; Ozuru, Dempsey, & McNamara, 2009), the Gates-MacGinitie reading comprehension measure may be representative of both students' reading comprehension and their background knowledge on general topics. The findings may represent both class reading achievement and general knowledge that is not specific to social studies or the social studies content taught in PACT (i.e., background knowledge measured by ASK).

In this study, we employed a large sample of students and classes, and the benefits of PACT for content knowledge acquisition remained robust across class levels, with no systematic differences in effects for the treatment based on the class's incoming level of background knowledge or reading comprehension. The PACT instruction contrasts with typical instruction in its more active approach to reading, learning, and applying the content to novel situations. This approach may help a range of classes improve their content acquisition. The PACT instructional practices can increase student acquisition of content knowledge, and learners in a wide range of class levels can benefit from this instruction.

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