Examining Elementary Students' Purposeful and Ancillary Prior Knowledge Activation When Reading Grade Level Texts

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— Abstract —

Prior knowledge activation is a crucial component of reading comprehension. Previous studies have examined students' prompted (or solicited) purposeful knowledge activation, which occurs when the explicit goal is to activate knowledge, as well as ancillary knowledge activation, which is when students indirectly use their prior knowledge to fill in gaps in the text, form an opinion, or question the author. However, little is known regarding elementary students' unprompted (or unsolicited) purposeful and ancillary activation of prior knowledge while reading grade-level texts. The purpose of the current study was to (a) examine differences between third- and fifth-grade students on their use of purposeful and ancillary prior knowledge activation when reading grade-level social studies and science texts and (b) determine how students' prior knowledge activation relates to their reading outcomes and reader profiles. Participants were 25 third-grade and 27 fifth-grade students from an urban school system in the southeastern United States. Participants were asked to think aloud as they read grade-level texts. Utterances were transcribed and coded according to the type of knowledge activation. Although repeated measures ANOVA revealed no significant differences in purposeful or ancillary activation across texts or between grade levels, the way in which students utilized these two types of prior knowledge activation (i.e., purposeful and ancillary) differed as a function of their reader profile. To uncover these differences, we took a case study approach to further explicate the complex relations between prior knowledge activation, other reading behaviors, and reading outcomes.

Keywords: prior knowledge activation, reading comprehension, think-aloud methodology

Prior knowledge has been shown to be a significant predictor of reading competence, guiding students' understanding and comprehension of written language (Anderson, Reynolds, Schallert, & Goetz, 1977; Kendeou, McMaster, & Christ, 2016). In fact, Anderson and Pearson (2002) stated that reading comprehension entails "the interaction of new information with old knowledge" (p. 255). However, for this interaction

between the text and reader to occur, readers must engage in prior knowledge activation by making their existing knowledge accessible (Förster & Liberman, 2007). Through this process, readers interact with texts and recognize relations between what they already know and the text in front of them.

Previous studies examining prior knowledge activation have focused on specific activation techniques that encourage either *purposeful* or *ancillary* knowledge activation. Purposeful activation of prior knowledge during reading occurs when the explicit goal is activating knowledge and necessitates the use of metacognitive knowledge, which "includes knowledge of general strategies that might be used for different tasks" (Pintrich, 2002, p. 219). When students know about strategies for learning, they are more likely to intentionally use those strategies during the learning process (Pintrich, 2002). These strategies aid students in directly referencing their knowledge base, such as referring back to a previous personal experience or previously learned facts or concepts. The instructional technique of asking students to write down everything they know about a topic, also called knowledge mobilization, encourages students to purposefully activate their prior knowledge. For example, participants might be asked to write down everything they know about Amelia Earhart before reading a text about her disappearance (Mannies, Gridley, Krug, & Glover, 1989) or asked to write down what they know about rattlesnakes before reading a text titled "The Rattlesnake and Its Enemies" (Alvermann, Smith, & Readence, 1985).

On the other hand, ancillary activation indirectly uses prior knowledge to fill gaps in the text, form an opinion about the text, or question the author. During ancillary activation, prior knowledge activation helps serve another purpose, but may not be the explicit goal of that particular reading strategy. For example, when students make knowledge-based inferences (Magliano, Trabasso, & Graesser, 1999) they may not directly recognize the ways in which prior knowledge helps them construct meaning of the text, and therefore they engage in ancillary knowledge activation. Alternatively, ancillary activation may occur when readers use what they know to make a prediction about what will happen next in the text.

Even though past research does shed light on the benefits of both purposeful and ancillary knowledge activation, less is known about how these types of activation work in concert, especially without external prompting. Additionally, when looking specifically at unprompted prior knowledge activation, previous research has not examined the influence that it may have on students' text comprehension. The purpose of the current study was to examine the extent to which third- and fifth-grade students used purposeful or ancillary prior knowledge activation while reading and to investigate how prior knowledge activation may influence students' reading outcomes.

Theoretical Framework and Previous Research

Prior Knowledge Activation and Reading Comprehension

Given the significant role of prior knowledge in supporting students' reading comprehension, a number of explanatory theories (e.g., Anderson et al., 1977; Ausubel, 1968; Kintsch, 1998) and empirical research studies (e.g., Gurlitt & Renkl, 2008; Mannies et al., 1989; Stahl, 2008; Wetzels, Kester, & van Merriënboer, 2011) have considered and investigated prior knowledge activation. For example, Kintsch's (1998) construction integration model proposes that the process of text comprehension includes the integration of text content with the reader's general prior knowledge and personal experience. According to Kintsch, readers assimilate information in the text with what they already know in an effort to create a situation model. This situation model is dependent on a student's goals for reading as well

as the amount of knowledge the reader has prior to engaging with the text (Kintsch, 1998).

Kintsch (2005) suggests that fluent adult readers automatically activate their prior knowledge, whereas novice readers might approach comprehension more like a problem-solving task. When the normal flow of comprehension breaks down, the use of deliberate strategies is helpful (Kintsch, 2005). It is important for students to know which reading strategies to use and when to use them (Paris, Wasik, & Turner, 1991). Specifically, poor readers struggle to use their prior knowledge to develop inferences from the text, but even low-ability and regular-ability readers benefit from external prompting to activate their prior knowledge (Biemans, Deel, & Simons, 2001; Carr & Thompson, 1996).

Developmental Aspects of Reading and Prior Knowledge Activation

The question remains when and for whom these prior knowledge activation strategies may be helpful. Alexander's (2005) description of reading from a lifespan developmental perspective provides insight into the potential influence of knowledge activation on students' comprehension of texts (i.e., reading outcomes). In Alexander's model, readers move from being more novice in reading (i.e., the acclimation stage), through competence, and finally toward greater expertise in reading (i.e., proficiency). Three factors—knowledge, interest, and strategies—are the forces that propel readers on their journey toward greater expertise (for a greater explication of the development of reading expertise, see Fox & Parkinson, 2018).

At issue in this study is the role of knowledge and strategies. With regard to knowledge, there are two types: domain and topic. Domain knowledge refers to the breadth of students' knowledge, whereas topic knowledge refers to the depth of students' knowledge about specific topics within the domain. Therefore, as students gain more domain and topic knowledge, they become more competent readers. Additionally, Alexander (2005) noted that readers' strategic processing changes as they develop expertise in reading. In the acclimation stage, students may depend more on surface-level strategies, such as rereading or underlining the text, rather than deep processing strategies, such as questioning the author. As readers move toward proficiency, they rely less on surface-level strategies and more on deep processing strategies.

Over time readers' knowledge and strategic processing change. Similarly, we might expect an increase or decrease in prior knowledge activation as students move through the stages of reading development. Therefore, we were interested in how students' prior knowledge activation shifts as they mature. The current study examined differences in third- and fifth-grade students' knowledge activation as well as how students' prior knowledge activation impacted their reading outcomes. Although both third- and fifth-grade students likely fall into the acclimation stage of reading development, we were interested to see if there were developmental differences between these two grades of elementary school students.

One way to examine the influence of students' prior knowledge activation on reading comprehension is by developing reader profiles. Reader profiles can support educators in increasing students' reading performance (Alexander, 2005; Dinsmore, Fox, Parkinson, & Bilgili, 2018). Reader profiles help capture the multidimensional nature of reading and have been used to group readers according to various attributes (e.g., Brasseur-Hock, Hock, Kieffer, Biancarosa, & Deshler, 2011; Dinsmore et al., 2018; Wolff, 2010). Alexander (2005) proposed six reader profiles: Highly competent readers have a sufficient knowledge base, a repertoire of surface and deep-level processing strategies, and interest in reading; seriously challenged readers exhibit reading difficulties ranging

from language-processing difficulties to limited background knowledge to negative motivational conditions; effortful processors have a high level of strategic effort and are successful readers due to their persistence with reading; knowledge-reliant readers rely on their existing knowledge; nonstrategic processors have a limited understanding of task demands and use few strategies; and resistant readers lack the desire or will to attain their reading potential. Additionally, Dinsmore, Fox, Parkinson, and Rahman (2010) proposed a seventh profile, interest-reliant readers, whose engagement with the text depends on their topic or situational interest. The key variables that make up these profiles are presented in Table 1.

Table 1
Patterns of Key Variables for Reader Profiles

Reader type	Background knowledge	Reading knowledge	Strategy knowledge	Reading interest	Engagement	Reading success
Effortful	+/–	–	–	+	+	+/–
Knowledge reliant	+/–	–	–	+/–	+/–	+/–
Nonstrategic	+/–	–	–	+/–	+/–	+/–
Highly competent	+/–	+	+	+	+	+
Challenged	–	–	–	–	–	–
Resistant	+/–	+	+	–	–	–

Gaps in the Current Literature

Although previous research supports the importance of prior knowledge activation in the reading process, there are several gaps in the literature that are addressed in the current study. First, previous investigations into prior knowledge activation tended to focus on instructional techniques that teachers use to guide prior knowledge activation (e.g., Biemans et al., 2001; Gurlitt & Renkl, 2010; van Loon, de Bruin, van Gog & van Merriënboer, 2013), rather than investigating students' unsolicited knowledge activation, with few exceptions (Spires & Donley, 1998). Despite the critical role that external prompts have in aiding students' comprehension (Carr & Thompson, 1996), external assistance is not always available to readers, especially when students read independently. Therefore, it is crucial that researchers and educators investigate the types of unsolicited knowledge activation that take place during reading, either purposeful or ancillary, and the influence of unsolicited activation on students' comprehension of texts.

Second, in previous studies, a more conservative approach was taken in examining the presence of teacher-prompted prior knowledge activation (e.g., Hattan, Singer, Loughlin, & Alexander, 2015). In those studies, only purposeful prompts of prior knowledge activation were included, and the authors reported that prior knowledge activation was rare. There was an implicit assumption in the literature that more knowledge activation would lead to better comprehension outcomes for students, without the ability to link frequency of knowledge activation to student outcomes (Hattan et al., 2015). The current study addressed both purposeful and ancillary prior knowledge activation in

relation to the frequency with which students activate their prior knowledge while reading as well as the ways in which prior knowledge activation may influence students' reading outcomes and identified reader profiles.

Participants targeted in the prior knowledge activation literature have been primarily high school (Hayes & Tierney, 1982; Salminen, Marttunen, & Laurinen, 2010; Spires & Donley, 1998) or undergraduate students (Alvermann & Hynd, 1989; Hattan & Alexander, 2018; McNamara & McDaniel, 2004; Pressley, Tanenbaum, McDaniel, & Wood, 1990), with a limited number of studies investigating elementary or middle school students (Biemans et al., 2001; Carr & Thompson, 1996). This gap in the research leaves educators to speculate about how different approaches to prior knowledge activation might influence younger students. Further, past research has primarily investigated prior knowledge activation in one domain, rather than examining two domains within the same study. For example, studies have analyzed prior knowledge activation and text comprehension in science (Amadieu et al., 2015; Wetzels et al., 2011), history/social studies (Martin, Konopak, & Martin, 1986; Spires & Donley, 1998), and reading (Hayes & Tierney, 1982; Kiili, Laurinen, Marttunen, & Leu, 2012), with only a handful of studies investigating prior knowledge activation across domains (Salminen et al., 2010). The current study investigates third- and fifth-grade students' unsolicited prior knowledge activation in multiple domains (i.e., science and social studies).

Current Study

The focus of the current study was to examine the role of prior knowledge activation during the interaction between text and reader. Specifically, we analyzed whether students used purposeful or ancillary prior knowledge activation while reading. Purposeful activation is when students explicitly consider how the text relates to something they already know, whereas ancillary knowledge activation is when students indirectly activate their prior knowledge to serve some other goal.

The current study focused on third- and fifth-grade students because those years are particularly crucial to students in Florida, where the data were collected. The state of Florida administers standardized assessments during third and fifth grades, with the possibility of retention at the end of third grade if students do not pass the assessments (Florida Department of Education, 2014). Further, although both third- and fifth-grade students likely fall within the acclimation stage of reading development, it is fairly typical for students' exposure to expository texts to increase as students advance in grade levels (Common Core State Standards Initiative, 2017; National Assessment Governing Board, 2010). Therefore, there are environmental differences between third- and fifth-grade students, which may affect students' reading development.

For the current study, we were interested in students' prior knowledge activation when they read academic texts that are required at their specific grade level, rather than asking students to read texts that are below or above that which is required for their current grade. Therefore, we used text passages that were part of third- and fifth-grade standardized tests at their respective grades.

In order to gain access to students' cognitive processes while reading, the data sources for the current study were concurrent think-alouds. Think-aloud protocols have seen increasing use in the research literature (Fox, 2009) and are a powerful way to uncover students' covert mental process, without changing task outcomes (Veenman, Van Hout-Wolters, & Afflerbach, 2006). Think-alouds were especially useful in the current study, because we were interested in students' prior knowledge activation that is *unprompted*.

This is particularly important because the expectation is that readers would have the metacognitive and regulatory ability to engage in these activities when they encounter comprehension difficulties (Afflerbach & Johnston, 1984; Pressley & Afflerbach, 1995). For the current study, students were asked to say out loud what they were thinking and doing while reading a text. There were no specific prompts, which provided insight into students' purposeful and ancillary prior knowledge activation. This is different from intervention research (e.g., Biemans et al., 2001; Hattan, 2019) when students are taught to activate their knowledge with a prompt from a researcher or teacher. Additionally, rather than inferring knowledge activation through the use of postreading measures, the think-aloud protocol captured students' thoughts in situ.

Data from the current study came from a larger study of elementary students' reader profiles (Dinsmore et al., 2018). The larger study examined students' prior knowledge and a broad range of reading strategies to identify which reader profiles (Alexander, 2005) emerged and how these profiles predicted reading success and failure. The purpose of the current study was to examine specific prior knowledge activation strategies and how this prior knowledge activation influenced other strategies (i.e., ancillary activation). We draw on some of the findings of the larger study—particularly the identification of the reader profiles—and expand on that here by placing the role of prior knowledge activation front and center.

Two research questions guided the current study:

1. Do third- and fifth-grade students differ on their use of purposeful and ancillary prior knowledge activation when reading grade-level social studies and science texts?

2. How do students' purposeful and ancillary prior knowledge activation relate to their reading outcomes and identified reader profile?

Method

The current study was part of a larger study that investigated third- and fifth-grade students' reader profiles (Dinsmore et al., 2018). Only the measures reported in this particular study are described here.

Participants were 25 third-grade students (mean age 8.9 years) and 27 fifth-grade students (mean age 11.0 years) from two elementary schools in an urban school system in the southeastern United States (43% male, 57% female). These participants were ethnically diverse and predominantly African American (46%). Only one student reported being a nonnative English speaker. Participants were selectively recruited to obtain a range of scores on state standardized reading assessments: the Florida Comprehensive Achievement Test (FCAT) for the fifth graders and the Florida Assessments for Instruction in Reading (FAIR) for the third graders. Students were selected with the recommendation of teachers, principals, and assistant principals based on the previous year's standardized and unstandardized test results. Specifically, students were identified from across the spectrum of reading achievement on the prior year's standardized reading test. Four students were dropped from the larger pool because there were no think-aloud data for these participants.

Materials

The materials for this study consisted of one science and one social studies passage

for third-grade students and one science and one social studies passage for fifth-grade students, with a total of four passages across both grade levels. These passages were taken from previously released materials used in the FCAT (Florida Department of Education, 2014) for third and fifth graders. Passages were selected to represent typical science and social studies passages across each grade level from the released test materials that were approximately equal in terms of length. Descriptive and readability statistics using coh-metrix (Graesser, McNamara, Louwerse, & Cai, 2004) for each passage are presented in Table 2.

Table 2

Readability Statistics for the Study Passages

Passage	Grade level	Word count	Domain	Flesch-Kincaid grade level	Narrativity (percentile)	Syntactic simplicity (percentile)	Word
A Gift of Trees	3	501	Social studies	5.7	33.7	74.2	94.4
Swim, Baby, Swim	3	699	Science	3.8	54.4	80.2	99.6
What Are You Figuring Now	5	853	Social studies	5.2	72.6	75.1	96.0
What Is an Ecosystem?	5	625	Science	8.8	15.9	76.4	96.4

Measures

The measures for the study included a demographics measure, prior knowledge measures for each passage topic, and reading outcomes for each passage.

Demographics. The demographics measure included questions about participants' gender, age, grade, ethnicity, and native language.

Prior knowledge. The prior knowledge questions assessed students' knowledge on the topic of each of the passages they read. The prior knowledge measures had six multiple-choice questions that were scored on a graduated scale. The graduated scale included four points for the correct answer, two points for an in-domain incorrect answer, one point for an out-of-domain answer, and zero points for an unrelated response. Here is an example item:

What does a *bolt* of cloth refer to?
a. a specific color of cloth (2)
b. when lightning strikes cloth (0)
c. a specific length of cloth (4)
d. the quality of cloth (1)

Students' scores on the prior knowledge items were examined using exploratory factor analysis (EFA) to reduce the prior knowledge items into a single score. Rather than simply summing the scores for each item, the EFA was utilized to remove error from the item scores to create a more error-free latent construct. Thus, rather than sum scores for the items, factor scores were derived from the EFA. These factor scores are sample dependent and have a mean of 0 and a standard deviation of 1. Construct reliability—evaluated using Coefficient *H*, which is a measure of latent reliability—of the prior knowledge measures ranged from .74 to .81, which are considered acceptable (Hancock & Mueller, 2001).

Reading outcomes. The reading outcomes used for this study consisted of two open-ended questions about each passage: What is the overall main idea of the passage? What are the important ideas that the passage tells about? The passage was available to the participants as they answered the reading outcome questions, making the memory demands of this task similar to what is asked for in the standardized reading comprehension assessments these students take. The first question regarding main idea was scored zero if the response was unrelated to identified main idea statements from the passage, one if a relevant but incomplete response was given, and two if an accurate statement of the main idea was provided. The second question regarding important ideas was scored zero if the response included no identified key points from the passage, one if one key point was included, and two if more than one key point was included in the response. It was very rare for participants to include more than two key points for this question. Scores for questions one and two were summed to create a total reading outcome score. Questions one and two had 79% and 76% exact inter-rater agreement for assignment of scores, respectively, across 50% of the total reading instances accounting for both passages each participant read. This was considered acceptable with one rater coding the remaining scores independently.

Procedures

Participants completed the study materials in two separate sessions. Participants were randomly assigned to either the science or social studies passage during the first session, in which they completed the demographics measure, a practice think-aloud, a think-aloud while reading their assigned passage, and the outcome measure for their assigned passage. During the second session, participants completed a think-aloud and outcome measures for the second passage.

The collected think-alouds were transcribed, and then purposeful and ancillary prior knowledge activation utterances were identified. Total utterances for the third graders ranged from 0 to 37, and total utterances for fifth graders ranged from 0 to 30. Table 3 includes each code, a description of the code, and an example of each code. The first author created the coding scheme following an iterative process of scheme application and refinement. Once the codes were refined, the second author was trained in the use of the coding scheme using four of the transcripts. To build inter-rater reliability, the second author then independently coded 17 think-alouds across all four passages (169 total codes, 32% of total utterances), with excellent inter-rater reliability (88% agreement; Cohen's kappa = 0.85; Fleiss, 1981). All disagreements were discussed and rectified in conference. There were no predictable patterns of disagreement, with the most disagreements being the inability to distinguish between *opinion* and *other* (four instances). Following this procedure, the first author coded the remaining transcripts. In addition, we used the reader profiles already coded in Dinsmore et al. (2018).

Table 3

Coding Scheme for Purposeful and Ancillary Knowledge Activation

Code	Description	Examples
Attempted prior knowledge activation (purposeful)	The reader attempts to make a connection between the text and something he or she already knows, but is unsuccessful.	"I never been to a festival before." "I never heard of a popcorn tree."
Personal experience (purposeful)	The reader refers back to an experience he or she has already had.	"This story reminds me of the first time I ummm, I had an apple tree." "My mom doesn't like cherries."
General world knowledge (purposeful)	The reader refers back to any known facts or concepts.	"Washington, D.C….has almost everything white." "Oh, that was the year the Titanic sank."
Inference (ancillary)	The reader uses what he or she already knows to fill in gaps in the text.	"He was, say, the person that's in charge." "The trees died probably because the tree had old roots."
Prediction (ancillary)	The reader uses what he or she knows to guess what will happen next in the text.	"The tree is g-growing cherry blossoms and she's gonna share it with her teachers and her friends and classmates." "I think when he grows he's going
Questioning (ancillary)	The reader uses background knowledge to ask a question about the text.	"How can a tree full of popcorn grow?" "Well, was the mayor Ozaki, was he kind of jealous?"
Opinion (Ancillary)	The reader uses background knowledge to state an opinion about something that occurs in the text.	"That's nasty." "Telling the truth is better than lying."
Other	The reader does not use his or her prior knowledge.	"I bet." "So while school is going people, the teachers take their students to view the trees."

These codings were developed by examining where each participant fell on key reading variables of interest referenced in Table 1 relative to other participants in the sample. For example, readers who possessed high levels of reading knowledge, background knowledge, strategy knowledge, reading interest, engagement, and reading success were coded as *highly competent* readers. Readers who possessed high levels of reading and strategy knowledge, but low levels of reading interest, engagement, and reading success were coded as *resistant* readers. These profiles had acceptable inter-rater agreement with 71% initial agreement across raters, with any disagreements rectified in conference.

Analyses

For question one we examined the within-subject differences of domain (i.e., social studies vs. science) and between-subject differences of grade level (i.e., third vs. fifth grade) using repeated measures analyses for both purposeful and ancillary prior knowledge. Prior to this analysis, univariate skewness and kurtosis were examined, which were all under the recommended values of 2 and 7, respectively (Finney & DiStefano, 2006), except for purposeful knowledge activation for the social studies passage (skew = 4.99; *kurt* = 28.77). Thus, we followed up by using a Mann-Whitney U-test to analyze any grade-level differences for the social studies passage.

For question two, we analyzed the effects of prior knowledge activation using a multiple regression model. Because the findings for question one, which are detailed subsequently, were nonsignificant and with very low effect sizes, we combined the grade-level and domain data into a total purposeful activation score and a total ancillary activation score for each participant. These scores, as well as their interaction effects, were regressed on outcome scores. These outcome scores were also univariate normal (skew = 0.68; *kurt* = 0.03), and normal probability plots were within an acceptable range. Finally, we created a summary table of the reader profiles with regard to purposeful activation, ancillary activation, and outcome scores (Table 4). Based on those data, cases were pulled from the sample to illustrate trends in these data.

Table 4

Examples of Students in Each Reader Profile.

Student	Reader profile	Outcome score	Purposeful activation utterances	Ancillary activation utterances	Total utterances	Social studies prior knowledge score	Science prior knowledge score	Sample utterance
306	Highly Competent	3	5	0	15	−0.10	−0.65	"My parents don't just worry about me that much." (Personal Experiences/ Purposeful PKA)
501	Effortful	4	1	36	40	−0.38	−0.02	"Why did he have a lot of jobs instead of just having one?" (Questioning/ Ancillary PKA)
353	Knowledge Reliant	1	2	11	13	1.07	−0.55	"This story reminds me of the first time I ummm, I had an apple tree." (Personal Experiences/ Purposeful PKA)
563	Interest Reliant	2	3	5	11	0.38	1.08	"I didn't know sea urchins were animals" (PKA Attempt/ Purposeful PKA)
356	Nonstrategic	3	0	1	4	−1.79	−0.38	"Popcorn trees" (other)
360	Seriously Challenged	2	0	0	1	−1.76	−2.28	"Is it really long?" (other)
559	Resistant	0	0	0	0	0.57	−0.92	N/A

Results and Discussion

Domains

The first question addressed differences in the frequency with which third- and fifth-grade students used purposeful or ancillary prior knowledge activation when reading. Repeated measures ANOVA revealed no significant or meaningful differences in purposeful activation across texts ($F = 0.079$, $p = .78$, $p\eta^2 = .002$) or between grade levels ($F = 0.18$, $p = .68$, $p\eta^2 = .004$) and in ancillary activation across texts ($F = 1.25$, $p = .27$, $p\eta2 = .024$) or between grade levels ($F = 1.47$, $p = .23$, $p\eta^2 = .028$). The lack of statistically significant differences between third- and fifth-grade students suggests that students in both grade levels may still be in the acclimation stage of reading development (Alexander, 2005) and have not yet advanced to competence. Further, according to Alexander's (2005) model of domain learning, both third- and fifth-grade students may rely heavily on surface-level strategies and have not yet developed a dependence on deeper processing strategies. Given this lack of significant or meaningful difference, we combined the grade levels and texts for subsequent analysis.

Across the two texts, students purposefully activated prior knowledge an average of 1.4 times (range = 0–20), or in 14% of their total utterances. The distribution of purposeful activation is presented in Figure 1. Participants used ancillary prior knowledge activation an average of 5.4 times across the two texts (range = 0–36), or in 53% of their total utterances. The distribution of ancillary activation is presented in Figure 2. Both purposeful and ancillary prior knowledge activation occurred more frequently than anticipated (Hattan et al., 2015), yet the range of students' responses is fairly large. Further, a number of students had zero instances of purposeful or ancillary prior knowledge activation, and other participants were more verbal during the think-aloud protocols and activated their prior knowledge several times during the reading process (see Figures 1 and 2).
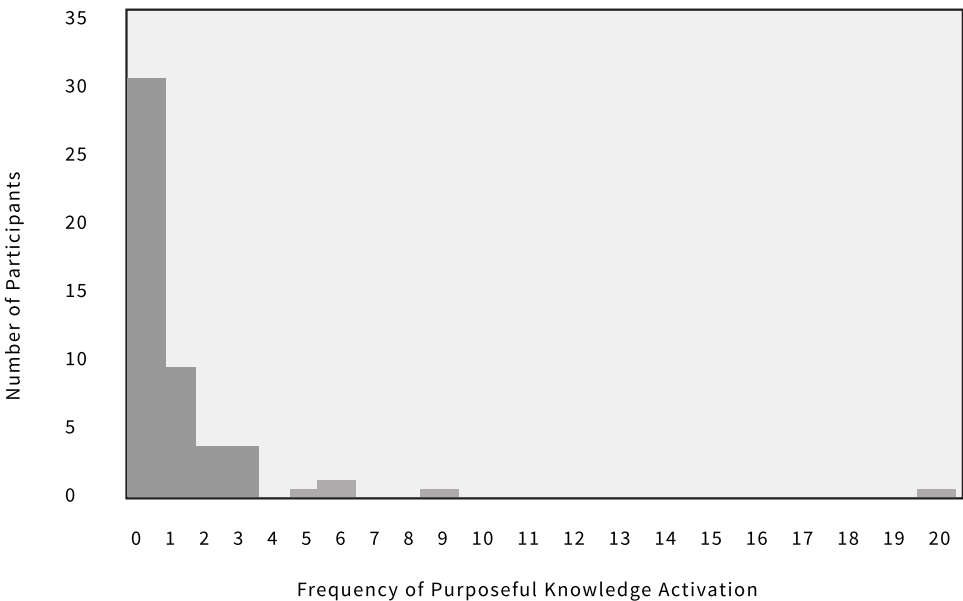

Frequency of Purposeful Knowledge Activation

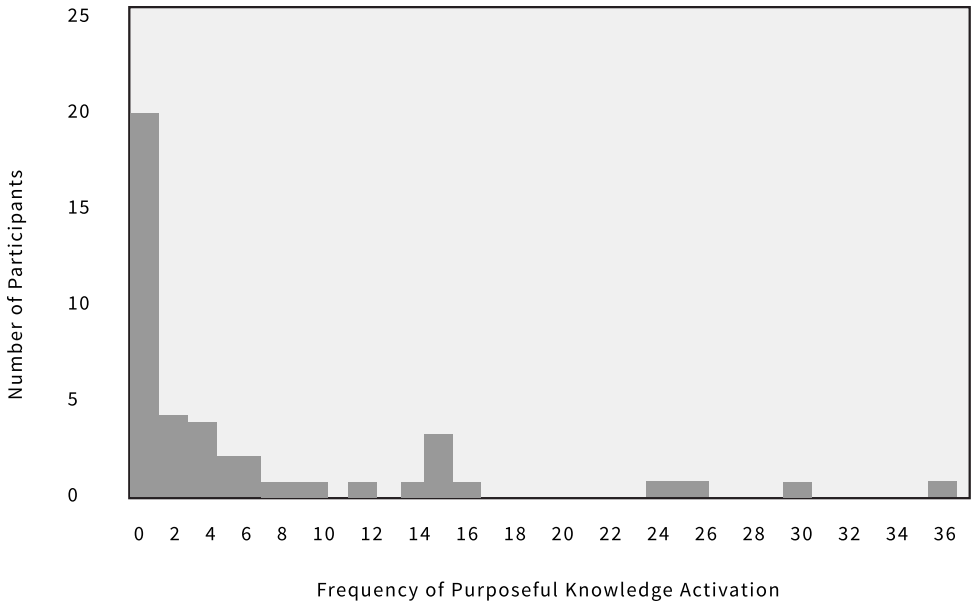*Figure 1. Distribution of Purposeful Knowledge Activation.*

Figure 2. Distribution of Ancillary Knowledge of Activation.

Differences in Student Outcomes and Reader Profiles

The second research question examined how differences in prior knowledge activation (i.e., purposeful versus ancillary) related to students' outcomes and their identified reader profile that were drawn from Dinsmore et al. (2018). Multiple linear regression revealed no linear relations between purposeful prior knowledge activation ($b = .062$, $t = 0.70$, $p = .49$), ancillary prior knowledge activation ($b = .038$, $t = 1.04$, $p = .31$), or the interaction between purposeful and ancillary ($b = -.017$, $t = -1.47$, $p = .15$) on reading outcomes (i.e., main idea and supporting details of the text). As we had expected purposeful prior knowledge activation to positively predict reading scores, this was a surprising result. However, further analyses of the reader profiles revealed interesting trends in these data.

Table 5 displays the summary data related to PKA and reading outcomes, and Tables 6 and 7 provide data by reader profile and grade level. Although we would have expected the highly competent readers to score higher on the outcomes (Dinsmore et al., 2018), this was not necessarily the case, with effortful processors scoring quite a bit higher (2.75 vs. 3.80, respectively). What is evident from this sample is that the effortful processors relied much more heavily on ancillary activation (almost 99% of the total activation codes), whereas the highly competent readers did this much less (75% of the total activation codes).

Table 5

Descriptive Statistics for Prior Knowledge Activation and Reading Outcomes

	Third graders		Fifth Graders	
	Mean (SD)	Min/Max	Mean (SD)	Min/Max
Social studies				
Purposeful PKA	0.76 (1.33)	0/5	0.63 (2.50)	0/13
Ancillary PKA	1.92 (3.28)	0/14	4.04 (6.61)	0/28
Total PKA	2.64 (4.44)	0/19	4.67 (6.94)	0/29
Science				
Purposeful PKA	0.92 (1.58)	0/5	0.63 (1.50)	0/7
Ancillary PKA	2.28 (3.54)	0/11	2.74 (4.15)	0/14
Total PKA	3.20 (4.44)	0/12	3.37 (4.11)	0/14
Reading outcomes	2.92 (1.73)	0/7	2.15 (1.85)	0/7

Note. PKA = prior knowledge activation.

As an exploratory step, we analyzed a subset of cases to examine what might be occurring in these data. We chose one student from each reader profile to examine the frequency of his or her purposeful and ancillary prior knowledge activation, in addition to participants' total number of utterances, outcome measures, and prior knowledge measure scores. Students' reader profiles were coded and developed in a previous study (Dinsmore et al., 2018). Table 4 presents the data for seven students who represent each reader profile, and below, three specific cases are discussed for the most frequently occurring reader profiles. Student numbers in the 300s refer to third graders, and those in the 500s refer to fifth graders.

Reader profile: Nonstrategic. Participant 356 was identified as nonstrategic, indicating that he or she operates with few or faulty strategies and does not have a clear understanding of the requirements set forth by the assigned task. This student engaged in purposeful activation zero times and ancillary activation one time out of four utterances across both reading selections. Most of this student's utterances were short restatements, such as "popcorn trees" or "birds swimming," with one utterance coded as ancillary activation ("I wonder how he's gonna fly again"). Participant 356 had very little prior knowledge in the social studies topic (–1.79) and little prior knowledge on the science topic (–0.38), yet this student's comprehension outcome score was 3. Other nonstrategic third-grade students scored similarly on the outcome measures ($M = 3.10$), yet nonstrategic fifth-grade students scored a bit lower on the outcome measures ($M = 1.56$). There are

several possible reasons for these results. One explanation is that participant 356, as well as other nonstrategic third-grade readers, may be good at testing. If students tend to be good at testing, they may not engage in reading comprehension strategies, thus being identified as nonstrategic readers (Pearson, 1978). Another explanation is that participant 356 may not be a particularly verbal child. It is possible that he or she silently engaged in reading strategies, but was not able to verbalize those thoughts during the think-aloud protocol, which is one drawback of this methodology.

Reader profile: Highly competent. Participant 306 was identified as a highly competent reader, which means that the student had a sufficient knowledge base and utilized multiple surface and deep-level strategies while reading. Although the majority of this student's utterances fell into the *other* category ("I wish I was in Japan so I could go to the fun festival"), he or she made several connections to prior experiences ("My parents don't just worry about me that much"). Out of this student's 15 utterances, five were labeled as purposeful connections, while there were zero instances of ancillary prior knowledge activation. For highly competent third-grade readers, prior knowledge on social studies and science concepts were factors scores that averaged 0.00 and 0.62, respectively. Participant 306 fell below the mean with prior knowledge scores of –0.10 for social studies and –0.65 for science. Additionally, this student earned a 3.00 on the outcome measure, which is similar to other highly competent third-grade readers. Data on participant 306 suggest that purposeful prior knowledge activation does not necessarily lead to better text comprehension. It is possible that this student did not produce a higher outcome score because he or she is still learning the process of reading. Although highly competent readers engage in multiple reading strategies, it is possible that this student is still learning how to best utilize those strategies in a way that supports his or her text comprehension.

Reader profile: Effortful processor. Participant 501 was considered an effortful processor, which includes students who have a high level of strategic effort and therefore tend to be successful due to their persistence with reading. Out of this student's 39 utterances across the two texts, only one included purposeful knowledge activation, with 36 of this student's utterances identified as ancillary prior knowledge activation. The vast majority of participant 501's utterances were questions, such as "Why did he have a lot of jobs instead of just having one?" Participant 501 scored –0.38 on the social studies prior knowledge measure and –0.02 on the science prior knowledge measure, and had more utterances on the social studies passage than on the science passage. He or she obtained a comprehension outcome score of 4.00, whereas other fifth-grade effortful processors averaged 3.25 on the outcome measures, and the one third-grade effortful processor scored 6.00 on the outcome measure.

Reader profiles and prior knowledge activation strategies. Overall, students' purposeful and ancillary prior knowledge activation, reader profiles, and reading outcomes provide us with complex data regarding students' reading comprehension. Although we expected highly competent readers to produce more prior knowledge activation utterances, as well as higher outcomes scores, this is not what occurred. Instead, the nonstrategic readers, who produced few purposeful or ancillary prior knowledge activation utterances, scored similarly to the highly competent readers, whereas the effortful processors engaged in little purposeful prior knowledge activation and higher ancillary activation, and produced higher scores on the reading outcomes (see Tables 4, 6, and 7).

Table 6

Prior Knowledge Activation by Reader Profile for Third Graders

	n	SS PK	SS Purp	SS Anc	SS Tot	Sci PK	Sci Purp	Sci Anc	Sci Tot	Outcomes
Highly competent	6	0.62	1.33	3.67	5.00	0.00	0.33	1.83	2.17	3.00
Effortful	1	−1.34	0.00	0.00	0.00	−0.32	0.00	1.00	1.00	6.00
Knowledge reliant	3	−0.23	1.33	3.33	4.67	0.50	0.33	1.33	1.67	1.67
Interest reliant	1	1.16	4.00	8.00	12.00	−0.32	0.00	3.00	3.00	5.00
Non-strategic	10	0.01	0.20	0.70	0.80	−0.10	1.60	1.80	3.40	3.10
Challenged	4	−0.56	0.25	0.25	0.50	0.00	1.00	5.00	6.00	2.00
Resistant	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Note. PK = prior knowledge, SS = social studies, Sci = science, Purp = purposeful, Anc = ancillary, Tot = total.

Table 7

Prior Knowledge Activation by Reader Profile for Fifth Graders

	n	SS PK	SS Purp	SS Anc	SS Tot	Sci PK	Sci Purp	Sci Anc	Sci Tot	Outcomes
Highly competent	6	0.31	2.50	5.17	7.67	0.13	1.50	6.33	7.83	2.50
Effortful	4	0.20	0.25	3.51	11.50	0.06	0.00	5.25	5.25	3.25
Knowledge reliant	2	0.49	0.00	8.50	10.50	-0.77	0.50	4.50	5.00	3.50
Interest reliant	3	0.27	0.33	1.68	2.67	0.02	1.67	0.67	2.33	2.33
Non-strategic	9	-0.09	0.00	3.11	0.44	0.31	0.22	0.33	0.56	1.56
Challenged	1	-0.39	0.00	0.00	1.00	-1.27	0.00	1.00	1.00	2.00
Resistant	2	-0.27	0.00	3.50	0.00	-1.54	0.00	0.00	0.00	0.00

Note. PK = prior knowledge, SS = social studies, Sci = science, Purp = purposeful, Anc = ancillary, Tot = total.

One possible explanation is that there is a lagged effect in terms of the highly competent readers' reading outcomes. Highly competent readers are engaged in the process of reading, have sufficient background knowledge, and utilize multiple reading strategies. Perhaps it is possible that these students are still honing in on their reading strategies and, after further development, will be able to effectively utilize various strategies to positively influence comprehension. On the other hand, the effortful processors produced higher outcome scores due to their perseverance and goal-directed behavior. Their extreme use of reading strategies led them to success, although they might benefit from working smarter, not harder (Alexander, 2005).

Additionally, although nonstrategic readers may depend on their test-taking skills or other attributes to produce acceptable scores on reading outcome measures, this ability may decrease as they encounter more challenging texts. Nonstrategic readers may be doing fine in elementary school, but as they develop, they are at risk of falling further behind, perhaps becoming challenged or resistant readers. These students would benefit from a clearer understanding of task demands so that they might efficiently and effectively use strategies during reading.

Conclusions and Implications

The interaction between texts and students' prior knowledge is the foundation of reading comprehension, as demonstrated in theory and empirical research (e.g., Ausubel, 1968; Bransford & Johnson, 1972; Kintsch, 1998). However, previous research has focused on specific knowledge activation techniques that assist students in activating their prior knowledge, rather than examining students' unsolicited activation (Gurlitt & Renkl, 2008; Wetzels et al., 2011). Our investigation provides three interesting insights into third- and fifth-grade students' unsolicited prior knowledge activation when reading grade-level texts that help explain the gap in readers' unprompted use of purposeful and ancillary prior knowledge activation.

First, our newly developed coding scheme appeared to function well in capturing learners' purposeful versus ancillary prior knowledge activation from think-alouds. This was evidenced by the high inter-rater reliability between the two coders. Having a reliable coding scheme for think-alouds enables researchers to better understand prior knowledge activation, as Pressley and Afflerbach's (1995) reading behaviors did more generally for coding thinking.

Second, the data from this investigation suggest that, when provided with the freedom to think aloud while reading a text, students used purposeful and ancillary prior knowledge activation more frequently than anticipated. Previous research demonstrated that teacher prompting of prior knowledge activation was rare in upper elementary classrooms (Hattan et al., 2015), leading us to believe that unsolicited knowledge activation would also be rare. Yet third- and fifth-grade students averaged 1.4 purposeful activation utterances and 5.4 ancillary activation utterances across the social studies and science texts. At the same time, although prior knowledge activation occurred more frequently than anticipated, over half of the participants engaged in zero or one instance of purposeful and ancillary prior knowledge activation across the two texts. Therefore, when provided with an avenue to verbalize their thoughts, third- and fifth-grade students activated their knowledge more frequently than anticipated, but still not as frequently as might be helpful for comprehension (Carr & Thompson, 1996). These data provide a useful baseline to consider what unsolicited prior knowledge activation might look like for third- and fifth-grade students.

Third, the results suggest that purposeful prior knowledge activation can be used as a scaffold to ancillary activation, especially for students in the acclimation stage of reading development. Although purposeful prior knowledge activation did not predict better outcomes, particularly when examining the highly competent readers versus the effortful processors, purposeful activation may have a latent lagged effect on outcomes later in students' development. This may be particularly true for highly competent readers who are actively engaged, have a sufficient knowledge base and interest in reading, and use various reading strategies, such as purposeful knowledge activation, to make sense of the text.

One analogy to consider is that purposeful knowledge activation is similar to learning to crawl before learning to walk. Initially, children may need the scaffold of crawling to build up the muscles necessary for walking. Similarly, students may first benefit from learning to purposefully activate their prior knowledge by making explicit connections between what they already know and the text in front of them. However, eventually their background knowledge can be automatically activated to serve some other purpose, such as making inferences, predictions, or questioning the text. Just like some children do not need to crawl before they walk, some students do not need to focus on purposeful activation before utilizing ancillary activation.

Although the current study included a small sample of students and was exploratory in nature, the results provide insights to be considered by practitioners. For one, teachers should be aware that many upper elementary students might not strategically activate their prior knowledge while reading, as evidenced by the relatively low number of purposeful prior knowledge activation utterances. Therefore, teachers may want to spend time modeling and teaching students how to activate their prior knowledge while reading texts on their own. For another, the results support the developmental nature of strategic processing (Alexander, 2005), and prior knowledge activation in particular. Teachers may want to consider students' developmental levels, as well as text difficulty, when determining to what extent they should assist or prompt students to activate their prior knowledge. Additionally, teachers should be aware that higher frequency of purposeful prior knowledge activation seems to be associated with highly competent readers, but is not definitively necessary to produce higher outcome scores on measures of reading comprehension.

Limitations and Future Direction

One potential limitation of the current study is that it does not focus on text coherence. This is partially due to the design of the study, given that we were interested in third- and fifth-grade readers' behaviors across texts, rather than within one specific text. It would be interesting for future studies to examine how purposeful and ancillary prior knowledge activation relate to text coherence, especially because there is evidence that increasing knowledge activation may be particularly important for texts in which there is low coherence (McNamara & Kintsch, 1996).

Although the think-alouds and subsequent knowledge activation coding scheme were helpful in elucidating the previously described relations, think-alouds may present some unique challenges when investigating knowledge activation. First, it is likely that participants do not verbalize all the activation that occurs (Pressley & Afflerbach, 1995), particularly because this becomes more automatic over time. Additionally, even though a practice think-aloud was conducted prior to the two passages, participants may have verbalized less during the think-alouds because this was a new procedure for them that was not used in their classrooms.

Second, think-alouds are done more frequently with older children, adolescents, and adults, so comparing younger and older children may be difficult as important developmental and contextual changes are occurring. These include the issues discussed previously that involve the skillful use of reading behaviors, changes in text characteristics, and changes in students' reading engagement. In addition, it will be important to consider both the quantity and nature of students' prior knowledge, such as whether the knowledge is declarative, procedural, or conditional. Typically, measures of prior knowledge focus on more declarative or factual representations of prior knowledge rather than procedural or conditional knowledge (Dinsmore & Fox, 2015).

One alternative to the think-aloud protocol is to examine students' unsolicited prior knowledge activation in classroom contexts. This might provide a more familiar environment for students to verbalize their prior knowledge activation while reading a text with their class. Although previous studies have examined teacher prompting of prior knowledge activation (Hattan et al., 2015), they have not investigated the frequency or quality of students' unsolicited knowledge activation utterances in classroom contexts. Given the importance of prior knowledge activation to reading success, it is important that research includes multiple methods and measures to triangulate ways in which readers can most skillfully and strategically activate their prior knowledge.

References

Afflerbach, P., & J ohnston, P. (1984). R esearch methodology o n t he u se of verbal reports in reading research. *Journal of Reading Behavior, 26*, 307–322. https://doi.org/10.1080/10862968409547524

Alexander, P. A. (2005). *The path to competence: A lifespan developmental perspective on reading*. Oak Creek, WI: National Reading

Conference. https://doi.org/10.1207/s15548430jlr3704_1

Alvermann, D. E., & Hynd, C. (1989). Effects of prior knowledge activation modes and text structure on nonscience majors' comprehension of physics. *Journal of Educational Research, 83*(2), 97–102.

https://doi.org/10.1080/00220671.1989.10885937

Alvermann, D. E., Smith, L. C., & Readence, J. E. (1985). Prior knowledge and the comprehension of compatible and incompatible text. *Reading Research Quarterly, 20*, 420–436.

https://doi.org/10.2307/747852

Amadieu, F., Salmerón, L., Cegarra, J., Paubel, P. V., Lemarié, J., & Chevalier, A. (2015). Learning from concept mapping and hypertext: An eye tracking study. *Educational Technology & Society, 18*(4), 100–112.

Anderson, R. C., & Pearson, P. D. (2002). A schema-theoretic view of basic processes in reading comprehension. In M. L. Kamil, P. B. Mosenthal, P. D. Pearson, & R. Barr (Ed.), *Handbook of reading research* (3rd ed., pp. 255–291). Mahwah, NJ: Lawrence Erlbaum.

https://doi.org/10.1017/cbo9781139524513.007

Anderson, R. C., Reynolds, R. E., Schallert, D. L., & Goetz, E. T. (1977). Frameworks

for comprehending discourse. *American Educational Research Journal*, *14*, 3 67–381.

https://doi.org/10.3102/00028312014004367

Ausubel, D.P. (1968). *Educational psychology: A cognitive view.* New York, NY: Holt, Rinehart and Winston.

Biemans, H. J. A., Deel, O. R., & Simons, P. R. (2001). Differences between successful and less successful students while working with the CONTACT-2 strategy. *Learning and Instruction, 11*, 265–281.

https://doi.org/10.1016/s0959-4752(00)00033-5

Bransford, J. D., & Johnson, M. K. (1972). Contextual prerequisites for understanding: Some investigations of comprehension and recall. *Journal of Verbal Learning and Verbal Behavior, 11*, 717–726. https://doi.org/10.1016/s0022-5371(72)80006-9

Brasseur-Hock, I. F., Hock, M. F., Kieffer, M. J., Biancarosa, G., & Deshler, D. D. (2011). Adolescent struggling readers in urban schools: Results of a latent class analysis. *Learning and Individual Differences, 21*, 438–452. https://doi.org/10.1016/j.lindif.2011.01.008

Carr, S. C., & Thompson, B. (1996). The effects of prior knowledge and schema activation strategies on the inferential reading comprehension of children with and without learning disabilities. *Learning Disability Quarterly, 19*(1), 48–61. https://doi.org/10.2307/1511053

Common Core State Standards Initiative. (2017). *Common Core State Standards for English language arts and literacy in history/social studies, science, and technical subjects*. Washington, DC: Council of Chief State School Officers and National Governors Association. Retrieved from http://www.corestandards.org/

Dinsmore, D. L., & Fox, E. (2015, August). *Tracking the relation between measures of prior knowledge and reading comprehension*. Paper presented at the biannual meeting of the European Association of Research on Learning and Instruction, Limassol, Cyprus.

Dinsmore, D. L., Fox, E., Parkinson, M. M., & Bilgili, D. (2018). Using reader profiles to investigate students' reading performance. *Journal of Experimental Education.* Advance online publication.
http://doi.org/10.1080/00220973.2017.1421519

Dinsmore, D. L., Fox, E., Parkinson, M. M., & Rahman, T. (2010, May). A deeper look at why readers succeed or fail. In D. McNamara (Chair), *Integration, depth, and complexity: Characterizing reader types through multidimensional profiling* Symposium presented at the annual meeting of the American Educational Research Association, Denver, CO.

Finney, S. J., & DiStefano, C. (2006). Non-normal and categorical data in structural equation modeling. In G. R. Hancock & R. O. Mueller (Eds.), *Structural equation modeling: A second course* (pp. 269–314). Charlotte, NC: Information Age.

Fleiss, J. L. (1981). Statistical methods for rates and proportions (2nd ed.). New York,

NY: John Wiley.
https://doi.org/10.1002/bimj.19740160814

Florida Department of Education. (2014). 2014 FCAT 2.0 writing: Frequently asked
    questions. Tallahassee, FL: Author.
    Retrieved from http://www.fldoe.org/core/fileparse.php/3/urlt/14fcat2writing.pdf

Förster, J., & Liberman, N. (2007). Knowledge activation. In A. W. Kruglanski & E. T.
    Higgins (Eds.), *Social psychology: Handbook of basic principles* (pp. 201–231).
    New York, NY: Guilford Press.

Fox, E. (2009). The role of reader characteristics in processing and learning from
    informational text. *Review of Educational Research, 7*(1), 197–261.
    https://doi.org/10.3102/0034654308324654

Fox, E., & Parkinson, M. M. (2018). Domain explorations of the model of domain
    learning—reading. In H. Fives & D. L. Dinsmore (Eds.), *The model of domain
    learning: Understanding the development of expertise* (pp. 89–107). New York,
    NY: Routledge. https://doi.org/10.4324/9781315458014-6

Graesser, A. C., McNamara, D. S., Louwerse, M. M., & Cai, Z. (2004). Coh-metrix:
    Analysis of text on cohesion and language. *Behavior Research Methods,
    Instruments, & Computers, 36*(2), 193–202. https://doi.org/10.3758/bf03195564

Gurlitt, J., & Renkl, A. (2008). Are high-coherent concept maps better for prior
    knowledge activation? Differential effects of concept mapping tasks on high
    school vs. university students. *Journal of Computer Assisted Learning, 24*,
    407–419. https://doi.org/10.1111/j.1365-2729.2008.00277.x

Gurlitt, J., & Renkl, A. (2010). Prior knowledge activation: How different concept
    mapping tasks lead to substantial differences in cognitive processes, learning
    outcomes, and perceived self-efficacy. *Instructional Science, 38,* 417–433.
    https://doi.org/10.1007/s11251-008-9090-5

Hancock, G. R., & Mueller, R. O. (2001). Rethinking construct reliability within latent
    variable systems. In R. Cudeck, S. du Toit, & D. Sorbom (Eds.), *Structural
    equation modeling: Present and future*—A festschrift in honor of Karl Joreskog
    (pp. 195–216). Lincolnwood, IL: Scientific Software International.

Hattan, C. (2019). Prompting rural students' use of background knowledge and
    experience to support comprehension of unfamiliar content.
    Reading Research Quarterly, 54(4).

Hattan, C. & Alexander, P. A. (2018). Scaffolding reading comprehension for competent
    readers. *Literacy Research: Theory, Method, and Practice, 67,* 1-14.
    https://doi.org/10.1177/2381336918786885

Hattan, C., Singer, L. M., Loughlin, S., & Alexander, P. A. (2015). Prior knowledge
    activation in design and in practice. *Literacy Research: Theory, Method, and
    Practice, 64*(1), 478–497. https://doi.org/10.1177/2381336915617603

Hayes, D. A., & Tierney, R. J. (1982). Developing readers' knowledge through analogy.
    Reading Research Quarterly, 17(2), 256–280.
    https://doi.org/10.2307/747486

Kendeou, P., McMaster, K. L., & Christ, T. J. (2016). Reading comprehension: Core components and processes. P*olicy Insights from the Behavioral and Brain Sciences, 3*(1), 62–69. https://doi.org/10.1177/2372732215624707

Kiili, C., Laurinen, L., Marttunen, M., & Leu, D. J. (2012). Working on understanding during collaborative online reading. *Journal of Literacy Research, 44*, 448–483. https://doi.org/10.1177/1086296x12457166

Kintsch, W. (1998). *Comprehension: A paradigm for cognition*. New York, NY: Cambridge University Press.

Kintsch, W. (2005). An overview of top-down and bottom-up effects in comprehension: The CI perspective. *Discourse Processes, 39*(2–3), 125–128. https://doi.org/10.1207/s15326950dp3902&3_2

Magliano, J. P., Trabasso, T., & Graesser, A. C. (1999). Strategic processing during comprehension. *Journal of Educational Psychology, 91*, 615–629. https://doi.org/10.1037//0022-0663.91.4.615

Mannies, N. J., Gridley, B. E., Krug, D., & Glover, J. A. (1989). Knowledge mobilization: Schema activation or generation effect? *Journal of General Psychology, 116*(2), 121–132. https://doi.org/10.1080/00221309.1989.9711116

Martin, M. A., Konopak, B. C., & Martin, S. H. (1986). Use of guided writing procedure to facilitate reading comprehension of high school text materials. *Research in Literacy: Merging Perspectives (National Reading Conference Yearbook), 35*, 66–72. https://doi.org/10.1080/10862969009547692

McNamara D. S., & Kintsch, W. (1996).Learning from texts: Effects of prior knowledge and text coherence. *Discourse Processes, 22*(3), 247-288. https://doi.org/10.1080/01638539609544975

McNamara, D. S., & McDaniel, M. (2004). Suppressing irrelevant information:

Knowledge activation or inhibition? J*ournal of Experimental Psychology: Learning Memory, & Cognition, 30,* 465–482. https://doi.org/10.1037/0278-7393.30.2.465

National Assessment Governing Board. (2010). *Reading Framework for the 2011 National Assessment of Educational Progress.* Retrieved from http://www.nagb.org/content/nagb/assets/documents/ publications/frameworks/reading-2011-framework.pdf

Paris, S. G., Wasik, B. A., & Turner, J. C. (1991). The development of strategic readers. In R. Barr. M. Kamil, P. Mosenthal, & P. D. Pearson (Eds.), *Handbook of reading research* (2nd ed., pp. 609–640). New York, NY: Longman.

Pearson, P. D. (1978). Some practical applications of a psycholinguistic model of reading. *What research has to say about reading instruction.* Newark, DE: International Reading Association.

Pintrich, P. R. (2002). The role of metacognitive knowledge in learning, teaching, and assessing. *Theory Into Practice, 41*(4), 219–225. https://doi.org/10.1207/s15430421tip4104_3

Pressley, M., & Afflerbach, P. (1995). V*erbal protocols of reading: The nature of*

constructively responsive reading. Hillsdale, NJ: Lawrence Erlbaum. https://doi.org/10.4324/9780203052938

Pressley, M., Tanenbaum, R., McDaniel, M. A., & Wood, E. (1990). What happens when university students try to answer prequestions that accompany textbook material? *Contemporary Educational Psychology, 15*(1), 27–35. https://doi.org/10.1016/0361-476x(90)90003-j

Salminen, T., Marttunen, M., & Laurinen, L. (2010). Visualizing knowledge from chat debates in argument diagrams. Journal of Computer Assisted Learning, 26, 379–391. https://doi.org/10.1111/j.1365-2729.2010.00354.x

Spires, H. A., & Donley, J. (1998). Prior knowledge activation: Inducing engagement with informational texts. *Journal of Educational Psychology, 90*(2), 249–260. https://doi.org/10.1037//0022-0663.90.2.249

Stahl, K. A. D. (2008). The effects of three instructional methods on the reading comprehension and content acquisition of novice readers. *Journal of Literacy Research, 40,* 359–393. https://doi.org/10.1080/10862960802520594

Van Loon, M. H., de Bruin, A. B. H., van Gog, T., & van Merriënboer, J. J. G. (2013). Activation of inaccurate prior knowledge affects primary-school students' metacognitive judgments and calibration. *Learning and Instruction, 24*, 15–25. https://doi.org/10.1016/j.learninstruc.2012.08.005

Veenman, M. V., Van Hout-Wolters, B. H., & Afflerbach, P. (2006). Metacognition and learning: Conceptual and methodological considerations. *Metacognition and Learning, 1*, 3–14. https://doi.org/10.1007/s11409-006-6893-0

Wetzels, S. A., Kester, L., & van Merriënboer, J. J. (2011). Adapting prior knowledge activation: Mobilisation, perspective taking, and learners' prior knowledge. *Computers in Human Behavior, 27*, 16–21. https://doi.org/10.1016/j.chb.2010.05.004

Wolff, U. (2010). Subgrouping of readers based on performance measures: A latent profile analysis. *Reading and Writing, 23*(2), 209–238. https://doi.org/10.1007/s11145-008-9160-8

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