ELEMENTARY TEACHERS' KNOWLEDGE OF READING COMPREHENSION, CLASSROOM PRACTICE, AND STUDENTS' PERFORMANCE IN READING COMPREHENSION

A Dissertation

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ABSTRACT

While the conceptual link between teachers' knowledge of reading-related concepts and student reading outcomes is widely acknowledged in the field, few studies have empirically examined this correlation, especially regarding student reading comprehension. Thus, the present dissertation study aimed to investigate teachers' knowledge of reading comprehension in a group of elementary teachers (n=240) who had received professional development focused on evidence-based reading comprehension instruction one year prior to taking part in the study. Moreover, as these teachers had implemented evidence-based reading comprehension instruction for one year, the present dissertation also examined the link between the upper elementary (i.e., Grade 3-5, n=103) teachers' knowledge and skills of reading comprehension, classroom reading comprehension instruction, and student (n= 3,514) reading comprehension achievement at the end of the school year. First, the Teacher Knowledge of Reading Comprehension (TKRC) survey was developed and examined for reliability and validity. Results found the TKRC to be a reliable (Cronbach's α= 0.85) and valid measure (i.e., explaining 57% of the variance) of teachers' content and pedagogical content knowledge for comprehension. Next, the relationship between teachers' knowledge on the TKRC, classroom instruction, and students' reading comprehension scores was analyzed. Using a series of Hierarchical Linear Models to control for the nested nature of the data, findings revealed that there was a significant interaction between teacher knowledge and classroom instruction. Specifically, based on an observation of classroom instruction, students provided good to excellent instruction by teachers with high knowledge tended to score statistically significantly higher on a standardized measure of reading comprehension (i.e., the Gray Silent Reading Test) than students provided the same quality of instruction by teachers with low knowledge levels, controlling for grade level, school SES level,

and teacher characteristics (i.e., years of experience, advanced degree, certification type, self-perception, self-reported amount of prior reading-related professional development). These findings help validate theoretical accounts alluding to the critical role teachers' knowledge plays in moderating student reading outcomes.

DEDICATION

This dissertation is dedicated to my husband, Kenny, who has always supported my goals and dreams. And, to my children, William, who encouraged me to take time to play throughout the process, and Grace Alida, who reminded me that all things are difficult before they are easy. Finally, I dedicate this dissertation to my parents, Michael and Diane Schumacher, who have encouraged and supported me in all that I do.

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CHAPTER I

INTRODUCTION

According to the International Literacy Association (ILA, 2019), "teachers matter more to student achievement than any other school-related factor" (p. 1). Effective teachers with good content and pedagogical skills can deliver high-quality classroom instruction (Haycock, 1998), which is the "best weapon against reading failure" (Snow et al., 1998, p. 343). Moreover, high-quality literacy instruction can help students "beat the odds" (Denton et al., 2003) against ecological variables significant to students' literacy achievement, including socioeconomic status (SES) (Fahle & Reardon, 2018) and home literacy environment (Chiu & McBride-Chang, 2006). Thus, the ILA (2019) emphasizes that all students have the right to a knowledgeable literacy educator who can provide evidence-based instructional practices that facilitate student reading outcomes and prevent later reading difficulties (Castles et al., 2018; Moats, 1994, 2009, 2020; National Institute of Child Health and Human Development, 2000).

While the conceptual link between teachers' knowledge of reading-related concepts and student reading outcomes is widely acknowledged in the field, few studies have empirically examined this correlation, especially in regard to student reading comprehension. The present dissertation aims to study the link between upper elementary (i.e., Grade 3-5) teachers' knowledge and skills of effective reading comprehension instruction based on the science of reading (e.g., text structures, vocabulary, main idea, summary, reading comprehension strategies) and student reading comprehension achievement. The study first examined whether the measure used to assess teachers' knowledge, the Teachers' Knowledge of Reading Comprehension (TKRC), is reliable and valid. Secondly, the study investigated if teacher characteristics (e.g.,

years of experience, certification type, grade level, advanced degree) influence teachers' knowledge of concepts necessary for effective reading comprehension instruction or the quality of teachers' classroom reading comprehension instruction at the end of the school year. Third, the study explored if teachers' knowledge of reading comprehension correlates with the level of reading comprehension instruction by Grade 3-5 classroom teachers based on an observation of classroom instruction. Fourth, the study examined if a teachers' reading comprehension-related knowledge, the level of reading comprehension instruction, or an interaction between knowledge and instruction relates to students' reading comprehension outcomes at the end of the school year.

Background

The Common Core State Standards (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010) states that students in grades 3-5 should be able to "determine the main idea of a text and explain how it is supported by key details" as well as "summarize the text" (CCSS.ELA-LITERACY.RI.4.2). However, findings from the most recent National Assessment of Education Progress (NAEP, 2019) highlight that 66% of U.S. fourth-grade students were unable to identify implicit main ideas and key details as well as explain simple cause and effect relationships. Even more alarming, only one-third of fourth-grade students surveyed believe they can definitely explain the meaning of a text they have read, and less than half had confidence that they could definitely identify the main idea of a text, with this percentage falling below 30% for the lowest-performing students (i.e., below 25th percentile) (NAEP, 2019). Similarly, recent research has shown that fourth and fifth-grade students in Texas consistently perform significantly lower on main idea and summary questions asked on state standardized reading assessments than any other construct assessed (e.g.,

vocabulary, inferencing) (Texas Education Agency, 2016, 2017; Wijekumar, Beerwinkle, et al., 2020).

Taken together, these findings are concerning, as Lyon (2001) found that students who fail to master reading comprehension skills such as main idea and summary in the elementary grades often never attain these skills, thus limiting their ability to progress to deeper levels of understanding (e.g., synthesis, analysis, evaluation). Consequently, literacy professionals have suggested that U.S. elementary students fail to achieve high levels of literacy proficiency. Moreover, since 2009, the gap in reading achievement between the lowest-performing students (10th percentile) and the highest performing students (90th percentile) at fourth grade has increased by almost ten points, with higher-performing students continuing to make gains in reading and lower performing students' scores decreasing (NAEP, 2019).

Students' poor performance on reading achievement assessments raises questions about the quality of reading comprehension instruction students receive. The National Reading Panel (NRP; National Institute of Child Health and Human Development, 2000) specifically defined each of the five core pillars of reading, namely, phonological/phonemic awareness, phonics, fluency, vocabulary/morphology, and text comprehension, as well as provided detailed reasons for their individual inclusion in the final report with the goal of presenting a cohesive scientific basis for reading development and instruction. Seidenberg et al. (2020) emphasize that these five pillars, which are closely linked, work together to facilitate proficient reading comprehension, the ultimate goal of reading. Further, the NRP also highlighted that these five concepts should be taught explicitly and systematically, especially for students with reading difficulties.

While both reading comprehension and the teaching of it are highly complex, ample research has demonstrated that students benefit from reading comprehension instruction that is

provided explicitly (Chall, 2002; Duffy et al., 1986; Kamil et al., 2008; NICHHD, 2000; Richards-Tutor et al., 2016; Rosenshine & Meister, 1994; Shanahan et al., 2010; Solis et al., 2012). In fact, explicit instruction is so critical to teaching reading comprehension strategies that "readers who are not explicitly taught these procedures are unlikely to learn, develop, or use them spontaneously" (NICHHD, 2000, p. 4-40). Further, Ness (2011) points out that failing to provide students with explicit instruction on reading comprehension strategies early in their academic careers may have negative consequences that extend far beyond the elementary school years.

Explicit instruction clearly explains and teaches a concept, models the skills needed in the learning process without confusion, and allows for guided practice with frequent feedback until the concept is mastered (Denton et al., 2014; Kamil et al., 2008). Explicit instruction "does not leave anything to chance and does not make assumptions about skills and knowledge that children will acquire on their own" (Torgesen, 2004, p. 363). Through explicit instruction, the teacher clearly describes the connection between the reading comprehension strategy or skill, when it should be employed, and how it is used to make meaning from the text. Additionally, the teacher models the use of the strategy, often thinking aloud to highlight the cognitive processes regularly unseen by students and provides time for the students to practice the comprehension strategy under expert guidance. This kind of teaching is seen as an imperative instructional move (Duffy, 2002).

Archer and Hughes (2010) identified elements of explicit instruction supported by extensive research (e.g., Brophy & Good, 1986; Christenson et al., 1989; NICHHD, 2000; Vaughn et al., 2000), including (1) direct and systematic instruction, (2) clear expectations, (3) teacher modeling with think alouds, (4) direct, unambiguous explanations with examples and

non-examples, (5) guided practice with frequent affirmative and corrective feedback, and (6) distributed and cumulative practice. Through these elements, teachers scaffold students' understanding of comprehension strategies, follow the gradual release of responsibility model, and develop skilled readers who fluently navigate making meaning from text. While all of the elements are important to explicit instruction, Blair et al. (2007) believe direct explanations, modeling, and guided practice are "at the heart of the explicit instructional model" (p. 434). This belief is supported by the finding that Grade 3-4 students with higher standardized reading scores had teachers who provided direct explanations and explained concepts in several different ways (Goodwin et al., 2021).

For many students, effective reading comprehension instruction requires the explicit teaching of reading comprehension strategies, such as main idea and summarization, that are important for understanding text (Kamil et al., 2008; Shanahan, 2005). This kind of explicit teaching is largely contingent on having a knowledgeable teacher who delivers effective literacy instruction based on the science of reading, or the "accumulated knowledge about reading, reading development, and best practices for reading instruction obtained by the use of the scientific method" (Petscher et al., 2020, p.268). Thus, this stimulates interest in raising the pedagogical and content knowledge of the teacher providing the instruction (International Dyslexia Association, 2018; ILA, 2018).

Statement of the Problem and Purpose of the Study

While it is evident that "explicit instruction is a powerful delivery system for teaching comprehension strategies" (Kamil et al., 2008, p. 18), teachers must have a solid understanding of reading comprehension skills and strategies and be able to apply this knowledge to various texts in order to be able to provide explicit instruction (Reutzel et al., 2016). Therefore, being

literate does not mean that one has the knowledge and skills to provide effective reading instruction to all students (Moats, 1994); instead, a teacher's explicit understanding of literacy concepts is necessary for successful instruction because one cannot teach what they do not explicitly understand themselves (Moats, 1994, 2014, 2020).

Moats (1994) first highlighted that experienced teachers lacked knowledge of phonetics, phonology, morphology, phonics, and the organization of the spelling system of English. While numerous studies have been published in the area of teachers' knowledge of the concepts underlying the science of reading since Moats' seminal study, misunderstandings remain. Thus, we can reasonably conclude that despite the curricular and professional development initiatives associated with the NRP (NICHHD, 2000) report, the critical factor of teacher knowledge has not been adequately addressed. For instance, studies examining teachers' phonological awareness and phonics knowledge are more substantiated by the literature, while fluency, vocabulary, and comprehension remain underrepresented. It is suggested that the lack of such studies is attributable to a focus on teachers in the early elementary grades (i.e., Kindergarten-Grade 2) in the literature, which highlights the need for future studies, such as the current study, to consider teachers' knowledge in older grades and of more complex constructs (e.g., comprehension) for a more comprehensive understanding of teachers' knowledge.

A recent systematic review of the literature (Hudson, Moore, et al., 2021) found that many studies of teacher knowledge only assessed teachers' knowledge of foundational literacy skills before and after teacher training without directly evaluating a link to student literacy outcomes or the effects on other types of knowledge critical to effective instruction (e.g., pedagogical knowledge). The componential model of reading (Aaron et al., 2008) highlights that psychological (e.g., teacher expectations) and ecological (e.g., classroom environment, materials

used for instruction) components also influence the development of reading skills. Similarly, the lattice model of the development of reading comprehension (Connor, 2016) emphasizes the importance of classroom factors, such as teachers' ability to plan and manage instructional activity and the quality of literacy instruction, on students' reading abilities. Thus, the current study aimed to address these gaps in the literature by investigating the relationship between teachers' knowledge and their level of classroom reading comprehension instruction, as well as the influence of teachers' knowledge and instruction on student reading outcomes.

Research Questions

1. Is the TKRC a valid and reliable measure of teachers' knowledge of reading comprehension?
2. Do teacher characteristics (i.e., experience, certification type, grade level, self-perception) at the end of the year correlate with teachers' knowledge score on the TKRC, Researcher-Developed Measure of Reading Comprehension, or the level of explicit classroom reading comprehension instruction observed at the end of the year (i.e., Time 3)?
3. Does teachers' knowledge score on the TKRC at the end of the school year (i.e., after initial professional development and one year of implementation) correlate with the level of explicit classroom reading comprehension instruction observed at the end of the year (i.e., Time 3)? Does teachers' score on the Researcher-Developed Measure of Reading Comprehension at the end of the school year correlate with the level of explicit classroom reading comprehension instruction observed at the end of the year (i.e., Time 3)?
4. Do either teachers' knowledge score on the TKRC or Researcher-Developed Measure of Reading Comprehension, level of classroom instruction, or an interaction between

knowledge and instruction correlate with students' reading comprehension abilities at the end of the year?

Upper elementary teachers are defined as those responsible for providing reading instruction to students in Grade 3 to Grade 5. Prior to the beginning of the school year, teachers attended two days of professional development on the Knowledge Acquisition and Transformation (KAT) framework (formally the Framework for the Accelerated Strategic Comprehension of Text [FASCT], see Hudson, Owens, et al., 2021 for more information), in which they learned evidence-based reading comprehension strategies to explicitly teach students how to use the structure of a text to select important ideas, logically associate the ideas, generate main ideas, extend the main ideas to summaries, extrapolate inferences, and monitor comprehension (Wijekumar, Beerwinkle, et al., 2020). The Teacher Knowledge of Reading Comprehension (TKRC) was used to assess teachers' knowledge of concepts related to effective reading comprehension instruction, including perceived abilities and factual knowledge in reading comprehension. Knowledge is defined as understanding information (e.g., terminology, instructional practices, skills) related to effective reading instruction. Reading comprehension is defined as "the essence of reading" (Durkin, 1993) and is an active process in which the reader constructs the meaning of a text while reading (Harris & Hodges, 1995). Classroom instruction is defined as how closely the implementation of instruction was to the intervention originally designed (Carroll et al., 2007; Kim et al., 2017). Classroom instruction is based on the KAT Classroom Observation Instrument, which examined teachers' explicit instruction of vocabulary, main idea, summary, and inferences during one reading comprehension lesson based on the KAT framework. A higher score on the instrument indicates greater fidelity to the KAT framework, thus higher quality of explicit reading comprehension instruction. Students are defined as those

enrolled in Grade 3 to Grade 5 in the participating school district. Student data were collected at the end of the school year (i.e., May 2021) using the Gray Silent Reading Test (GSRT; Wiederholt & Blalock, 2000) and a researcher-developed measure (i.e., Main Idea Competency).

Conceptual Framework

The NRP (NICHHD, 2000), after a critical review of the literature, identified seven comprehension strategies with strong scientific support for improving students' reading comprehension when taught explicitly: (1) comprehension monitoring, (2) cooperative learning, (3) graphic organizers, (4) question answering, (5) question generation, (6) story structure, and (7) summarization. While not specifically highlighted by the NRP report, explicit comprehension instruction around the five text structures (i.e., description, sequence, problem and solution, cause and effect, and compare and contrast) has also been shown to improve students' comprehension, especially for expository texts which are often more challenging for students (Meyer et al., 2002; Wijekumar et al., 2012, 2014). However, recent studies have exposed teachers' lack of understanding of text structures, a key concept in the teaching of reading comprehension (Beerwinkle et al., 2018; Reutzel et al., 2016; Wijekumar et al., 2019). Teachers have also demonstrated a limited understanding of ways to support students' comprehension through text-based discussion, with teachers often asking literal rather than inferential questions and directing students to reread rather than aiding their attempts to make sense of the text (e.g., Kucan et al., 2010; Shake, 1988).

The assessment of Grade 3-5 classroom teachers' knowledge, especially for reading comprehension, builds upon these findings and helps inform the science of teaching reading. The conceptual framework for this study is drawn from both the NRP (NICHHD, 2000) and Meyer et al.'s (2002) findings for effective reading comprehension instruction.

Significance of the Study

Much of the literature on teacher knowledge has a narrow focus on foundational, word-level constructs such as phonemic awareness and phonics. While research supports the important role that teachers' knowledge of these foundational literacy concepts plays in students' reading achievements (e.g., Brady et al., 2009; Cash et al., 2015; Ehri & Flugman, 2018; McCutchen et al., 2002, 2009; Peltier et al., 2020; Piasta et al., 2009; Spear-Swerling & Zibulsky, 2014), little is known about teachers' knowledge of other constructs that are critical to attaining proficient levels of reading (i.e., fluency, vocabulary, reading comprehension) and how this knowledge may influence student reading achievement. Thus, this study will contribute to the science of reading in several ways. First, if upper elementary grade teachers' knowledge scores correlate with classroom instruction, it will shed light on the connection between knowledge and practice. Second, examining the extent of the association between teachers' knowledge and student achievement outcomes validates theoretical accounts alluding to the role teachers' knowledge play in moderating student outcomes, in addition to linguistic and student factors. There are also direct and indirect implications for teaching reading. Specifically, findings may inform the content of teacher preparation programs that would equip teachers with adequate literacy instruction skills, facilitating the designing of instruction well-suited to students' learning needs. The concluding hypothesis would be that students reading achievement can improve when they are taught by teachers with good content and pedagogical skills who deliver high-quality classroom instruction.

Definition of Terms

- **Classroom instruction** is defined as how closely the implementation of instruction was to the intervention originally designed (Carroll et al., 2007; Kim et al., 2017).

- **Main idea** is defined as a "coherent memory representation showing the logical connections" between the most important ideas of the text (i.e., the "GIST") (Wijekumar, Beerwinkle, et al., 2020, p.324). There can be a main idea for a paragraph, section of the text, or the entire text.
- **Reading comprehension** is defined as "the essence of reading" (Durkin, 1993) and is "the process of simultaneously extracting and constructing meaning through interaction and involvement with written language" (RAND Reading Study Group, 2002).
- **Students** are defined as those enrolled in Grade 3 to Grade 5 in the participating school district.
- **Summarization** is defined as condensing ideas from the text into a succinct, synthesized form (Honig et al., 2018), which depends on the reader's ability to "identify important information, eliminate irrelevant details, and integrate main ideas across paragraphs" (Stevens et al., 2019, p. 132)
- **Teachers' content knowledge** is defined as understanding information (e.g., terminology, instructional practices, skills) related to effective reading instruction (Binks, 2008),
- **Teachers' pedagogical content knowledge** is defined as the ability to apply content knowledge and understanding in the context of teaching reading (Shulman, 1987).
- **Text structure** is "the organization of ideas, the relationship among the ideas, and the vocabulary used to convey meaning to the reader" (Pyle et al., 2017, p. 469). Meyer (1975) suggested that five specific text structures (i.e., sequence, description, comparison, problem-solution, cause-effect) underlie most written text, regardless of genre, with sequence and description structures often being nested within the higher-order structures

of comparison, problem-solution, cause-problem-solution, and cause-effect (Meyer & Wijekumar, 2007; Wijekumar et al., 2012).

- **Vocabulary** is defined as knowledge of a word, including both a definition and also how that word fits into the world (Stahl, 2005). It is multifaceted, including both breadth (how many words one knows) and depth (how many different ways one can use the same word) (Beck & McKeown, 1985). Successful text comprehension requires understanding what the words mean (NICHHD, 2000).

CHAPTER II

LITERATURE REVIEW

Proficient reading comprehension, or the ability to understand and interpret text (Castles et al., 2018), is critical for success in school and life. Students with poor reading comprehension are more likely to experience suicidal thoughts, drop out of school, and end up in the criminal justice system (Daniel et al., 2006; Hernandez, 2011; Moody et al., 2000). Thus, it is imperative that students receive explicit instruction for reading comprehension. However, as demonstrated by Scarborough's (2001) Reading Rope, skillful reading comprehension involves many skills such as decoding abilities, reading fluency, background knowledge, vocabulary, inferencing skills, awareness of text structure, and getting the "gist" of the text (Cain et al., 2020). Thus, reading comprehension is quite complex, and explicit reading comprehension instruction helps students build the skills required to understand and interpret text (Shanahan, 2020; Shanahan et al., 2010).

Construction-Integration Model of Text Comprehension

In the construction-integration (C-I) model of reading comprehension, Kintsch (2013) classified the reading comprehension process into three levels of mental representations 1) surface structure, 2) a textbase, and 3) a situation model. The surface structure level involves decoding words and letters, while the textbase level encompasses making literal meaning from the text at the sentence level (Boegaerds-Hazenberg et al., 2020; Kintsch, 1988, 2013). A situational model of comprehension, which integrates a readers' prior knowledge, consists of connecting ideas from the text at a global level to create increasingly complex mental representations. This situation model is necessary for proficient text comprehension as it facilitates making predictions, resolving conflicting information, and developing inferences

(Kintsch, 1988; van den Broek et al., 1999). The C-I model suggests that the construction of a situation model is enabled when readers are aware of the hierarchical organization of the text (i.e., text structure), which allows them to more successfully integrate their prior knowledge with the information presented in the text (Kintsch, 2013).

Text Structure-Based Reading Comprehension Instruction

Text structure is "the organization of ideas, the relationship among the ideas, and the vocabulary used to convey meaning to the reader" (Pyle et al., 2017, p. 469). Meyer (1975) suggested that five specific text structures (i.e., sequence, description, comparison, problem-solution, cause-effect) underlie most written text, regardless of genre, with sequence and description structures often being nested within the higher-order structures of comparison, problem-solution, and cause-effect (Meyer & Wijekumar, 2007; Wijekumar et al., 2012). Text structure is a feature of a text and a strategy for skillful readers to grasp the gist of a text; thus, teachers are encouraged to incorporate this strategy into their reading instruction (Meyer, 1975; Wijekumar, Meyer, et al., 2020). Through instruction, students can learn to use the hierarchical organization of the text as a framework for identifying relationships between ideas (Wijekumar et al., 2012). When readers can identify text structures and connect ideas from the text together logically, they are more likely to only consider important ideas and eliminate irrelevant information (Meyer & Poon, 2001). In addition, focusing on only the key ideas in the text facilitates students' ability to generate accurate main ideas and summaries after reading, which tends to promote a deeper understanding of the text (Kendeou & van den Broek, 2007; Meyer, 1975; Meyer et al., 1980). Therefore, instructional activities should be designed based on the text structure to guide students in generating main ideas and make inferences (Wijekumar et al., 2013, 2014; Wijekumar, Meyer, et al., 2020; Williams et al., 2014, 2016).

Research has found that students who use these top-level structures to support reading comprehension tend to be higher performing readers than students who fail to recognize the hierarchical organization of information in texts (Hiebert et al., 1983; Kendeou & van den Broek, 2007; Meyer et al., 1980; Rapp et al., 2007), evidenced by the good readers' ability to recall important information from the text, attend to both the external and internal structure of ideas, and ask relevant questions while reading. In addition, over two decades of reading research, including three meta-analyses, have found that teaching students to use top-level structure and text structure as a strategy while reading can support and improve students' reading comprehension skills (Boegaerds-Hazenberg et al., 2020; Hebert et al., 2016; Meyer et al., 2002; Pyle et al., 2017; Wijekumar et al., 2012, 2013, 2014; Wijekumar, Meyer, et al., 2020; Williams et al., 2014, 2016). For example, a recent meta-analysis of 44 experimental and quasi-experimental studies found that text structure instruction provided to students in grades 4-6 in an authentic educational setting had positive effects on several aspects of reading comprehension, including comprehension questions (g=0.25), text structure knowledge (g=0.34), recall (g=0.38), and summarization (g=0.58) (Boegaerds-Hazenberg et al., 2020).

Text structure-based reading comprehension instruction is included in several state standards (e.g., Texas Essential Knowledge and Skills) as well as the Common Core State Standards (CCSS; National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010). Consequently, text structure instruction is often the most utilized NRP (NICHHD, 2000) recommended strategy in popular reading textbooks for elementary grades (Beerwinkle et al., 2021). In a review of five prevalent reading textbooks, Beerwinkle et al. found that text structure-based instruction comprised 44% of Grade 3 lessons, 56% of Grade 4 lessons, and 31% of Grade 5 lessons across textbooks. However, Beerwinkle and colleagues

found a lack of consistency for top-level structure instruction, with three to seven different strategies relating to text structure across textbooks. Further, Beerwinkle et al. (2018) and Dewitz et al. (2009) noted an overall lack of explicit comprehension strategy instruction within reading textbooks. Research has shown that reading textbooks commonly used by classroom teachers have an average of three to six lessons devoted to instruction on main idea and summarization, respectively, per year (Beerwinkle et al., 2018, 2021). This lack of explicit instruction leaves students with little time for guided practice of these strategies and confirms Shanahan's (2005) claim that most commercial textbooks do not provide students with adequate instruction or time to master a strategy.

Differing from most textbook top-level structure-based reading comprehension lessons, Wijekumar et al. (2013, 2014, 2018) and Wijekumar, Meyer, et al. (2020) have developed the Knowledge Acquisition and Transformation (KAT) framework. KAT provides direct and explicit text structure instruction for students and scaffolds their learning of main idea generation, summarization, and inferring based on the top-level structure of a text. The KAT framework includes the following steps:

1. Identify the overall top-level structure of a text (comparison, cause and effect, problem and solution, description, and sequence). Students may use signaling words explicitly stated or implied to aid in their identification of the top-level structure.
2. Use a consistent sentence stem based on the overall structure of the text (e.g., The problem is ___. The solution(s) is/are ___.) to generate the main idea statement.
3. Develop a summary by adding supporting details about each part of the main idea statement.

4. Answer inference questions by integrating the top-level structure, main idea, and prior knowledge.
5. Use top-level structures to assist in answering multiple-choice questions about the main idea or summary of the text.

Wijekumar et al. (2012, 2013, 2014) and Wijekumar, Meyer, et al. (2020) have implemented KAT with fourth- and fifth-grade students in high-poverty, rural, and suburban schools. In these studies, teachers replaced approximately 20-45 minutes of students' weekly language arts classroom instruction with an instructional, web-based text structure software (Intelligent Tutoring System for the Text Structure Strategy [ITSS]). ITSS followed the KAT framework and incorporates key instructional moves such as modeling, practice activities, assessment, and immediate feedback. As students interact with ITSS, they learned to (1) identify the top-level structure of the text, (2) use the top-level structure to generate the main idea and summary, (3) make inferences, and (4) monitor their reading comprehension. Wijekumar et al. (2012, 2013, 2014) and Wijekumar, Meyer, et al. (2020) had similar findings. Across studies, grade four and five students who were provided text structure instruction from ITSS scored statistically significantly higher on reading comprehension measures than students who did not receive ITSS instruction. Moreover, the What Works Clearinghouse (WWC ITSS Intervention Report, 2021) has the highest degree of confidence (i.e., "Met Standards without Reservation") in Wijekumar et al.'s (2012, 2014) findings, suggesting that the text structure strategy intervention from ITSS produced the gains observed in students' reading comprehension scores.

Most recently, Wijekumar, Meyer, et al. (2020) utilized a large-scale randomized control trial to examine the use of ITSS with fourth- and fifth-grade students at or below the 25th percentile on measures of reading comprehension (i.e., Gray Silent Reading Test [GRST],

Wiederholt & Blalock, 2000; and researcher-developed measure) at the beginning of the year. The researchers randomly assigned students' classrooms to either a treatment or control group, with the treatment group engaging in ITSS lessons approximately 20-30 minutes a week and the control group receiving standard reading comprehension classroom instruction. At the end of the school year, both fourth- and fifth-grade struggling readers in the treatment group outperformed students in the control group on all reading comprehension measures, with small to moderate effects found on the GRST (g= 0.28 for grade 4; g=0.52 for grade 5).

A key point shared in the NRP (NICHHD, 2000) report is that reading comprehension strategies, including text structure, should be taught explicitly and systematically. Afflerbach et al. (2008) highlight that teachers need to be able to explain, model, and classify successful reading strategies into different parts and describe how the parts work together. This emphasis on explicit instruction certainly places expectations on teachers' knowledge, as Moats (2014) explains:

> To teach text comprehension, the teacher needs substantial preparation in how to teach word meanings, sentence structures, referential and cohesive aspects of text, and overall text organization. Without that background, teachers are much more likely to rely on formulaic comprehension strategy approaches, reading aloud or passage rereading as a substitute for teaching students how to interpret the text, or discussion of the content of the passage without attention to the manner in which meaning is conveyed (p. 77).

While KAT is a straightforward strategy, designing instruction that provides the steps for using strategies to support reading comprehension explicitly and systematically may be challenging for teachers, especially if they are not fully aware of text structures or recognize how

the hierarchical organization of texts supports reading comprehension. Consequently, evidence-based reading comprehension strategy instruction is often absent from the majority of classroom reading instruction (Beerwinkle et al., 2018; Pearson & Cervetti, 2017; Pressley, 2008; Wijekumar et al., 2019).

Teacher's Knowledge of Evidence-Based Comprehension Strategies

Teachers' knowledge of comprehension skills and strategies is still relatively unknown compared to teachers' levels of understanding for phonological awareness and phonics (Hudson, Moore, et al., 2021). In a systematic review of the literature, Hudson et al. noted the dearth of studies that examined the constructs of fluency, vocabulary, and reading comprehension, which prohibited their ability to draw definitive conclusions regarding teachers' knowledge of these concepts. However, some studies have examined teachers' knowledge of these complex constructs (i.e., fluency, vocabulary, comprehension) and exposed teachers' misunderstandings of key concepts surrounding effective instruction (Beerwinkle et al., 2018; Leader-Janssen & Rankin-Erickson, 2013; Masters et al., 2010; Reutzel et al., 2016; Spear-Swerling & Cheesman, 2012; Wijekumar, Beerwinkle, et al., 2020).

Leader-Janssen and Rankin-Erickson (2013) assessed preservice teachers' knowledge and self-efficacy for teaching reading comprehension to elementary students. The preservice teachers in the study had just completed a reading methods course. Using the Content Knowledge for Teaching Reading (Phelps & Schilling, 2004), Leader-Janssen and Rankin-Erickson measured teachers' understanding of comprehension (35 items, Cronbach's α=0.75), teaching comprehension (18 items, Cronbach's α=0.67), and word analysis skills (35 items, Cronbach's α=0.82). The Content Knowledge for Teaching Reading survey primarily uses teaching scenarios to assess teachers' knowledge and ability to apply knowledge in the context of teaching. The

researchers also developed the Teacher Efficacy Scale for the Teaching of Reading to assess teachers' self-efficacy for teaching concepts identified by the NRP as critical to reading instruction (NICHHD, 2000). Reliability was 0.98 for the self-efficacy measure, which had participants rank their self-perceived level of confidence on a 100-point scale for each of the 28 items on the survey (e.g., design lessons for comprehension of narrative text using a variety of instructional methods; assess reading comprehension in at least three different ways). Leader-Janssen & Rankin-Erickson found that while preservice teachers had a relatively high self-efficacy for teaching reading, their level of content knowledge was poor. For example, scores on the Content Knowledge for Teaching Reading survey averaged around 61-64% for the reading comprehension subtest and around 54-60% for the word analysis subtest.

Similarly, Masters et al. (2010) examined teachers' understanding of evidence-based vocabulary and reading comprehension instruction in 110 Grade 4 teachers from primarily high-needs schools in rural and urban settings. All of the participants were certified classroom teachers, with the majority holding a Master's Degree. Approximately 70% of the participants had six or more years of teaching experience.

Masters and colleagues developed a survey with 47 items designed to measure teachers' knowledge and practice of concepts related to evidence-based vocabulary and reading comprehension instruction. Knowledge items assessed teachers' content knowledge (e.g., list the seven comprehension strategies that improve students' comprehension, identify a Tier 2 word) through open and closed responses. Practice items measured teachers' self-reported instructional practices (e.g., frequency of teaching students to make inferences, frequency of discussing vocabulary before reading) using a 4-point Likert scale (i.e., 1-rarely, 2-sometimes, 3-frequently, 4-always). Masters et al. reported that all vocabulary and comprehension items had acceptable

reliability, with Cronbach's α of 0.82 and 0.89 for vocabulary knowledge and practice, respectively, and Cronbach's α of 0.66 and 0.88 for comprehension knowledge and practice, respectively. Results revealed that teachers averaged around 46-47% accuracy on reading comprehension knowledge items (i.e., listing the seven comprehension strategies found by the NRP to be highly effective, select an effective comprehension strategy from a list, explaining how and when to use a strategy) and 14-16% accuracy on vocabulary knowledge items. However, teachers reported frequently using evidence-based reading comprehension (i.e., mean=3.11-3.15) and vocabulary (i.e., mean=2.76-2.81) instruction.

Wijekumar, Beerwinkle, et al. (2020) were also interested in teachers' self-reported use of evidence-based instructional practices to teach reading comprehension to elementary school students. The researchers asked 155 elementary teachers to complete a survey of 15 open-ended questions (e.g., what types of reading comprehension methods do you use in the classroom, do you teach text structure during language arts). Wijekumar, Beerwinkle, et al. also asked teachers to read a passage and write the passage's main idea. Two trained raters scored each main idea statement using an eight-point scale (1=lowest, 8=highest). Results revealed that less than half of the participants reported using main idea, inference tasks, and summarization to promote students' understanding of text (i.e., 28%, 27%, and 48% for each strategy, respectively). Moreover, only 62% of the reported instructional practices for comprehension were recognized by the NRP (NICHHD, 2000), with "asking students to generate a summary" being the most frequent NRP strategy mentioned. Further, teachers' score for generating a main idea after reading averaged around 72% accuracy, with 43 teachers scoring below a 50%.

Spear-Swerling and Cheesman (2012) assessed 142 teachers, most of whom had experience teaching reading to students in kindergarten through Grade 5. Researchers assessed

teachers' knowledge through the Teacher Knowledge Survey, a 66-item researcher-developed survey designed to measure teachers' pedagogical content knowledge of phonemic awareness, phonics, fluency, vocabulary, and comprehension. Thirty-three percent of the survey measured content knowledge (e.g., Why is fluency important to reading comprehension?), and sixty-seven percent assessed application (e.g., Which of the following sets of words would be best for a teacher to use when providing students with examples of words conforming to the silent e (magic e) phonics generalization?). Based on theoretical considerations, constructs were grouped into three categories: (1) phonemic awareness and phonics(17 items, Cronbach's α=0.71), (2) fluency, vocabulary, and comprehension (24 items, Cronbach's α=0.71), and (3) assessment (25 items, Cronbach's α=0.77). When examining teachers' performance on fluency, vocabulary, and comprehension items, survey results demonstrated that while teachers had an understanding of using think-alouds and Venn diagrams to teach comprehension, participants were largely unfamiliar with the NRP report and other research-based instructional models for teaching comprehension (e.g., reciprocal teaching, questioning the author). Spear-Swerling and Cheesman also noted that teachers tended to perform better on items assessing knowledge rather than application.

Similarly, Spear-Swerling and Zibulsky (2014) used the Teacher Knowledge Survey and the Language Arts Activity Grid to examine the relationship between teachers' knowledge and how they would allocate instructional time during a two-hour language arts instructional block. One hundred two elementary or special education teachers completed the measures. Teachers averaged around 59% correct on the Teacher Knowledge Survey's fluency, vocabulary, and comprehension subtest. The allocation of instructional time revealed that teachers, regardless of grade level, tended to devote very little time to explicit vocabulary instruction (i.e., less than five

minutes on average). Further, time planned for reading comprehension instruction (e.g., answering questions, making predictions, summarization) was minimal across grade levels as well (i.e., 11.9 minutes in kindergarten-grade 1; 13.1 minutes in grade 2-3; and 10.3 minutes in grade 4-5, on average). Interestingly, Spear-Swerling and Zibulsky found that teachers who were more familiar with the NRP (NICHHD, 2000) report tended to score higher on the Teacher Knowledge Survey; however, teachers' fluency, vocabulary, and comprehension subtest score did not significantly correlate with their instructional time allocation for these concepts.

Several recent studies have also highlighted teachers' misunderstandings of top-level structures and how these structures can support students' reading comprehension (Beerwinkle et al., 2018; Reutzel et al., 2016; Wijekumar et al., 2019; Wijekumar, Beerwinkle, et al., 2020). For instance, Reutzel et al. (2016) surveyed 21 randomly selected primary grade teachers (i.e., grades 1-3) to examine their knowledge of text structures, their ability to apply this knowledge to various texts, and their perceived understanding of text structures. As part of the survey, teachers identified the text structure of 20 informational texts, including trade books, content-area textbooks, and core reading program selections, as well as explain the rationale behind their decision. Further, teachers answered five open-ended questions (e.g., what text types do you know, what text structures do you know, what text genres do you know), which were qualitatively coded by the researchers.

Findings from Reutzel et al. (2016) revealed that, while all teachers believed teaching text structures was important to reading comprehension, they could only identify text structures in authentic children's text with 37% accuracy. The teachers also demonstrated confusion regarding the difference between text structures and genres, often providing overlapping answers

such as “informational” or “tables” for both constructs. Mirroring prior research (Cunningham et al., 2004; Leader-Janssen & Rankin-Erickson, 2013; Masters et al., 2010), teachers in Reutzel and colleagues study had inaccurate views of their text structure knowledge, with teachers believing they had moderate to moderately-high knowledge of informational text structures.

Beerwinkle et al. (2018) not only surveyed grade 4 (n=65) and grade 5 (n=66) teachers’ knowledge of text structures but also observed classroom instruction for evidence of explicit teaching of text structures. Teachers, primarily from low socio-economic (SES) schools, had an average of 15 years of teaching experience, and the majority held a bachelor’s degree. Classroom observations, which took place in 36 classrooms during the spring semester, were approximately 20-40 minutes in length. A trained member of the research team documented instructional practices focused on reading throughout the observation (every 90 seconds). While all teachers indicated using text structure to teach reading comprehension, most teachers (91%) could only name two or fewer text structures identified by Meyer (1975). Moreover, Beerwinkle et al. reported that explicit comprehension instruction comprised an average of 0.86-2.89% of the observed time, and no observation included instruction on summarization, an effective instructional skill that helps students improve their memory for what is read (NICHHD, 2000). Thus, the authors concluded that the teachers in their study lacked an explicit understanding of top-level structures and how to use them to effectively support student’s reading comprehension development (Beerwinkle et al., 2018).

Wijekumar et al. (2019) mirrored Beerwinkle et al.’s (2018) and Reutzel et al.’s (2016) findings through their assessment of 280 grade 4 and 5 classroom teachers from primarily low SES schools serving minority students. Teachers, who had an average of 13.2 years of teaching

experience, completed an open-ended survey focused on identifying text structures and instructional practices used for reading comprehension. Like the previously mentioned studies, Wijekumar et al. (2019) found that while 99% of teachers reported using text structure as an instructional method, only 54% could correctly name at least one text structure. Further, more than 80% of the teachers surveyed demonstrated a misunderstanding between text structure and other textual elements (e.g., genre, summary). Wijekumar et al. (2019) also found that teachers reported commonly using read alouds and discussions to teach reading comprehension rather than specific strategies recommended by the NRP (NICHHD, 2000).

Taken together, findings from the studies reviewed confirm that teachers often misunderstand their level of knowledge in relation to their actual level of understanding (Cunningham et al., 2004; Meeks & Kemp, 2017) and struggle themselves with the generation of main ideas (Kucan et al., 2010). Consequently, one can conclude that teachers' knowledge may be insufficient to provide effective instruction in text structures and other reading comprehension strategies, as teachers were generally not able to "articulate clearly or enact this knowledge when needed" (Reutzel et al., 2016, p. 91). In addition, teachers' misunderstandings of concepts surrounding reading comprehension instruction are concerning, as the "Peter Effect" highlights that a teacher may not teach well what they do not understand and have not mastered themselves (Binks-Cantrell, Washburn, et al., 2012).

Teacher Knowledge and Student Reading Outcomes

A growing body of research is beginning to establish the important role that a teacher's knowledge of literacy concepts plays in students' reading achievements (Brownell et al., 2017; Cash et al., 2015; Ehri & Flugman, 2018; Lane et al., 2008; McCutchen et al., 2002, 2009;

Peltier et al., 2020; Piasta et al., 2009; Spear-Swerling & Brucker, 2004); however, the findings focus primarily on foundational literacy skills. For example, Peltier et al. (2020) and Spear-Swerling and Brucker (2004) investigated the correlation between preservice teachers' knowledge of foundational literacy skills and students' reading outcomes. Participants in these two studies attended a 16-week university course focused on early literacy development and engaged in approximately eight (Spear-Swerling & Brucker, 2004) or 12 (Peltier et al., 2020) 30–60 minute one-on-one tutoring sessions with an elementary student with reading difficulties.

Spear-Swerling and Brucker (2004) found that teachers' scores for graphophonemic segmentation and irregular word identification at the end of the semester moderately and statistically significantly correlated to students' word-reading growth. Spear-Swerling and Brucker posited that as teachers' knowledge increased, teachers became more aware of selecting appropriate examples and targeting specific skills (e.g., changing initial phonemes to make a new word) during instruction. Similarly, Peltier et al. (2020) found that teachers' knowledge of foundational skills at the end of the semester strongly and statistically significantly correlated (r=0.71, p=.03) to students' average growth in foundational skills (i.e., phonological processing, letter and word recognition, nonsense word decoding, word recognition) as measured by the Kaufman Test of Educational Achievement (KTEA–III; Kaufman et al., 2014).

McCutchen et al. (2002) examined the knowledge and practice of 44 kindergarten to grade 1 teachers and the reading growth of their students (n=492) over one school year. An intensive two-week summer professional development focused on foundational skills and three additional follow-up sessions throughout the school year were provided to teachers in the treatment group (n=24). Teachers' knowledge was measured at the beginning and end of the study using the Informal Survey of Linguistic Knowledge (Moats, 1994), which focused on the

foundational constructs of phonological awareness, phonics, and morphological awareness. The researchers also completed three to four classroom observations of all teachers throughout the school year. Observed instruction was coded for knowledge affordance, literacy activity, textual context, group context, and implicit or explicit instruction. Students' reading growth was measured throughout the year using a battery of assessments, including the Test of Phonological Awareness (TOPA; Torgesen & Bryant, 1994), the comprehension and vocabulary subtests of the Gates-MacGinitie Reading Tests (MacGinitie & MacGinitie, 1989), and the spelling subtest of the Wechsler Individual Achievement Test (WIAT; Wechsler, 1991) in Grade 1.

While McCutchen and colleagues (2002) found no direct relationship between teachers' knowledge and student reading gains, they found an indirect relationship through classroom instruction. Teachers who received professional development deepened their knowledge of foundational constructs and changed their classroom practices. Specifically, grade 1 teachers who received professional development dedicated significantly more time to comprehension instruction than control group teachers. Consequently, students taught by trained teachers had improved reading outcomes (i.e., reading comprehension, vocabulary, spelling, phonemic awareness).

Similar to the aims of the proposed study, Piasta et al. (2009) examined the relations of teacher knowledge, classroom instruction, and student reading gains. Piasta et al.'s study involved 42 grade 1 teachers from ethnically and socioeconomically diverse schools and 437 grade 1 students taught by the participating teachers, 41% of whom were from low SES backgrounds. All of the teachers had a bachelor's degree and were highly experienced, with an average of 11.4 years of teaching experience. Teachers' foundational skill knowledge was measured using the Teacher Knowledge Assessment: Language and Print (Cronbach's α=0.87),

an assessment consisting of 34 multiple-choice items and 11 open-ended items. Additionally, trained research team members observed 48 classrooms and recorded all instructional activities lasting 15 seconds or more during the literacy block. Coding was completed at the level of the student; thus, the number of instructional minutes of explicit decoding instruction could vary from student to student based on the observation. For example, student A would have more minutes of explicit decoding instruction than student B if student A worked in a small group with the teacher while student B read independently.

Piasta et al. (2009) reported that the average score on the Teacher Knowledge Assessment was 52% correct and was not correlated to teachers' level of education or certification. Further, based on classroom observations, students received an average of approximately seven and a half minutes of explicit decoding instruction. Grade 1 students' literacy abilities were measured at the beginning and end of the school year using a battery of assessments from Woodcock-Johnson (Woodcock et al., 2001) Letter-Word Identification and Picture Vocabulary subtests. While neither teacher knowledge nor instructional practices directly correlated with student reading gains after controlling for students' fall scores and school SES levels, the interaction between teacher knowledge and explicit decoding instruction significantly predicted students' growth in word identification. Piasta et al. found that explicit phonics instruction provided by more knowledgeable teachers (i.e., scoring at the 50th percentile or higher) resulted in statistically significantly higher student gains in word-reading skills than students taught by less knowledgeable teachers (i.e., scoring in the lowest 25th percentile). Moreover, the more time that less knowledgeable teachers spent providing explicit decoding instruction, the poorer their students' performed on word identification skills in the spring.

Researchers attribute this finding to the less knowledgeable teachers providing inaccurate examples and being less able to respond correctly to student errors during instruction.

Given the previous findings that many teachers believed text structure and comprehension instruction to be important (Reutzel et al., 2016), the findings of Cash et al. (2015) are also worthy of being noted. Cash and colleagues examined 262 prekindergarten teachers' beliefs and knowledge of children's language and literacy skills in relation to students' (n=1,134) early literacy outcomes. In order to measure beliefs, teachers rated (1= not important, 4= essential) their self-perceived importance of specific skills for students entering kindergarten (e.g., blending syllables into words, identify the sounds that correspond to specific letters, map spoken words to words in print). The teachers' beliefs measure had a reported reliability of 0.82. In addition, researchers measured teachers' knowledge through a 12-item survey that required teachers to categorize skills by language (i.e., vocabulary, pragmatics, narrative skills) or literacy (i.e., phonological awareness, print concepts, alphabet knowledge) domain. Finally, students' language and literacy skills were measured at the beginning and end of the year using the Peabody Picture Vocabulary Test (Dunn & Dunn, 1997), the picture vocabulary subtest of the Woodcock-Johnson III Tests of Achievement (Woodcock et al., 2001), and two subtests (print knowledge, phonological awareness) from the Test of Preschool Early Literacy (Lonigan et al., 2007).

Interestingly, Cash and colleagues (2015) found that students' gains in print knowledge and phonological awareness over the prekindergarten year could be predicted by teachers' knowledge of literacy skills but not by their beliefs about these skills. Specifically, teachers' knowledge of language predicted students' gains in vocabulary skills, while teachers' literacy knowledge predicted students' gains in print knowledge. Thus, this research demonstrates that

simply believing a concept or skill is important does not always equate to the ability to teach it well.

When considering constructs beyond that of phonological awareness, phonics, and morphological awareness, there is a large gap in the literature of studies examining the relationship between teachers' knowledge and student reading achievements. Few studies have investigated the relationship between a more complex construct and student reading outcomes (Lane et al., 2008; Park et al., 2019). Lane and colleagues (2008) examined the connection between teachers' knowledge of fluency and students' oral reading fluency outcomes. The researchers measured the oral reading fluency knowledge, including an awareness of fluency instruction and assessment, of 133 kindergarten through grade 3 teachers (n=27 kindergarten, n=29 grade 1, n=20 grade 2, and n=24 grade 3). The teachers mostly held a bachelor's degree and had an average of approximately 12 years of experience.

To assess their knowledge, teachers completed five open-ended questions developed by Lane and colleagues (2008) (e.g., what is reading fluency, why is it important for children to develop reading fluency, what instructional methods could be used to develop reading fluency). Their responses were scored using a rubric that assigned a point value to each question's response (i.e., 0= no knowledge, 1= little knowledge, 2= some or acceptable knowledge, 3=expert knowledge). Additionally, teachers identified instructional methods they used in their classrooms. Modeling fluent reading, repeated reading, and practice with peers were the most commonly reported methods utilized by teachers. Reading data was collected for students (n=1,717) enrolled in the participating teachers' classes. Seventy-one percent of the students were from low SES backgrounds, and 12% were enrolled in a program for English learners. Students completed the Nonsense Word Fluency (grade 1 and 2) or Oral Reading Fluency (grade

3) subtest of the Dynamic Indicators of Basic Early Literacy (DIBELS; Good & Kaminski, 2002) at four time points across the school year. In addition, the Peabody Picture Vocabulary Test (PPVT; Dunn & Dunn, 1997) was administered at the end of the year to measure students' verbal abilities.

Lane and colleagues (2008) utilized a multilevel latent growth model with PPVT scores as the student-level predictor and fluency knowledge variables as teacher-level predictors to analyze the data. The researchers found that few teachers possessed a deep understanding of oral reading fluency. For example, most teachers failed to identify all three aspects of fluency (accuracy, rate, prosody) outlined by the NRP (NICHHD, 2000) in their definitions. However, teachers' knowledge of oral reading fluency explained a significant portion of the variance in the reading fluency growth of grade 1 and 2 students (11% and 86%, respectively). Thus, teachers who had a deeper understanding of oral reading fluency, including its importance to proficient reading comprehension, assessment, and instruction, had students who read faster and more accurately. Lane et al. conclude that "teachers who know why they are teaching something may be better able to determine when and for whom to provide instruction" (p. 76); however, it is important to note that Lane and colleague's study did not include observations of classroom instruction to confirm this notion.

Building off Lane et al.'s (2008) study, Park et al. (2019) investigated 42 special education teachers' knowledge of fluency, their classroom fluency instruction, and the oral reading fluency gains of 170 students with specific learning disabilities (SLD) in grades 3-5. Park and colleagues utilized the same teacher knowledge measure as Lane et al. (2008) but extended the research to include an observation of teachers' classroom fluency instruction as well. Findings from a regression model revealed that teachers' knowledge was not statistically

significantly related to classroom instruction. However, replicating Lane et al.'s findings, the two-level multilevel modeling analysis, with students nested within teachers, found that students with SLD taught by more knowledgeable teachers scored higher on the oral reading fluency subtest of DIBELS (Good & Kaminski, 2002). Park and colleagues concluded that teachers' knowledge is indeed a factor in students' oral reading fluency abilities.

Reading comprehension is a complex construct and is the ultimate goal of reading. However, there is a gap in the literature connecting teachers' knowledge of comprehension to classroom instruction and students' literacy outcomes. For example, Duke et al. (2011) pointed out that more research "that examines the knowledge teachers need to engage in specific practices supportive of comprehension" is needed (p. 82). Based upon the findings from studies of foundational constructs (e.g., McCutchen et al., 2002; Peltier et al., 2020; Piasta et al., 2009; Spear-Swerling & Brucker, 2004), it can be hypothesized that a relationship may exist between teachers' knowledge, classroom instruction, and students' growth in more complex constructs (i.e., fluency, vocabulary, comprehension) as well. Thus, the present study aimed to add to the literature on teacher's knowledge of concepts and skills needed to provide effective reading instruction based on the science of reading and echoes McCutchen and colleagues (2002) belief that when "effective practice is in the hands (and heads) of teachers, who work on the educational front lines, we may begin to hope for progress in the only reading war that really matters - the one against reading and writing disability" (p.82).

CHAPTER III

METHODOLOGY

This study was undertaken within the context of a larger study. The larger study was designed to test the effect of text structure reading comprehension instruction delivered via a web-based software (ITSS; e.g., Wijekumar et al., 2013, 2014) on grade 3-5 students' reading comprehension outcomes. However, an impact on student reading comprehension gains above and beyond the ITSS effect was anticipated for teacher knowledge and explicit reading comprehension instruction. Thus, this study will examine the relations among teacher knowledge, classroom practice, and student outcomes.

Research Design

The purpose of this study is to investigate how well upper-grade elementary teachers are prepared to effectively teach reading comprehension, a skill that requires understanding aspects critical to proficient reading comprehension such as text structures, main idea, summary, and vocabulary. Specifically, this study aims to identify if upper elementary grade teachers who have attended a two-day web-based professional development and implemented a reading comprehension instructional strategy for one school year prior to the current study demonstrate an understanding of the knowledge needed to provide explicit reading comprehension instruction. Teachers' perceived ability to teach reading comprehension to typically developing and struggling readers was also measured.

To answer the research questions, the *Teacher Knowledge of Reading Comprehension* (TKRC) and a Researcher-Developed Measure of Reading Comprehension were used to examine the knowledge and skills of teachers from a large district in the South. As part of a larger study on text structure instruction (KAT), internal review board (IRB) and district approval of the

research has been obtained. Teachers signed informed consent documents at the beginning of the study, agreeing to participate in the research.

Initial Practice-Based Professional Development

At the beginning of the larger study (i.e., May 2020), all participants received two days (i.e., 12 hours) of practice-based professional development (PBPD) on the topic of reading comprehension (i.e., using top-level structures and main idea) and learning KAT procedures. The PBPD was delivered virtually due to the COVID-19 pandemic. Over the course of the virtual two-day training, teachers participated in both whole group and small group instruction as well as completed independent activities on the Massively Open Online Virtual (MOOV) platform. The initial two-day virtual training included theoretical foundations of reading comprehension and text structure instruction, introduction to the KAT lesson plan framework, model lessons, guided practice with feedback, reflection on teaching practices, and support of expert mentors.

Participants were also provided with a training manual that included an introduction to text structures with regards to the text structure research conducted by Meyer (1975) and Wijekumar et al. (2012, 2014, 2017), a do's and don'ts of using text structure in the classroom, text structure sentence stems and posters, as well as comparison, cause and effect, and problem and solution practice passages. The training manual also included several exemplar reading comprehension lesson guides using the KAT framework for students in grades three and above. Because making inferences is a critical piece of the comprehension puzzle, the training manual has a section dedicated to frequently used question stems for grades 3-5. Additionally, the training manual included blank lesson guides for teachers to use during and after the training.

After the initial two-day training, teachers had access to an extensive file library on the MOOV learning system. The file library includes completed comprehension lesson guides in each of the three higher-order text structures (i.e., comparison, cause and effect, problem and solution), practice passages corresponding to each of the top-level structures, science and social studies-related resources, lesson guides that correspond to selections from a variety of textbooks, KAT posters and bookmarks, PowerPoint presentations for use by teachers, videos of the planning and modeling of lessons as well as student videos to be used by teachers and students in a synchronous or asynchronous setting, and research relevant to this topic. Access to the file library did not expire; therefore, teachers could reference the materials and videos any time after the initial training was complete. Further, all participants were invited to voluntary monthly check-in meetings led by members of the research team.

Follow-Up Practice-Based Professional Development

Following one year of classroom implementation (i.e., May 2021), the larger study held a one-day web-based practice-based professional development to elevate and extend participating teachers' understanding of reading comprehension instruction. At the beginning of this session, the researcher presented participants with the TKRC And Researcher-Developed Measure of Reading Comprehension. Participation in the TKRC and Researcher-Developed Measure of Reading Comprehension was voluntary, and participants were assured that all information would be kept confidential and de-identified. The participating teachers completed the two web-based measures individually through the MOOV platform. No feedback or comments were provided during the assessment, and the use of reference materials was discouraged. While teachers completed the measures individually on their own electronic devices, it is acknowledged that

social desirability may be present; however, the researcher encouraged participants to answer survey items honestly.

A context for the research design, description of the sampling selection, and approaches for analyzing data are discussed in greater detail below.

Setting and Participants

The study took place in one large school district in the southern United States. As part of a larger study, the district's Grade 2-5 teachers implemented text structure instruction (KAT) during their daily language arts instruction during the 2020-2021 school year. KAT is designed to be a ten to15-minute daily routine that explicitly teaches students to identify the top-level text structure (i.e., comparison, cause-effect, problem-solution), identify important ideas, generate a main idea statement using the text structure as a scaffold, extend the main idea statement into a summary, and extrapolate inferences.

Teachers

The participants included 240 teachers (n=181 Female) from 21 different schools in a large school district in the southern United States. All participants were a part of the larger study and received two days of reading comprehension professional development one year prior to taking part in the present study. As part of the larger study, the district expected all participants to implement KAT instruction for the school year prior to the present study. However, participation in the TKRC and Researcher-Developed Measure of Reading Comprehension was voluntary.

Teacher demographic information was collected and is presented in Table 1. Table 1 also presents teacher demographic information from the district and state in which the research took

place. No significant differences were found between the survey respondents and the overall population of teachers in the district or state.

Of the 240 participants, 197 were general education classroom teachers, 31 were instructional specialists or coaches, seven were special education teachers, and five served in administrative roles. While 49 teachers did not report their years of teaching experience, the average years of teaching experience reported was 9.61 (range 0 to 25 years), with a standard deviation of 7.20. Of the participants, 103 received their certification through a traditional undergraduate program leading to a bachelor's degree and teaching credential, 67 participants received their teaching credentials through an alternative certification program, 14 received their certification through a master's program that also awarded a teaching credential, and seven participants received their teaching credentials through a post-baccalaureate credentialing program. Forty-nine participants did not identify their certification route. The participants' educational levels include 59.2% Bachelor's Degree, 18.3% Master's Degree, and 1.25% Doctorate Degree. Forty-nine participants did not identify their education level. Additionally, more than half (i.e., 54%) of the participants indicated that they believed their formal preparation to teach reading comprehension had been adequate or extensive. When asked about the amount of reading-related professional development participants had attended before taking part in the research (i.e., May 2021), 1.3% indicated they had no prior reading-related professional development, 1.3% reported previously attending less than 6 hours of reading-related professional development, 17.5% of participants indicated they had received between 6 and 15 hours of reading-related professional development, 24.6% of participants indicated they had received between 16 and 35 hours of reading-related professional development, and 35% reported previously attending more than 35 hours of reading-related professional development.

Twenty percent of participants did not indicate their prior amount of reading-related professional development.

Of the 240 teachers who completed the TKRC, 103 grade 3-5 teachers' classroom instruction was observed by three trained research team members. A comparison of the observed teachers to the non-observed teachers showed no statistically significant differences in teacher characteristics (i.e., race, gender, years of experience, advanced degree, certification type, self-reported amount of prior reading-related professional development). Further, observed and non-observed teachers did not statistically significantly differ on the TKRC. An exception was that observed teachers had a higher average score on the Researcher-Developed Measure of Reading Comprehension (p=.02).

Table 1
Teacher Demographics

Category	**Participants (Grades 2-5)**	**District (Grades K-12)**	**State (Grades K-12)**
Total	240	1,880	719,502
Ethnic Distribution			
Hispanic	32.5%	25.6%	27.7%
White	30.0%	49.1%	58.4%
African-American	12.9%	20.6%	10.6%
Asian	1.25%	2.1%	1.7%
Other	1.25%	0.2%	1.6%
Not Reported	19.6%		
Gender			
Female	76.3%	74.6%	76.2%
Male	4.17%	25.4%	23.8%
Not Reported	19.6%		
Highest Degree Held			
No Degree	none	1.2%	1.4%
Bachelors	59.2%	71.9%	73.6%
Masters	18.3%	26.0%	24.3%
Doctorate	1.24%	0.9%	0.7%
Not Reported	20.4%		

Years of Experience			
Beginning Teacher	0.83%	6.6%	7.0%
1-5 Years	29.2%	39.7%	28.9%
6-10 Years	21.7%	20.3%	19.0%
11-20 Years	18.8%	23.6%	29.3%
21+ Years	9.17%	9.7%	15.7%
Not Reported	20.4%		
Role			
2nd Grade Teacher	17.1%		
3rd Grade Teacher	21.7%		
4th Grade Teacher	22.5%		
5th Grade Teacher	19.2%		
Instructional Coach or Specialist	12.9%		
Special Education Teacher	2.9%		
Administrator	2.1%		
Not Reported	1.6%		

Students

Reading comprehension scores were collected for all participating Grade 3-5 students in the district (N=3,514; Grade 3 n=1,051; Grade 4 n=1,262; Grade 5 n=1,201) at the end of the year (i.e., May 2021). While individual student demographic information was not collected, Table 2 presents the demographics for the students in the district and the state in which the research took place. The demographics for the students in the district are 65.6% Hispanic, 17.8% African American, 10.6% Caucasian, 3.3% Asian, 2.1% Two or More Races, and 0.5% Other. Approximately 50% of the students in the district are Female. Overall, 75.7% of the students are classified as economically disadvantaged, 31.4% are English learners, and 65.6% are at-risk. Special education services 9.3% of the students in the district. Across the 21 participating schools, an average of 80.5% of students participated in the free or reduced-price school lunch program (SD=14.03, range 30.2%-93%), a frequently used gauge of socioeconomic status (SES).

Table 2
Student Demographics

Category	District	State
Ethnic Distribution		
White	10.6%	27.0%
Hispanic	65.6%	52.8%
African-American	17.8%	12.6%
Asian	3.3%	4.6%
Two or More Races	2.1%	2.5%
Other	0.5%	0.05%
Gender		
Female	50.1%	48.8%
Male	49.9%	51.2%
Economically Disadvantaged	75.7%	60.2%
English Learners	31.4%	20.3%
At-Risk	65.6%	50.5%
Special Education	9.3%	10.7%

Measures

Teachers

Demographics. Teachers' demographic variables, including years of experience, race, gender, certification type, and grade level taught were collected. Information on teachers' elementary school campuses was collected so that the teachers' data could be nested within schools.

Teacher Knowledge of Reading Comprehension (TKRC). To measure teachers' knowledge, the Teacher Knowledge of Reading Comprehension (TKRC) was developed by the researcher. The TKRC is based on previous studies of teachers' knowledge (Binks-Cantrell, Joshi, et al., 2012; Ely et al., 2014; Peltier et al., 2020; Spear-Swerling & Cheesman, 2012;

Spear-Swerling & Zibulsky, 2014) and modules from Reading Rockets developed by the Center for Effective Reading Instruction. The TKRC measures teachers' content knowledge, pedagogical content knowledge, and application abilities of reading comprehension.

The TKRC consists of 39 refined multiple-choice items and three fill-in-the-blank items from a former 50-item survey used in a pilot study with 114 teachers. Based on results from the pilot study, items were removed from the TKRC based on item difficulty (i.e., difficulty= 0 or 1) and item discrimination (i.e., $p<.19$). Each multiple-choice item on the TKRC included four specific answer choices as well as the option for participants to select "I don't know." Items were scored as either right (1) or wrong (0), with only one answer choice being correct for each item. The three fill-in-the-blank items asked participants to write the prefix, root, and suffix or suffixes of a given word. Thus, the total number of answers scored and evaluated for analysis per survey totaled 39 when considering each separate answer into the total number. The TKRC contained items that aimed to measure teachers' content knowledge, pedagogical content knowledge, and application. Content knowledge items (n=15) assessed teachers' content knowledge (e.g., definitions, why is vocabulary important to reading comprehension). Application items (n=11) assessed teachers' understanding of how to apply their knowledge (e.g., what is the prefix, root word, and suffix in a given word, what is the main idea of the paragraph). Pedagogical content knowledge items (n=13) assessed teachers' ability to apply their content knowledge in the context of teaching. Pedagogical content knowledge items presented a teaching scenario and asked teachers to select the best answer.

Finally, the TKRC included 12 items that assessed teachers' perceived self-expertise in the area of reading comprehension. These self-perception items were measured on a Likert scale of 1= minimal, 2=moderate, 3= very good, and 4=expert. Background information (e.g., race,

gender, years of experience) was also collected for each participant at the beginning of the survey.

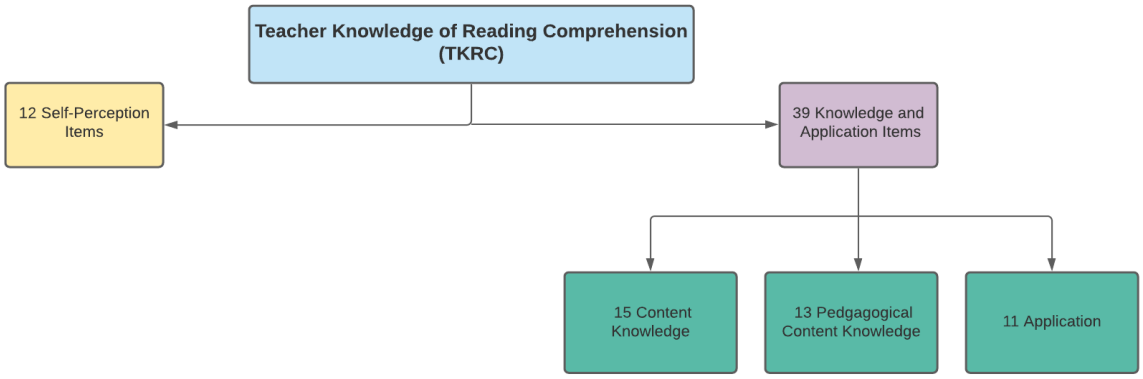

Figure 1. *Theoretical Breakdown of Survey Items*

Researcher-Developed Measure of Reading Comprehension. A passage with an overall text structure of problem and solution was given to teachers to assess their reading comprehension skills, specifically, their ability to generate the main idea after reading. The passage had a sixth-grade reading level and a word count of 756 words. Teachers were asked to read the text independently on the MOOV platform. After reading, the passage was removed from the teachers' view, and they were asked to generate the passage's main idea.

Mirroring prior research (Beerwinkle, 2018; Wijekumar et al., 2013), the main idea analysis, which was based on Meyer et al.'s (2010) semantic structure approach, was programmed into a computerized scoring system that provides consistently high reliability to the scores (see Wijekumar et al., 2017). Teachers' main idea statements were evaluated by the MOOV and scored for (a) organization, (b) cause, (c) problem, and (d) solution. The four subsections were measured on a 0-3 quality rating scale, with 0 being no knowledge of top-level structures and 3 showing excellent knowledge. Synonyms and misspellings were programmed into the computer for each category and scored as correct.

For the organization category, a score was determined by how closely the teacher's main idea statement aligned with the text's overall structure (i.e., problem-solution). As detailed in Meyer et al. (2010), a score of 0 would indicate that the teacher's main idea had no correspondence to the article's text structure, while a score of 3 would indicate an exact match. Similarly, for the cause, problem, and solution categories, a higher score indicates that the teacher included key supporting details related to the given category (e.g., key supporting details about the problem or key supporting details about the solution).

The main idea total score, used as an outcome variable, was the sum of the four sections. Thus, teachers could score up to 12 points total. The main idea total scores were ordinally coded into four levels, which corresponded to the ratings of Poor Knowledge (i.e., overall score of 0-3), Fair Knowledge (i.e., overall score of 4-6), Good Knowledge (i.e., overall score of 7-9), and Excellent Knowledge (i.e., overall score of 10-12). Like Meyer et al.'s (2010) suggestion, an overall score of seven or higher suggests the teacher utilized the top-level text structures to generate main ideas.

Classroom Instruction. For the larger study, 103 grade 3-5 teachers' classroom instruction was observed by three trained research team members at three time points throughout the school year. Interrater reliability was obtained during training. One observation took place in the fall semester, and two observations took place in the spring semester. All observations were recorded. Research assistants used the KAT Classroom Fidelity Observation Instrument (see Appendix B) to code the observed reading comprehension instruction. The third observation (Time 3) was utilized in the current study to coincide with the other teacher and student data collection, which took place at the end of the school year. Time 3 observations lasted approximately 42 minutes, on average.

Each observation had 100 possible points and examined instruction in the areas of text structure, vocabulary, main idea, summary, and inferences. Maximum points were awarded for each concept if the teacher was observed providing direct explanations using correct academic language (i.e., text structures, main idea), modeling instruction, and allowing guided and independent practice for students. This kind of explicit reading comprehension instruction has been associated with improved reading outcomes for students (e.g., Goodwin et al., 2021; NICHHD, 2000) and is theoretically linked to the knowledge measured by the TKRC and Researcher-Developed Measure of Reading Comprehension. The observation scores corresponded to the ratings of Poor Instruction (i.e., overall score of 20 or below), Fair Instruction (i.e., overall score of 30-50), Good Instruction (i.e., overall score of 60-80), and Excellent Instruction (i.e., overall score of 90 or above). Thus, a higher overall score suggests that a higher quality of reading comprehension instruction was being provided to students.

Students

Standardized Test of Reading Comprehension. Students' reading comprehension was measured using the Gray Silent Reading Test (GRST) (Wiederholt & Blalock, 2000) at the end of the school year (i.e., May 2021). The GRST assesses students' reading comprehension abilities, including identifying main ideas of text read. The GRST, administered in a group setting and designed for students aged seven to 25, comprises 13 short passages with five multiple-choice questions following each passage. The passages increase in difficulty and complexity as students move through the assessment. The GRST has two alternate forms, A and B. Form A (Cronbach's α=0.95) was used in the current study. In research question 3, the students' end-of-year GSRT adjusted score was used as the outcome measure. Scoring procedures outlined in the testing manual were used to score the GRST.

Main Idea Competency. A passage titled "Rats" that has been used in prior research to assess students' reading comprehension abilities was also utilized in the current study at the end of the school year (i.e., May 2021) (Beerwinkle, 2018; Meyer et al., 2010; Wijekumar et al., 2013, 2014; Wijekumar, Meyer, et al., 2020). The passage was given to students through the MOOV to assess their reading comprehension skills, specifically, their ability to generate a main idea statement after reading. The passage had an overall text structure of cause, problem, and solution and a word count of 98 words. Students were asked to read the text independently. After reading, the passage was removed from the students' view, and students were asked to write the main idea of the passage.

Similar to prior research (e.g., Beerwinkle, 2018; Wijekumar et al., 2013, 2014, 2017), Meyer et al.'s (2010) semantic structure approach was programmed into the MOOV and used to score students' main idea statements. Computer scoring by the MOOV has been verified by human raters, with a computer-human interrater reliability equal to 0.99 (Wijekumar et al., 2017). Students' main idea statements were evaluated by the MOOV and scored on an 8-point scale that was developed based on scoring procedures from prior research (see Table 3; e.g., Beerwinkle, 2018; Meyer et al., 2010; Wijekumar, Meyer et al., 2020). Synonyms and misspellings were programmed into the computer. Therefore, students were not negatively impacted by their misspellings (e.g., *docter* for *doctor*, *ratt* for *rat*) or choice of synonyms (e.g., *puppy* for *dog*, *threat* for *danger*) as long as the statement's meaning was retained. A score of 7-8 was given when the main idea statement focused on all three components of the text structure (i.e., cause, problem, and solution). A score of 5-6 was given when some components of the text structure were evident in the main idea statement (i.e., problem or solution). A score of 3-4 was given when an incorrect text structure was identified in the main idea statement (e.g., comparison

or sequence). A score of 1-2 was given when a general statement (e.g., it was about dogs) was written for the main idea. Similar to Meyer et al.'s (2010) suggestion, it is posited that an overall score of six or higher suggests the student is utilizing the top-level structures of text to generate main ideas.

Table 3
Researcher Designed Outcome Measures and Scoring Approaches with Examples

Construct measured	Scoring approach and examples of scoring guidelines
Main Idea (Problem-Solution) Competency (without passage in view)	Score 1-8 1= no problem, no solution, no cause 2= signaled cause but not problem and no solution 3= one part of the problem and solution 4= problem and cause but no solution or incorrect solution 5= problem and solution (correct content of problem and solution) 6= problem, solution, and cause of the problem mention only in the solution part 7= similar to 6 but additionally presented the cause of the problem when discussing the problem 8= problem, solution, and cause in the problem and cause eliminated in the solution part

Adapted from Wijekumar et al. (2013)

Procedures

Access to the district was secured through the district's participation in the larger study on text structure reading comprehension instruction. Teachers were recruited using both purposive and convenience sampling. Purposive sampling was used because of the need to recruit participants who were employed to specifically teach reading to grade 3-5 students and who had received the initial professional development on KAT in May of 2020. The participating district allowed the research team to hold a one-day web-based professional development session at the end of the school year (May 2021) for all grade 2-5 teachers

participating in the larger study. The professional development session lasted approximately eight hours and was designed to elevate and extend teachers' understanding of reading comprehension.

At the beginning of the eight-hour training, participants completed the TKRC and the Researcher-Developed Measure of Reading Comprehension. All surveys were completed electronically through the Massively Open Online Virtual (MOOV) system used by the larger study. The total number of correct items on the TKRC were recorded for final analysis. Further, items were grouped by subtest based on the criteria outlined in the instrument information to analyze each subtest.

All grade 3-5 students with parental permission completed the GRST and Main Idea Competency during their regularly scheduled reading instruction at the end of the school year (i.e., May 2021) through the MOOV platform. Students had 30 minutes to complete each measure of reading comprehension (GRST, Main Idea Competency), respectively. All participating students had received the KAT text structure-based comprehension instruction during the school year.

Research Questions

1. Is the TKRC a valid and reliable measure of teachers' knowledge of reading comprehension?
2. Do teacher characteristics (i.e., experience, certification type, grade level, amount of reading-related professional development, self-perception) at the end of the year correlate with teachers' knowledge score on the TKRC, researcher-developed measure of reading comprehension, or the level of explicit classroom reading comprehension instruction observed at the end of the year (i.e., Time 3)?

3. Does teachers' knowledge score on the TKRC at the end of the school year (i.e., after initial professional development and one year of implementation) correlate with the level of explicit classroom reading comprehension instruction observed at the end of the year (i.e., Time 3), controlling for teacher characteristics? And does teachers' score on the researcher-developed measure of reading comprehension at the end of the school year correlate with the level of explicit classroom reading comprehension instruction observed at the end of the year (i.e., Time 3), controlling for teacher characteristics?
4. Do either teachers' knowledge score on the TKRC or researcher-developed measure of reading comprehension, level of classroom instruction, or an interaction between knowledge and instruction correlate with students' reading comprehension abilities at the end of the year, controlling for teacher characteristics and school socio-economic level?

Data Analysis

Research Question 1

To answer RQ1, the TKRC was analyzed for reliability using Cronbach's alpha. Further, item difficulty and discriminability were examined. The proportion of participants who correctly answered an item indicates the item's difficulty (*p*) index. According to Wood (1960), easier items have a higher difficulty index. The discrimination index (D) was calculated by comparing the number of participants with survey scores in the top 27% who correctly answered an item to the number of participants in the bottom 27% of survey scores who correctly answered an item (Wiersma & Jurs, 1990). A higher discrimination index (D) suggests that the item better differentiates teachers with good knowledge versus poor (Crocker & Algina, 2006).

Finally, due to the binary nature of the variables on the TKRC, a factor analysis of the tetrachoric correlations was employed to investigate performance score patterns on the different survey items for

the entire sample. A tetrachoric correlation is the degree of relationship between two dichotomous variables and can range from -1 to 1. According to Holgado-Tello et al. (2010), a factor analysis of the tetrachoric correlation matrix better fit the theoretical model of their ordinal data compared to factorization of the Pearson correlation matrix. The number of factors was selected based on the variance proportion. A varimax orthogonal rotation was used, thereby resulting in uncorrelated factors. Factor loadings over 0.30 were analyzed to define each construct, as factor loadings over 0.30 are generally considered moderate, and loadings over 0.60 are considered large. Factor loadings under 0.30 were not considered as they are typically considered weak.

Research Question 2

To answer RQ2, a series of Hierarchical Linear Models (HLM; Raudenbush & Bryk, 2002) was used to control the nested nature of the data, with teachers nested within schools. Years of teaching experience, grade level of teaching, certification type, self-reported amount of prior reading-related professional development, and self-perception were input at level-1 to predict each knowledge outcome and level of classroom instruction. Certification type was dummy coded, with traditional certification as "0" and alternative certification as "1". Grade level was dichotomously coded, with teaching at Grade 2 as "0", Grade 3 as "1", Grade 4 as "2", and Grade 5 as "3". Self-reported amount of prior reading-related professional development was dichotomously coded, with no time at all as "1", less than six hours as "2", six to 15 hours as "3", 16-35 hours as "4", and more than 35 hours as "5". Degree was dummy coded, with "0" as a bachelor's degree and "1" as an advanced degree (i.e., master's or doctorate). Years of teaching experience and self-perception score were grand-mean centered (centered around the mean of the whole sample) to create a meaningful intercept. See Eq. (2) for the unconditional model.

(1) Level 1 (teacher level): $\mathbf{Y_{ij} = \beta_{0j} + \beta_{1j}Experience_{ij} + \beta_{2j}Grade_{ij} + \beta_{3j}Certification_{ij} + \beta_{4j}ReadingPD + \beta_{5j}SelfPerception_{ij} + \beta_{6j}Degree_{ij}\, e_{ij}}$

Y_{ij} is the knowledge score or classroom instruction score for teacher *i* in school *j*, β_{0j} is the school-specific intercept, $Experience_{ij}$, $Grade_{ij}$, $Certification_{ij}$, $ReadingPD_{ij}$, $SelfPerception_{ij}$, and $Degree_{ij}$ are the teacher characteristic variables for teacher *i* in school *j*, β_{1j} is the regression coefficient that captures the effect that experience has on knowledge or instruction, β_{2j} is the regression coefficient that captures the effect that grade-level taught has on knowledge or instruction, β_{3j} is the regression coefficient that captures the effect that certification type has on knowledge or instruction, β_{4j} is the regression coefficient that captures the effect that amount of reading-related professional development has on knowledge or instruction, β_{5j} is the regression coefficient that captures the effect that amount of self-perception score has on knowledge or instruction, β_{6j} is the regression coefficient that captures the effect that advanced degree has on knowledge or instruction, and e_{ij} is the error term at the teacher level.

Level 2A (school level): $\mathbf{\beta_{0j} = \gamma_{00} + U_{0j}}$

The adjusted mean score in a school is further modeled as the mean score across all schools plus a residual (i.e., school random effect associated with the intercept).

Level 2B: $\mathbf{\beta_{1j} = \gamma_{10} + U_{1j}}$

The effect of Experience on knowledge or instruction score in a school is further modeled as the mean effect across all schools plus an error (or residual school random effect associated with the slope)

Level 2C: $\beta_{2j} = \gamma_{20} + U_{1j}$

The effect of Grade on knowledge or instruction score in a school is further modeled as the mean effect across all schools plus an error (or residual school random effect associated with the slope)

Level 2D: $\beta_{3j} = \gamma_{30} + U_{1j}$

The effect of Certification on knowledge or instruction score in a school is further modeled as the mean effect across all schools plus an error (or residual school random effect associated with the slope)

Level 2E: $\beta_{4j} = \gamma_{40} + U_{1j}$

The effect of Self-Perception on knowledge or instruction score in a school is further modeled as the mean effect across all schools plus an error (or residual school random effect associated with the slope)

Level 2F: $\beta_{5j} = \gamma_{50} + U_{1j}$

The effect of Self-Perception on knowledge or instruction score in a school is further modeled as the mean effect across all schools plus an error (or residual school random effect associated with the slope)

Level 2G: $\beta_{6j} = \gamma_{60} + U_{1j}$

The effect of Degree on knowledge or instruction score in a school is further modeled as the mean effect across all schools plus an error (or residual school random effect associated with the slope.

Combined: $\mathbf{Y_{ij} = \gamma_{00} + \gamma_{10}Experience_{ij} + \gamma_{20}Grade_{ij} + \gamma_{30}Certification_{ij} + \gamma_{40}ReadingPD_{ij} + \gamma_{50}SelfPerception_{ij} + \gamma_{60}Degree_{ij}}$

Research Question 3

To answer RQ3, HLM (Raudenbush & Bryk, 2002) was used to control for the nested nature of the data, with teachers nested within schools. Intraclass correlation (ICC) was examined to determine the variability among schools. Knowledge scores on the TKRC and Researcher-Developed Measure of Reading Comprehension were grand-mean centered and input at level 1 to determine the relationship to teachers' classroom instruction score at the end of the school year (i.e., Time 3). Teachers' years of experience, grade level of instruction, certification type, amount of reading-related professional development, self-perception, and advanced degree were controlled for at level 1. See Eq. (2) for the unconditional model.

(2) Level 1: $\mathbf{Y_{ij} = \beta_{0j} + \beta_{1j}Knowledge_{ij} + \beta_{2j}Experience_{ij} + \beta_{3j}Grade_{ij} + \beta_{4j}Certification_{ij} + \beta_{5j}ReadingPD + \beta_{6j}SelfPerception_{ij} + \beta_{7j}Degree_{ij} + e_{ij}}$

Y_{ij} is the Time 3 instruction score for teacher *i* in school *j*, β_{0j} is the school-specific intercept, $Knowledge_{ij}$ is the score for teachers' knowledge on the TKRC or researcher-developed measure of reading comprehension for teacher *i* in school *j*, β_{1j} is the regression coefficient that captures the effect that knowledge has on classroom instruction, β_{2j} is the regression coefficient that captures the effect that experience level has on classroom instruction, β_{3j} is the regression coefficient that

captures the effect that grade level has on Time 3 instruction score, β_{4j} is the regression coefficient that captures the effect that certification type has on knowledge or instruction, β_{5j} is the regression coefficient that captures the effect that amount of reading-related professional development has on knowledge or instruction, β_{6j} is the regression coefficient that captures the effect that amount of self-perception score has on knowledge or instruction, β_{7j} is the regression coefficient that captures the effect that advanced degree has on knowledge or instruction, and e_{ij} is the error term at the teacher level.

Level 2A: $\beta_{0j} = \gamma_{00} + U_{0j}$

The adjusted mean score in a school is further modeled as the mean score across all schools plus a residual (i.e., school random effect associated with the intercept).

Level 2B: $\beta_{1j} = \gamma_{10} + U_{1j}$

The effect of knowledge on Time 3 instruction score in a school is further modeled as the mean effect across all schools plus an error (or residual school random effect associated with the slope)

Level 2C: $\beta_{2j} = \gamma_{20} + U_{2j}$

The effect of Experience on knowledge or instruction score in a school is further modeled as the mean effect across all schools plus an error (or residual school random effect associated with the slope)

Level 2D: $\beta_{3j} = \gamma_{30} + U_{3j}$

The effect of Grade on knowledge or instruction score in a school is further modeled as the mean effect across all schools plus an error (or residual school random effect associated with the slope)

Level 2E: $\beta_{3j} = \gamma_{40} + U_{4j}$

The effect of Certification on knowledge or instruction score in a school is further modeled as the mean effect across all schools plus an error (or residual school random effect associated with the slope)

Level 2F: $\beta_{5j} = \gamma_{50} + U_{5j}$

The effect of Self-Perception on knowledge or instruction score in a school is further modeled as the mean effect across all schools plus an error (or residual school random effect associated with the slope)

Level 2G: $\beta_{6j} = \gamma_{60} + U_{6j}$

The effect of Self-Perception on knowledge or instruction score in a school is further modeled as the mean effect across all schools plus an error (or residual school random effect associated with the slope)

Level 2H: $\beta_{7j} = \gamma_{70} + U_{7j}$

The effect of Degree on knowledge or instruction score in a school is further modeled as the mean effect across all schools plus an error (or residual school random effect associated with the slope.

Combined: $Y_{ij} = \gamma_{00} + \gamma_{10}\mathbf{Knowledge}_{ij} + \gamma_{20}\mathbf{Grade}_{ij} + \gamma_{30}\mathbf{Experience}_{ij} + \gamma_{40}\mathbf{Certification}_{ij} + \gamma_{50}\mathbf{ReadingPD}_{ij} + \gamma_{60}\mathbf{SelfPerception}_{ij} + \gamma_{70}\mathbf{Degree}_{ij}$

Research Question 4

To answer RQ4, a series of HLM nesting students within teachers was used. Students' scores on the GRST and Main Idea Competency were set as the outcome. Models controlled for students' grade level (0= grade 3, 1= grade 4, 2= grade 5) at level-1. At level-2, teachers' knowledge score on the TKRC or Researcher-Developed Measure of Reading Comprehension and level of explicit reading comprehension instruction (i.e., Time 3 observation) were entered as predictors in the model. Further, an interaction between knowledge and instruction was created and entered at level-2. Models controlled for the schoolwide percentage of students participating in the free or reduced-price lunch program, teachers' years of experience, teacher certification, teachers' amount of reading-related professional development, teachers' self-perception of abilities, and teachers' advanced degree at level-2. Thus, a main effect of teachers' knowledge score, a main effect of the level of explicit reading comprehension instruction, and an interaction effect between knowledge and instruction were examined. All continuous variables were grand-mean centered, allowing coefficients to be interpreted relative to the sample mean. See Eq. (3) for the unconditional model

(3) Level 1 (student): $\mathbf{Y_{ij} = \beta_{0j} + \beta_{1j}Grade_j + e_{ij}}$

Y_{ij} is the reading comprehension score for student *i* in teacher *j*, β_{0j} is the teacher-specific intercept, Grade-level$_{ij}$ is the student characteristic variables for student *i* in teacher *j*, β_{1j} is the regression coefficient that captures the effect that grade level has on reading comprehension score, and e_{ij} is the error term at the student level.

Level 2A (teacher):

$$\beta_{0j} = \gamma_{00} + \gamma_{01}\mathbf{gm\_knowledge}_j + \gamma_{02}\mathbf{gm\_Instruction}_j + \gamma_{03}\mathbf{gm\_knowledge}_j\mathbf{*gm\_Instruction}_j + \gamma_{04}\mathbf{gm\_FRL}_j + \gamma_{05}\mathbf{Experience}_{ij} + \gamma_{06}\mathbf{Certification}_{ij} + \gamma_{07}\mathbf{ReadingPD}_{ij} + \gamma_{08}\mathbf{SelfPerception}_{ij} + \gamma_{09}\mathbf{Degree}_{ij} + \mathbf{U}_{0j}$$

The adjusted mean in a student is further predicted by the teachers' grand mean-centered knowledge score (gm_knowledge), teachers' grand-mean centered classroom instruction score(gm_instruction), an interaction between teachers' knowledge and classroom instruction, the grand mean-centered schoolwide percentage of students participating in the free or reduced-price lunch program (gm_FRL), and teacher characteristics (i.e., years of experience, certification, amount of reading-related professional development, self-perception, and advanced degree).

Level 2B:

$$\beta_{1j} = \gamma_{10} + \gamma_{11}\mathbf{gm\_knowledge}_j + \gamma_{12}\,\mathbf{gm\_Instruction}_j + \gamma_{13}\mathbf{gm\_knowledge}_j\mathbf{*\,gm\_Instruction}_j + \gamma_{14}\mathbf{gm\_FRL}_j + \gamma_{15}\mathbf{Experience}_{ij} + \gamma_{16}\mathbf{Certification}_{ij} + \gamma_{17}\mathbf{ReadingPD}_{ij} + \gamma_{18}\mathbf{SelfPerception}_{ij} + \gamma_{19}\mathbf{Degree}_{ij} + \mathbf{U}_{1j}$$

The relationship between students' comprehension score in a teacher is further predicted by the teachers' grand mean-centered knowledge score (gm_knowledge), teachers' grand-mean centered classroom instruction score (gm_Instruction), an interaction between teachers' knowledge and classroom instruction, the grand mean-centered schoolwide percentage of students participating in the free or reduced-price lunch program (gm_FRL), and teacher characteristics (i.e., years of experience, certification, amount of reading-related professional development, self-perception, and advanced degree).

Level 2C: $\beta_{1j} = \gamma_{20} + U_{1j}$

The effect of students' grade on comprehension score in a teacher is further modeled as the mean effect across all teachers plus an error.

Combined:

$$Y_{ij} = \gamma_{00} + \gamma_{10}\mathbf{grade}_{ij} + \gamma_{01}\mathbf{gm\_knowledge}_{j} + \gamma_{02}\mathbf{gm\_instruction}_{j} + \gamma_{03}\mathbf{gm\_knowledge}_{j}\mathbf{*instruction}_{j} + \gamma_{04}\mathbf{gm\_FRL}_{j} + \gamma_{05}\mathbf{Experience}_{ij} + \gamma_{06}\mathbf{Certification}_{ij} + \gamma_{07}\mathbf{ReadingPD}_{ij} + \gamma_{08}\mathbf{SelfPerception}_{ij} + \gamma_{09}\mathbf{Degree}_{ij}$$

CHAPTER IV

RESULTS

This chapter presents the results of the dissertation study. STATA17 was used to conduct all statistical analyses. In the present study, the knowledge and instruction scores of elementary teachers who had participated in an intensive professional development focused on evidence-based reading comprehension instruction one year before taking part in the study (i.e., May 2020) were analyzed. Moreover, the participating school district also expected the teachers to implement evidence-based reading comprehension instruction in their reading lessons for the school year before the study (i.e., the 2020-2021 school year).

Research Question 1 Results: Reliability and Validity of the TKRC

Item difficulty

Item difficulty (*p)* was calculated for each of the 39 items on the TKRC. As seen in Table 4, no items had an extreme p value of 0.00 or 1.0, indicating that no item on the TKRC is worthless. The overall average of the difficulty coefficients on the TKRC was 0.68 (0.18), which is nearly at the idea difficulty level of 0.65 for a multiple-choice survey consisting of items with five alternatives. Further, item difficulty ranged from 0.15-0.90, with 67% of items falling between p=0.50 - 0.85 and 38% of items falling within 0.10 of the optimal difficulty range of p=0.55-0.75. The most challenging item on the survey was the question asking participants to identify the seven reading comprehension strategies supported by the National Reading Panel (*p*=0.15), followed by asking participants to identify the definition of a Tier Two vocabulary word (*p*=0.25). The questions with the highest p value were identifying the definition of an inference and a pedagogical content knowledge related to vocabulary instruction (i.e., providing students with a student-friendly definition) (*p*=0.90, respectively).

Table 4
TKRC Item Difficulty

	Survey Item	Difficulty Index (*p*)
1.	What are the seven comprehension strategies the National Reading Panel found to improve students' reading comprehension? Check the seven that apply.	0.15
2.	Tier 2 vocabulary words refer to:	0.25
3.	Which of the following would most likely be a Tier 2 vocabulary word from the passage?	0.29
4.	The genre of this passage is (fiction)	0.40
5.	For each of the following words, please list the prefix, root, and suffix (You may use a dash to represent "none." If two fall under one category, please list both.) (*beautifully)*	0.43
6.	For each of the following words, please list the prefix, root, and suffix (You may use a dash to represent "none." If two fall under one category, please list both.) (*disruption)*	0.49
7.	Which of the following statements is the best description of the relationship between children's oral reading fluency and their reading comprehension?	0.52
8.	The genre of this passage is (expository)	0.55
9.	Which of the following statements best describes the relationship between children's oral vocabulary knowledge and their decoding skills?	0.58
10.	What is the best summary of the passage?	0.59
11.	For each of the following words, please list the prefix, root, and suffix (You may use a dash to represent "none." If two fall under one category, please list both.) (*undoubtedly)*	0.60
12.	If you are introducing the word *reluctant* the best way to define it for students is…	0.60
13.	Which of the following strategies would be best to employ to promote metacognition?	0.66
14.	Which of the following should you consider when teaching vocabulary?	0.67
15.	Ms. Loflin has noticed that some of her 4th-grade students have had difficulty understanding some of the vocabulary terms. Which of the following is a recommended strategy Ms. Loflin should use to teach vocabulary?	0.68
16.	Mr. Weatherly wants to help his students answer the question, "Why does Elephant throw Tiger into the air and swat him?". Which of the following comprehension skills should he provide explicit instruction on?	0.70
17.	If a teacher wanted to help children infer the meaning of the word scarlet from context, which of the following sentences would provide the best example for him to use?	0.70
18.	The text structure of this passage *(narrative text)* is	0.72
19.	If you are introducing a new word, essential, the best way to define it for students is…	0.73
20.	Students may have a difficult time comprehending words that are not part of their:	0.74
21.	Using the text structure helps students to:	0.74

22.	The signal words because, resolved, result, so that, and consequently are usually found in the following text structure	0.75
23.	Which question requires higher-level reasoning?	0.76
24.	Alyssa, a fifth-grader, is able to retell the events of stories she has read and can usually answer questions about details in the stories correctly. However, she has a great deal of difficulty answering questions about characters' motivations and questions about the themes or morals of stories. Moreover, she has the same types of difficulties answering questions even when listening to stories read aloud by the teacher. This pattern of difficulties suggests that Alyssa has problems primarily with:	0.76
25.	What is the best main idea of the passage, Elephants?	0.76
26.	Students who read words accurately but cannot comprehend:	0.77
27.	Which activity could be used in activating a students' prior knowledge:	0.81
28.	Mr. Chong, a 5th grade English teacher, knows that incorporating morphology into his word study mini-lessons will help his students read and understand multisyllabic words. Therefore, he decides to teach:	0.83
29.	The purpose of activating students' prior knowledge is to:	0.83
30.	Which of the following is a recommended strategy/principle to consider when teaching vocabulary?	0.83
31.	A fifth-grade teacher has a number of struggling comprehenders in her class, students who can decode adequately but who have trouble understanding what they have read. The teacher wants to find a way to help the struggling comprehenders be successful in understanding a historical novel set during the Civil War. Of the following activities, which would be best for this purpose?	0.83
32.	A fourth-grade teacher wants her students to compare and contrast different ideas in a text they have read to help them generate the main idea. Which of the following types of graphic organizers would probably be most useful for this purpose?	0.83
33.	A fifth-grade teacher notices that many of her students seem confused about the meaning of the word incomprehensible, which they have encountered while reading a novel aloud in class. If the teacher wants to help students learn the meaning of the word and extend their vocabulary knowledge to other words, which of the following should she do?	0.85
34.	Which of the following types of vocabulary words would be most appropriate to pre-teach before a science-related read aloud?	0.85
35.	Which of the following statements is the best description of the relationship between children's ability to decode words and their reading comprehension	0.86
36.	The text structure of this passage *(expository text)* is	0.86
37.	Reading comprehension can be defined as	0.86
38.	Questions that combine background knowledge and text information to create a response describes which of the following:	0.90
39.	Ms. Daniels has noticed that some of her 4th-grade students have had difficulty understanding some of the vocabulary terms. Which of the following strategies would be the best for Ms. Daniels to use on a consistent basis to help her students learn and use vocabulary terms?	0.90

Item discrimination

Item discrimination, which examines how well an item distinguishes between participants who did well and participants who did poorly, was calculated by comparing the number of correct responses from participants scoring in the top 27% to participants scoring in the bottom 27% on the TKRC. Table 5 displays the discrimination index (D) for each of the items on the TKRC. The discrimination indexes for the items on the TKRC range from 0.17-0.62, with a mean of 0.32 (0.11). Based on suggestions from Ebel and Frisbie (1986), some questions on the TKRC are marginal items that may need revision (i.e., D=0.20-0.29); however, approximately 49% of the items on the TKRC have discrimination indexes that are classified as good or very good (i.e., D=0.30 or higher).

Table 5
TKRC Item Discrimination

	Survey Item	Discrimination Index (*D*)
1.	What are the seven comprehension strategies the NRP found to improve students' reading comprehension? Check the seven that apply.	0.18
2.	Tier 2 vocabulary words refer to:	0.26
3.	Which of the following would most likely be a Tier 2 vocabulary word from the passage?	0.22
4.	The genre of this passage is (fiction)	0.43
5.	For each of the following words, please list the prefix, root, and suffix (You may use a dash to represent "none." If two fall under one category, please list both.) (*beautifully)*	0.58
6.	For each of the following words, please list the prefix, root, and suffix (You may use a dash to represent "none." If two fall under one category, please list both.) (*disruption)*	0.42
7.	Which of the following statements is the best description of the relationship between children's oral reading fluency and their reading comprehension?	0.62
8.	The genre of this passage is (expository)	0.31
9.	Which of the following statements best describes the relationship between children's oral vocabulary knowledge and their decoding skills?	0.38
10.	What is the best summary of the passage?	0.45
11.	For each of the following words, please list the prefix, root, and suffix (You may use a dash to represent "none." If two fall under one category, please list both.) (*undoubtedly)*	0.45
12.	If you are introducing the word *reluctant,* the best way to define it for students is…	0.28
13.	Which of the following strategies would be best to employ to promote metacognition?	0.34
14.	Which of the following should you consider when teaching vocabulary?	0.49
15.	Ms. Loflin has noticed that some of her 4th-grade students have had difficulty understanding some of the vocabulary terms. Which of the following is a recommended strategy Ms. Loflin should use to teach vocabulary?	0.23
16.	Mr. Weatherly wants to help his students answer the question, "Why does Elephant throw Tiger into the air and swat him?". Which of the following comprehension skills should he provide explicit instruction on?	0.22
17.	If a teacher wanted to help children infer the meaning of the word scarlet from context, which of the following sentences would provide the best example for him to use?	0.31
18.	The text structure of this passage *(narrative text)* is	0.23
19.	If you are introducing a new word, *essential*, the best way to define it for students is…	0.20
20.	Students may have a difficult time comprehending words that are not part of their:	0.28
21.	Using the text structure helps students to:	0.20

22.	The signal words because, resolved, result, so that, and consequently are usually found in the following text structure	0.23
23.	Which question requires higher-level reasoning?	0.31
24.	Alyssa, a fifth-grader, is able to retell the events of stories she has read and can usually answer questions about details in the stories correctly. However, she has a great deal of difficulty answering questions about characters' motivations and questions about the themes or morals of stories. Moreover, she has the same types of difficulties answering questions even when listening to stories read aloud by the teacher. This pattern of difficulties suggests that Alyssa has problems primarily with:	0.37
25.	What is the best main idea of the passage, Elephants?	0.35
26.	Students who read words accurately but cannot comprehend:	0.40
27.	Which activity could be used in activating a students' prior knowledge:	0.29
28.	Mr. Chong, a 5th grade English teacher, knows that incorporating morphology into his word study mini-lessons will help his students read and understand multisyllabic words. Therefore, he decides to teach:	0.25
29.	The purpose of activating students' prior knowledge is to:	0.25
30.	Which of the following is a recommended strategy/principle to consider when teaching vocabulary?	0.29
31.	A fifth-grade teacher has a number of struggling comprehenders in her class, students who can decode adequately but who have trouble understanding what they have read. The teacher wants to find a way to help the struggling comprehenders be successful in understanding a historical novel set during the Civil War. Of the following activities, which would be best for this purpose?	0.31
32.	A fourth-grade teacher wants her students to compare and contrast different ideas in a text they have read to help them generate the main idea. Which of the following types of graphic organizers would probably be most useful for this purpose?	0.43
33.	A fifth-grade teacher notices that many of her students seem confused about the meaning of the word incomprehensible, which they have encountered while reading a novel aloud in class. If the teacher wants to help students learn the meaning of the word and extend their vocabulary knowledge to other words, which of the following should she do?	0.25
34.	Which of the following types of vocabulary words would be most appropriate to pre-teach before a science-related read aloud?	0.28
35.	Which of the following statements is the best description of the relationship between children's ability to decode words and their reading comprehension	0.32
36.	The text structure of this passage *(expository text)* is	0.35
37.	Reading comprehension can be defined as	0.25
38.	Questions that combine background knowledge and text information to create a response describes which of the following:	0.20
39.	Ms. Daniels has noticed that some of her 4th grade students have had difficulty understanding some of the vocabulary terms. Which of the following strategies would be the best for Ms. Daniels to use on a consistent basis to help her students learn and use vocabulary terms?	0.17

Factor analysis

The first nine factors, which explained around 57 % of the overall variance, were extracted. Based on the items that loaded substantially on each construct, each factor was named as follows: *(a) comprehension content knowledge, (b) KAT framework, (c) morphemic awareness and knowledge, (d) signal word knowledge, (e) vocabulary pedagogical content knowledge, (f) basic comprehension knowledge (g) knowledge of oral language comprehension, (h) comprehension pedagogical content knowledge, (i) Tier Two word knowledge and application.* See Figure 2 for a breakdown of survey items based on the factor analysis.

Comprehension Content Knowledge. The first factor explained 7.99% of the total variance. Table 6 displays the moderate to large, rotated factor loadings for the first factor. All items relate to comprehension content knowledge; thus, the first factor is theoretically representative of measuring content knowledge of reading comprehension.

Table 6
Factor 1: Comprehension Content Knowledge

Items	Factor Loadings
Which of the following strategies would be best to employ to promote metacognition?	0.63
Students who read words accurately but cannot comprehend	0.62
Questions that combine background knowledge and text information to create a response describes which of the following:	0.60
Which of the following is a recommended strategy/principle to consider when teaching vocabulary?	0.52
The purpose of activating students' prior knowledge is to:	0.43
Which of the following statements is the best description of the relationship between children's ability to decode words and their reading comprehension?	0.38
Which of the following should you consider when teaching vocabulary?	0.38

Eigenvalue	6.99
Variance Explained	18.39%

KAT Framework. The second factor explained 7.08% of the total variance. Table 7 displays the moderate to large, rotated factor loadings for the second factor. All items relate to the KAT framework, which teaches participants how to identify the top-level structure and use it as a scaffold to support the generation of a main idea and summary as well as answer inferencing questions. The second factor is therefore theoretically representative of measuring participants' application of the KAT framework.

Table 7
Factor 2: KAT Framework

Items	**Factor Loadings**
What is the best main idea of the passage?	0.65
The text structure of this passage is…	0.65
Alyssa, a fifth-grader, is able to retell the events of stories she has read and can usually answer questions about details in the stories correctly. However, she has a great deal of difficulty answering questions about characters' motivations and questions about the themes or morals of stories. Moreover, she has the same types of difficulties answering questions even when listening to stories read aloud by the teacher. This pattern of difficulties suggests that Alyssa has problems primarily with:	0.50
What is the best summary of the passage?	0.48
Reading comprehension can be defined as	0.39
Eigenvalue	2.22
Variance Explained	5.86%

Morphemic Awareness and Knowledge. The third factor explained 6.75% of the total variance. Table8 displays the moderate to large, rotated factor loadings for the third factor. All items relate to morphemic awareness, such as breaking a word apart into the prefixes, root, and suffixes, or content knowledge related to morphology instruction. The third factor is therefore theoretically representative of measuring participants' morphemic awareness and knowledge.

Table 8
Factor 3: Morphemic Awareness and Knowledge

Items	Factor Loadings
Please list the prefix, root, and suffix in the word *undoubtedly* (You may use a dash to represent "none." If two fall under one category, please list both.)	0.71
Please list the prefix, root, and suffix in the word *disruption* (You may use a dash to represent "none." If two fall under one category, please list both.)	0.64
Please list the prefix, root, and suffix in the word *beautifully* (You may use a dash to represent "none." If two fall under one category, please list both.)	0.54
Mr. Chong, a 5th grade English teacher, knows that incorporating morphology into his word study mini-lessons will help his students read and understand multisyllabic words. Therefore, he decides to teach:	0.43
Eigenvalue	2.17
Variance Explained	5.74%

Signal Word Knowledge. The fourth factor explained 6.33% of the total variance. Table 9 displays the moderate to large, rotated factor loadings for the fourth factor. Only one item loaded substantially on the fourth factor, and it asked about participants' knowledge of signaling words in relation to text structure. Consequently, the fourth factor is therefore theoretically representative of measuring participants' signal word knowledge.

Table 9
Factor 4: Signal Word Knowledge

Items	Factor Loadings
The signal words *because*, *resolved*, *result*, *so that*, and *consequently* are usually found in the following text structure	0.73
Eigenvalue	1.97
Variance Explained	5.21%

Vocabulary Pedagogical Content Knowledge. The fifth factor explained 6.30% of the total variance. Table 10 displays the moderate to large, rotated factor loadings for the fourth factor. All items move beyond general vocabulary content knowledge and ask participants to apply their knowledge to instructional situations. The fifth factor is therefore theoretically representative of measuring participants' vocabulary pedagogical content knowledge.

Table 10
Factor 5: Vocabulary Pedagogical Content Knowledge

Items	Factor Loadings
A teacher wants to help students build their vocabulary knowledge, which of the following words would most likely be a Tier 2 vocabulary word from the passage and the best to use for explicit vocabulary instruction?	0.76
A fifth-grade teacher has a number of struggling comprehenders in her class, students who can decode adequately but who have trouble understanding what they have read. The teacher wants to find a way to help the struggling comprehenders be successful in understanding a historical novel set during the Civil War. Of the following activities, which would be best for this purpose?	0.65
A fourth-grade science teacher is about to teach a unit on the digestive system. Which of the following types of vocabulary words would be most appropriate to pre-teach?	0.38
A fifth-grade teacher notices that many of her students seem confused about the meaning of the word incomprehensible, which they have encountered while reading a novel aloud in class. If the teacher wants to	0.35

help students learn the meaning of the word and extend their vocabulary knowledge to other words, which of the following should she do?	
Eigenvalue	1.94
Variance Explained	5.09%

Foundational Comprehension Knowledge. The sixth factor explained 6.16% of the total variance. Table 11 displays the moderate to large, rotated factor loadings for the sixth factor. All items are basic comprehension knowledge questions. The sixth factor is therefore theoretically representative of measuring participants' basic comprehension knowledge.

Table 11
Factor 6: Basic Comprehension Knowledge

Items	**Factor Loadings**
What are the seven comprehension strategies the NRP found to improve students' reading comprehension?	0.55
The genre of this passage is…	0.60
The genre of this passage is…	0.58
Which of the following could be used in activating a students' prior knowledge?	0.48
Eigenvalue	1.71
Variance Explained	4.50%

Knowledge of Oral Language Comprehension. The seventh factor explained 4.18% of the total variance. Table 12 displays the moderate to large, rotated factor loadings for the seventh factor. Only one item loaded substantially on the sixth factor, and it relates to oral language comprehension. Thus, the seventh factor is therefore theoretically representative of measuring participants' knowledge oral language comprehension.

Table 12
Factor 7: Knowledge of Oral Language Comprehension

Items	Factor Loadings
Students may have a difficult time comprehending words that are not part of their:	0.62
Eigenvalue	1.59
Variance Explained	4.18%

Comprehension Pedagogical Content Knowledge. The eighth factor explained 4.03% of the total variance. Table 13 displays the moderate to large, rotated factor loadings for the eighth factor. All items move beyond general comprehension content knowledge and ask participants to apply their knowledge to instructional situations. The eighth factor is therefore theoretically representative of measuring participants' comprehension pedagogical content knowledge.

Table 13
Factor 8: Comprehension Pedagogical Content Knowledge

Items	Factor Loadings
Mr. Weatherly wants to help his students answer the question "*Why does Elephant throw Tiger into the air and swat him?*". Which of the following comprehension skills should he provide explicit instruction on?	0.63
A fourth-grade teacher wants her students to compare and contrast different ideas in a text they have read to help them generate the main idea. Which of the following types of graphic organizers would probably be most useful for this purpose?	0.42
Eigenvalue	1.53
Variance Explained	4.03%

Tier Two Word Knowledge and Application. The ninth factor explained 3.78% of the total variance. Table 14 displays the moderate to large, rotated factor loadings for the ninth factor. All items relate to Tier Two vocabulary word knowledge and application. The ninth factor is therefore theoretically representative of measuring participants' Tier Two vocabulary word knowledge and application

Table 14
Factor 9: Tier Two Word Knowledge and Application

Items	**Factor Loadings**
If you are introducing the word *reluctant*, the best way to define it for students is…	0.73
If you are introducing a new word, *essential*, the best way to define it for students is…	0.61
Tier 2 vocabulary words refer to:	0.44
If a teacher wanted to help children infer the meaning of the word scarlet from context, which of the following sentences would provide the best example for him to use?	0.31
Eigenvalue	1.43
Variance Explained	3.78

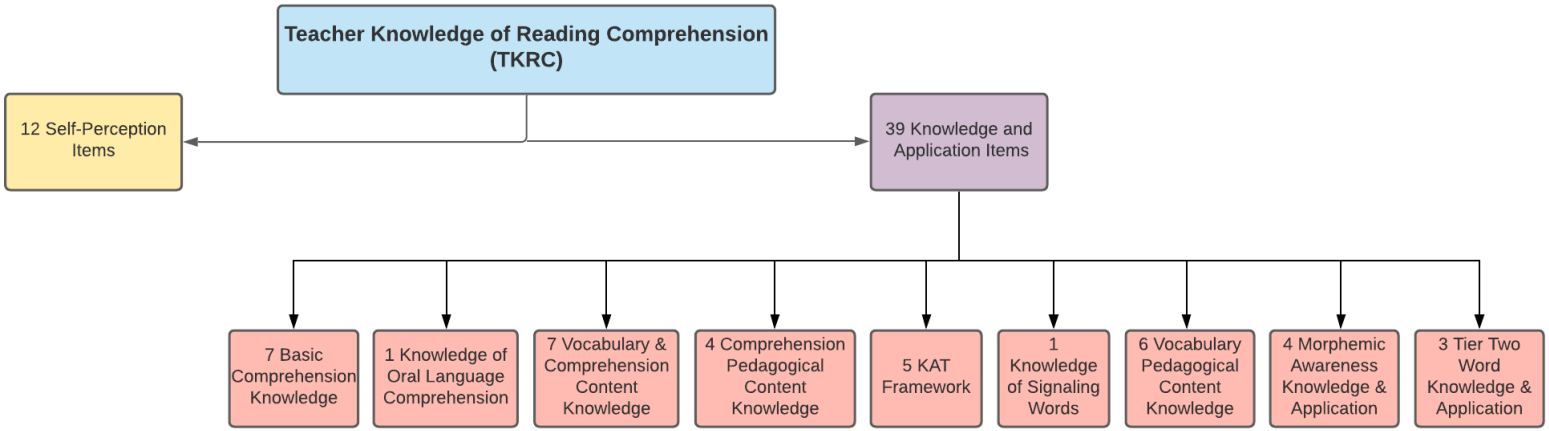

Figure 2. Final TKRC Survey Items Based on Factor Analysis

Reliability

The TKRC was found to have acceptable reliability, with a Cronbach's α= 0.85 for the entire 51 item survey in the present study. Table 15 displays the reliability analysis for scores on the TKRC. No alpha-if-item deleted statistic exceeded the overall Cronbach's α of 0.85, thereby suggesting that the items worked well in the present sample of elementary school teachers.

Table 15

Reliability Analysis

Item	Obs	Sign	Item-test correlation	Item-rest correlation	Average inter-item covariance	Alpha if Deleted
Q1	240	+	0.276	0.220	0.023	0.845
Q2	240	+	0.220	0.167	0.024	0.846
Q3	240	+	0.209	0.151	0.024	0.847
Q4	240	+	0.252	0.212	0.024	0.845
Q5	240	+	0.284	0.236	0.023	0.845
Q6	240	-	-0.078	-0.137	0.025	0.852
Q7	240	+	0.231	0.192	0.024	0.845
Q8	240	+	0.324	0.286	0.023	0.844
Q9	240	+	0.273	0.216	0.023	0.845
Q10	240	+	0.315	0.282	0.023	0.844
Q11	240	+	0.267	0.219	0.023	0.845
Q12	129	+	0.065	0.014	0.024	0.846
Q13	240	+	0.183	0.139	0.024	0.846
Q14	240	+	0.221	0.171	0.024	0.846
Q15	240	+	0.166	0.124	0.024	0.846
Q16	240	+	0.267	0.225	0.023	0.845
Q17	240	+	0.308	0.261	0.023	0.844
Q18	240	+	0.187	0.137	0.024	0.846
Q19	240	+	0.207	0.153	0.024	0.846
Q20	240	+	0.281	0.237	0.023	0.845
Q21	240	+	0.258	0.203	0.023	0.845
Q22	240	+	0.311	0.270	0.023	0.844
Q23	240	+	0.082	0.029	0.024	0.849
Q24	240	+	0.141	0.086	0.024	0.848
Q25	240	+	0.147	0.088	0.024	0.848
Q26	240	+	0.231	0.174	0.023	0.846
Q27	240	+	0.200	0.142	0.024	0.847
Q28	240	+	0.355	0.301	0.023	0.843
Q20	240	+	0.180	0.121	0.024	0.847
Q30	240	+	0.160	0.108	0.024	0.847
Q31	240	+	0.296	0.248	0.023	0.845
Q32	240	+	0.232	0.179	0.023	0.846

Q33	240	+	0.373	0.323	0.023	0.843
Q34	240	+	0.392	0.353	0.023	0.843
Q35	240	+	0.221	0.168	0.024	0.846
Q36	240	+	0.133	0.088	0.024	0.847
Q37	240	+	0.173	0.132	0.024	0.846
Q38	240	+	0.292	0.253	0.023	0.844
Q39	240	+	0.208	0.175	0.024	0.846
Q40	240	+	0.534	0.479	0.022	0.839
Q41	240	+	0.531	0.470	0.022	0.839
Q42	240	+	0.491	0.428	0.022	0.840
Q43	240	+	0.622	0.574	0.022	0.836
Q44	240	+	0.721	0.682	0.021	0.833
Q45	240	+	0.559	0.501	0.022	0.838
Q46	240	+	0.637	0.586	0.022	0.836
Q47	240	+	0.652	0.606	0.022	0.835
Q48	240	+	0.622	0.572	0.022	0.836
Q49	240	+	0.635	0.586	0.022	0.836
Q50	240	+	0.650	0.600	0.021	0.835
Q51	240	+	0.629	0.579	0.022	0.836
Test scale					**0.023**	**0.846**

Descriptive Statistics

Table 16 displays the means and standard deviations for the teacher measures, including the TKRC, Researcher-Developed Measure of Reading Comprehension, self-perception for teaching reading comprehension, and the level of reading comprehension instruction. Note that the TKRC items were scored as either right or wrong. Therefore, the mean for the TKRC can be thought of as the proportions of participants answering the survey correctly. The TKRC mean was 0.69 (SD=0.13), with a range of 0.15-0.95. Approximately 51% of the participants scored at or above 70% accuracy on the TKRC. When broken down by role, instructional coaches (M=0.76, SD=0.09) scored statistically significantly higher than classroom teachers (M=0.67, SD=0.14; $p<.001$) and special education teachers (M=0.65, SD=0.06; $p=0.03$). There were no statistically significant differences between the scores of classroom teachers and special education teachers ($p=0.61$).

When looking at each construct area, teachers scored statistically significantly lower ($p<.001$) on items aimed at basic comprehension knowledge (e.g., the seven NRP strategies, identifying the

genre of text) compared to all other items on the TKRC. Similarly, while there was no statistically significant difference between participants' morphemic knowledge and application (M=0.59, SD=0.30) and Tier Two word knowledge (M=0.59, SD=0.30) (p=0.46), participants scored statistically significantly lower in these two areas than all of the other remaining knowledge areas other than basic comprehension skills.

The Researcher-Developed Measure of reading comprehension mean was 4.82 (SD=3.08), indicating that, on average, participants had "Fair Knowledge" (i.e., score of 4-6). Further, 40% of participants scored in the "Poor Knowledge" (i.e., main idea total score of 0-3) range. Only 10.6% of participants had a main idea total score indicating they had "Excellent Knowledge" (i.e., score of 10-12).

Teachers, on average, believed they had moderate knowledge for teaching comprehension to elementary students. Approximately 16% of the participants believed they held "very good" or "expert" knowledge for the teaching of reading comprehension. When broken down by construct, teachers did not statistically significantly differ on their self-perception for teaching vocabulary versus teaching comprehension (p=0.23). However, participants did score themselves statistically significantly lower on their ability to teach reading comprehension and vocabulary to below-average readers than typically developing p=.002) and above-average readers (p<.001).

At the Time 3 observation of instruction, which took place at the end of the school year, teachers scored an average of 71.26 on the KAT Classroom Fidelity Observation Instrument. This score indicates that, on average, teachers were providing good reading comprehension instruction for students. Moreover, approximately 25% of the observed teachers were found to be providing excellent instruction (i.e., score of 90 or above), while approximately 18% of the teachers were providing poor to fair instruction (i.e., score below 60).

Table 16
Teacher Outcomes (n=240)

	M (SD)	Range
TKRC Overall	0.69 (0.13)	0.16-0.95
Comprehension Content Knowledge	0.76 (0.21)	
KAT Framework Knowledge	0.76 (0.22)	
Morphemic Knowledge	0.59 (0.30)	
Signal Word Knowledge	0.74 (0.43)	
Vocabulary Pedagogical Content Knowledge	0.74 (0.21)	
Basic Comprehension Knowledge	0.48 (0.25)	
Oral Language Comprehension	0.74 (0.44)	
Comprehension Pedagogical Content Knowledge	0.77 (0.26)	
Tier Two Word Knowledge and Application	0.57 (0.24)	
Researcher-Developed Measure	4.82 (3.08)	0-12
Problem	1.03 (0.77)	0-3
Solution	1.36 (0.94)	0-3
Cause	1.41 (1.00)	0-3
Organization	1.01 (1.11)	0-3
Self-Perception	2.52 (0.46)	1-4
Comprehension	2.55 (0.53)	1-4
Vocabulary	2.52 (0.51)	1-4
Typically Developing Readers	2.48 (0.67)	1-4
Below-Average Readers	2.38 (0.66)	1-4
Above-Average Readers	2.58 (0.63)	1-4
Instruction (n=103)		
Time 3	71.26 (18.40)	20-100

Table 17 displays the correlations between teacher outcomes and variables. The TKRC and the Researcher-Developed Measure of Reading Comprehension had a small, statistically significant correlation (r=0.23, p<.001). Teachers' self-perception of reading comprehension knowledge, as well as years of experience and amount of reading-related professional development, were statistically significantly correlated to the TKRC (r= 0.19, 0.23, and 0.32, respectively). No teacher characteristic variables were statistically significantly correlated with the Researcher-Developed Measure of Reading Comprehension. Similarly, Time 3 instruction was only statistically significantly correlated with grade level (r=0.24, p=.02).

Table 17
Correlation Matrix- Teacher Variables

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. TKRC	1.00								
2. Self-Perception	0.19**	1.00							
3. Researcher-Developed Measure	0.23***	-0.09	1.00						
4. Classroom Instruction Time 3	-0.05	-0.08	0.02	1.00					
5. Experience	0.23**	0.10	-0.004	-0.05	1.00				
6. Reading PD	0.32***	0.16*	0.03	0.02	0.22**	1.00			
7. Certification	0.12	-0.05	0.005	0.03	0.13	-0.04	1.00		
8. Grade	0.13	0.19*	0.005	0.24*	0.34***	0.08	0.11	1.00	
9. Degree	0.01	0.16*	-0.04	-0.13	0.21**	0.16*	-0.25***	0.30***	1.00

*=p<.05, **=p<0.01, ***=p<.001

Table 18 displays the means and standard deviations for the student measures, including the GSRT and Main Idea Competency measure. The GSRT adjusted score mean was 15.73 (SD=12.70), with a range of 0-65. The average GSRT age level was 8.33 (SD=2.53). The Main Idea Competency mean was 2.05 (SD=1.30), with a range of 0-8. As displayed in Table 19, there was a small, statistically significant correlation between the GSRT and the Main Idea Competency measure (GSRT adjusted r=0.43, GSRT age r=0.36). Further, both the GSRT and Main Idea Competency were positively, statistically significantly correlated with students' grade level and negatively, statistically significantly correlated with school SES level (i.e., the school-wide percentage of students participating in the free and reduced-price school lunch program).

Table 18
Student Outcomes (n=3,514)

	M (SD)	Range
GSRT Adjusted Score	15.73 (12.79)	0-65
GSRT Age Level	8.33 (2.53)	6.75-18.25
Main Idea Competency	2.05 (1.30)	0-8

Table 19
Correlation Matrix-Student Variables

	GSRT Adjusted Score	Main Idea Competency	Grade Level
GSRT Adjusted Score	1.00		
Main Idea Competency	0.43*	1.00	
Grade Level	0.27*	0.24*	1.00

*=p<.001

Research Question 2 Results: Relationship between Knowledge and Teacher Characteristics

HLM was used to control for the nested nature of the data, with teachers nested within schools (n=21). Preliminary analyses showed little variability among schools on the TKRC and Researcher-

Developed Measure of Comprehension, with only 4.11% and 6.57% of the total variability existing at the school level, respectively (TKRC intraclass correlation [ICC] = 0.0411, researcher-developed measure ICC= 0.0667). Similarly, ICC for teachers' Time 3 observation was small (i.e., ICC= 0 .0826), indicating little variability among schools.

Results for the model examining the direct relation of teacher characteristics to TKRC score are shown in Table 20. Years of teaching experience (γ_{10}=0.002, p=0.111), certification type (γ_{20}=0.024, p=0.198), grade level (γ_{30}=0.005, p=0.447), self-perception score (γ_{50}=0.033, p=0.094), and advanced degree (γ_{60}=-0.023, p=0.332) did not significantly predict TKRC scores. However, TKRC scores were statistically significantly predicted by participants' self-reported amount of prior reading-related professional development (γ_{40}=0.034, p<.001). Participants' TKRC score, on average, increased as participants' self-reported amount of prior reading-related professional development increased (See Figure 3) (No time at all n=3, Less than 6 hours n=3, 6 to 15 hours n=42, 16 to 35 hours n=59, more than 35 hours n=84, not reported n=49). As seen in Table 20, there was little to no unexplained variance in slopes between or within schools.

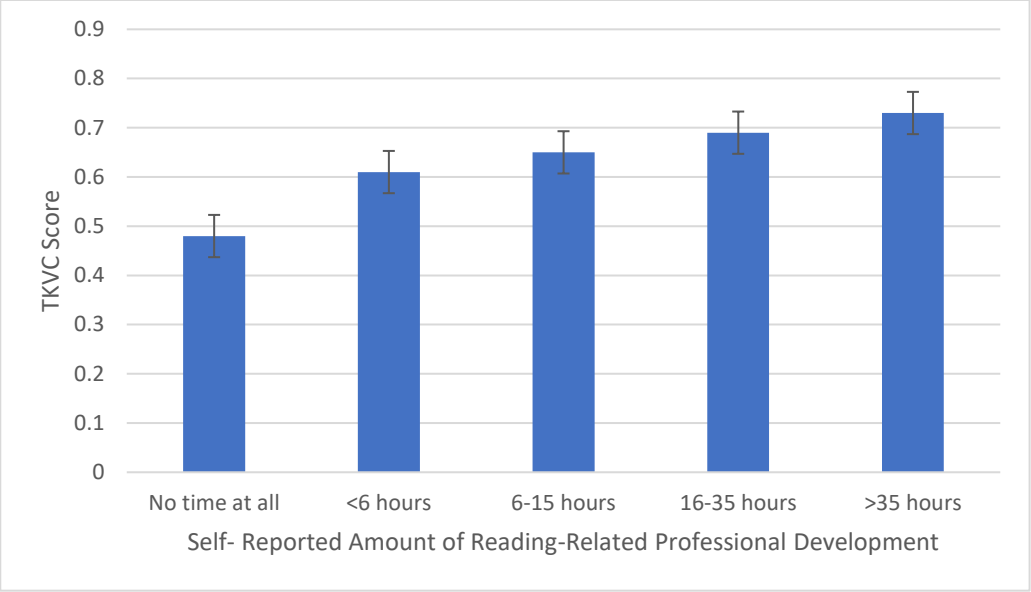

Figure 3. TKRC Score and Self-Reported Amount of Prior Reading-Related Professional Development

Results for the model examining the direct relation of teacher characteristics to the Researcher-Developed Measure of Comprehension score are shown in Table 20. Years of teaching experience (γ_{10}=-0.034, p=0.345), certification type (γ_{20}=-0.026, p=0.957), grade level (γ_{30}=0.281, p=0.163), amount of reading-related PD (γ_{40}=0.066, p=.800), self-perception score (γ_{50}=-0.584, p=0.253), and advanced degree (γ_{60}=-0.338, p=0.581) did not significantly predict participants' scores on the Researcher-Developed Measure of Comprehension. The unexplained variance in slopes between schools is 0.681, and the unexplained variance within schools is 8.89.

Results for the model examining the direct relation of teacher characteristics to teachers' Time 3 observation of instruction are shown in Table 20. Time 3 instruction score was only statistically significantly related to the grade level that participants teach (γ_{30}=5.75, p=0.008). Years of teaching experience (γ_{10}=-0.195, p=0.492), certification type (γ_{20}=-0.115, p=0.977), amount of reading-related PD (γ_{40}=0.663, p=.747), self-perception score (γ_{50}=-4.68, p=0.300, and advanced degree (γ_{60}=-6.07,

p=0.229) did not significantly predict participants' scores at the Time 3 observation. The unexplained variance in slopes between schools is 4.78, and the unexplained variance within schools is 286.55.

Table 20
Hierarchical Linear Modeling Results for Relation of Teacher Characteristics to Knowledge and Instruction Scores

Variable	TKRC (n=240)	Researcher-Developed Measure (n=240)	Time 3 Instruction (n=103)
Intercept	0.531*** (0.046)	4.33*** (1.22)	59.23*** (10.00)
Experience (gmc)	0.002 (0.001)	-0.033 (0.036)	-0.195 (0.284)
Certification	0.024 (0.019)	-0.026 (0.486)	-0.115 (4.04)
Grade Level	0.005 (0.007)	0.281 (0.202)	5.75** (2.18)
Self-Perception (gmc)	0.033 (0.020)	-0.584 (0.511)	-4.68 (4.52)
Reading PD	0.034*** (0.010)	0.066 (0.261)	.663 (2.05)
Advanced Degree	-0.023 (0.023)	-0.338 (0.612)	-6.07 (5.04)
Random Effects			
School level	<.001	0.681 (0.564)	4.78 (25.62)
Teacher level	0.014 (0.002)	8.89 (1.01)	286.55 (49.02)

*=p<.05, **=p<.01, ***=p<.001
Note. Values are coefficients from the two-level HLM predicting scores. Values in parentheses are standard errors for the coefficients; gmc= grand-mean centered.

Research Question 3 Results: Relationship between Knowledge and Instruction

Results for the model examining the direct relation of teacher knowledge to classroom instruction scores are shown in Table 21. Controlling for teacher characteristics, score on the TKRC did not significantly relate to participants' Time 3 instruction score (γ_{10}=-11.50, p=0.44). Similarly,

controlling for teacher characteristics, the Researcher-Developed Measure of Comprehension score did not significantly relate to participants' Time 3 classroom observation score (γ_{10}=-0.23, p=0.687).

Table 21
HLM Results for Relation of Teacher Knowledge to Instruction Scores (*n=103)*

	Coeff	*(SE)*	*p*
TKRC			
Intercept	54.24	(10.01)	<.001***
Experience (gmc)	-0.10	(0.29)	0.74
Certification	-0.65	(4.05)	0.87
Grade Level	6.28	(2.19)	0.004**
Self-Perception (gmc)	-4.37	(4.54)	0.34
Reading-Related PD	1.74	(2.06)	0.40
Advanced Degree	-7.05	(5.10)	0.17
TKRC score (gmc)	-11.50	(14.99)	0.44
Random Effects			
School level	4.33	(27.43)	
Teacher level	290.97	(50.29)	
Researcher-Developed Measure of Comprehension (RDMC)			
Intercept	60.88	(10.48)	<.001***
Experience (gmc)	-0.22	(0.29)	0.45
Certification	-0.07	(4.09)	0.99
Grade Level	5.65	(2.24)	0.01*
Self-Perception (gmc)	-5.36	(4.59)	0.24
Reading-Related PD	0.33	(2.13)	0.88
Advanced Degree	-5.00	(5.23)	0.34
RDMC score (gmc)	-0.23	(0.58)	0.69
Random Effects			
School level	0.102	(0.30)	
Teacher level	294.96	(44.73)	

Note. gmc= grand mean centered

Research Question 4 Results: Relationship between Student Reading Scores, Teacher Knowledge, and Classroom Instruction

HLM was used to control for the nested nature of the data, with students nested within teachers (n=128). Preliminary analyses showed that for the GSRT adjusted score, 13.6% of the total variability existed at the teacher level (ICC=0.1361). For the Main Idea Competency score, 8.41% of the total

variability existed at the teacher level (ICC=0.0841). As displayed in Tables 22 and 23, approximately 83.5%-98.6% of the between classroom variance in students' achievement on the reading comprehension outcomes is accounted for by the predictors in the final models.

TKRC

Results for the model examining the relation of teacher knowledge based on the TKRC, instruction, and an interaction between knowledge and instruction to students' reading comprehension scores are shown in Table 22. After controlling for students' grade level, percentage of schoolwide students participating in the free and reduced-price school lunch program, and teacher characteristics, the model examining the relation of teacher scores on the TKRC, Time 3 instruction score, and an interaction between knowledge and instruction to students' GSRT adjusted score revealed that TKRC scores (γ01=2.02, p=.51) did not significantly relate to students' end of year GSRT adjusted scores. However, while Time 3 instruction score (γ_{02}=-0.05, p=0.02) was statistically significant, there was a statistically significant interaction between TKRC score and Time 3 instruction score (γ_{03}=0.60, p<.001).

As seen in Figure 4, regardless of teacher knowledge level, students' GSRT scores increased as teachers' quality of instruction increased. However, with poor reading comprehension instruction (score=0 at Time 3 observation), model results show that students of low, average, and high knowledge teachers have a score of 13.26, 13.52, and 13.79, respectively on the GSRT at the end of the school year. Thus, there was basically no difference in student reading comprehension scores based on teacher knowledge when poor instruction was provided. However, students provided good instruction (i.e., score=60-80 at Time 3 observation) by teachers with high knowledge (i.e., one or more standard deviation about the mean) had a GSRT score of 40.31-49.15, while students provided good instruction by teachers with low knowledge (i.e., one or more standard deviation below the mean) had a GSRT

score of 30.42-36.28. Moreover, students provided excellent instruction (i.e., score=90 or above at Time 3 observation) by teachers with high knowledge had a GSRT score of 53.57. This dramatically differs from the score of 39.00 for students provided excellent instruction by teachers with low knowledge. Thus, students provided with excellent instruction from high-knowledge teachers tended to score an average of 15 points higher than students provided the same level of instruction from low-knowledge teachers. Further, it is important to note that while there was no statistically significant difference between scores when instruction was poor or fair (i.e., score below 60 at Time 3 observation; $p=0.35$), the GSRT adjusted scores of students receiving good or excellent instruction (i.e., score at or above 60 at Time 3 observation) from high knowledge teachers were statistically significantly different than the scores of students receiving the same quality of instruction from low knowledge teachers ($p=.01$).

The GSRT adjusted scores and teacher knowledge scores are continuous. Therefore, plausible teacher knowledge scores at 1 SD below the mean, the mean, and 1 SD above the sample mean have been modeled.

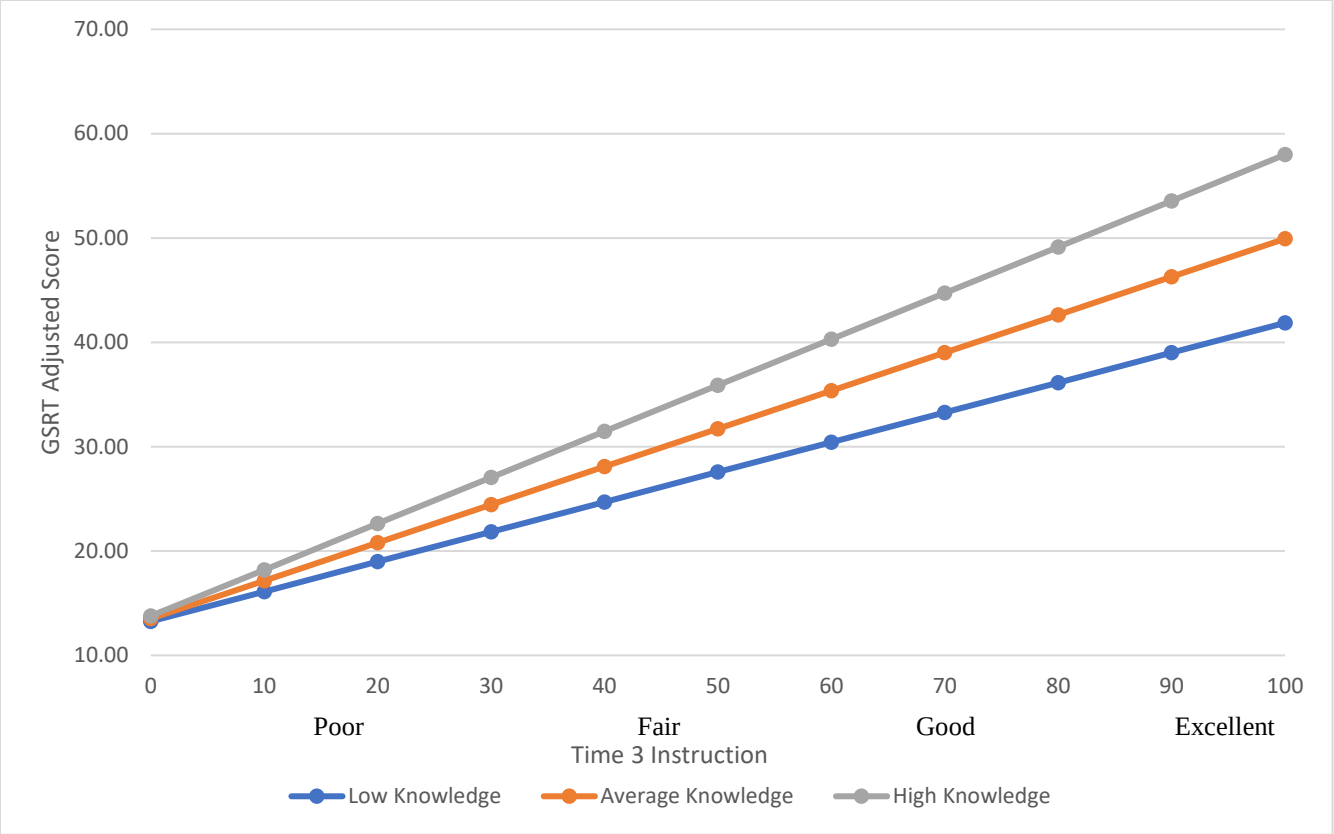

Figure 4. Relation of Teacher TKRC and Instruction to Student GSRT Adjusted Score, controlling for student grade level, school free and reduced lunch percentage, and teacher characteristics.
Note. Teacher knowledge scores fall one standard deviation or more below the mean (low, at or below .55), at the mean (average, .69), and one standard deviation or more above the mean (high, at or above .83).

In regards to the Main Idea Competency measure, after controlling for students' grade level, percentage of schoolwide students participating in the free and reduced-price school lunch program, and teacher characteristics, the model examining the relation of teacher scores on the TKRC, Time 3 instruction score, and an interaction between knowledge and instruction to students' main idea competency score revealed that TKRC scores (γ_{01}=0.06, p=.84), Time 3 instruction score (γ_{02}=-0.004, p=0.07), and the interaction between TKRC score and Time 3 instruction score (γ_{03}=0.028, p=.08) did not significantly relate to students' end of year main idea competency scores.

Table 22

Hierarchical Linear Modeling Results for Relation of TKRC and Instruction to Student Reading Comprehension Scores

	GSRT Adjusted Score			Main Idea Competency		
	Coeff	*(SE)*	*p*	Coeff	*(SE)*	*p*
Intercept	12.13	(2.18)	<.001***	1.89	(0.22)	<.001***
Student-level variable						
Grade Level	4.93	(0.48)	<.001***	0.44	(0.05)	<.001***
Classroom-level variable						
Experience (gmc)	0.06	(0.06)	0.24	0.008	(0.006)	0.14
Certification	0.88	(0.75)	0.24	-0.10	(0.07)	0.18
Self-Perception (gmc)	1.25	(0.97)	0.20	0.05	(0.09)	0.59
Reading-Related PD	-0.40	(0.46)	0.39	-0.05	(0.05)	0.30
Advanced Degree	-1.46	(0.95)	0.13	-0.30	(0.09)	0.002**
FRL level	-21.59	(2.71)	<.001***	-1.63	(0.25)	<.001***
TKRC score (gmc)	2.02	(3.04)	0.51	0.06	(0.29)	0.84
Time 3 score (gmc)	-0.05	(0.02)	0.02*	-0.004	(0.002)	0.07
TKRC x Time 3	0.60	(0.16)	<.001***	0.03	(0.02)	0.08

Random Effects	Unconditional Model		Final Model		Unconditional Model		Final Model	
Teacher level	22.66	(3.85)	1.97	(1.45)	0.144	(0.030)	0.001	(0.013)
Student level	143.78	(3.49)	150.31	(5.34)	1.57	(0.043)	1.50	(0.058)

Note. FRL= school-wide percentage of students participating in free and reduced-price school lunch program; gmc= grand mean centered; TKRC= Teacher Knowledge of Reading Comprehension

*p<.05, **p<.01, ***p<.001

Researcher-Developed Measure of Reading Comprehension

Results for the model examining the relation of teacher knowledge based on the Researcher-Developed Measure of Reading Comprehension, classroom instruction, and an interaction between knowledge and instruction to students' reading comprehension scores are shown in Table 23. After controlling for students' grade level, percentage of schoolwide students participating in the free and reduced-price school lunch program, and teacher characteristics, the model examining the relation of teacher scores on the Researcher-Developed Measure of Comprehension, Time 3 instruction score, and an interaction between knowledge and instruction to students' GSRT adjusted score revealed that the Researcher-Developed Measure of Comprehension scores (γ_{01}=-0.03, p=.461), Time 3 instruction score (γ_{02}=-0.04, p=0.10), and interaction between the Researcher-Developed Measure of Comprehension score and Time 3 instruction score (γ_{03}=-0.001, p=.517) did not significantly relate to students' end of year GSRT adjusted scores.

After controlling for students' grade level, percentage of schoolwide students participating in the free and reduced-price school lunch program, and teacher characteristics, the model examining the relation of teacher scores on the Researcher-Developed Measure of Reading Comprehension, Time 3 instruction score, and an interaction between knowledge and instruction to students' main idea competency score revealed that the Researcher-Developed Measure of Comprehension scores (γ_{01}=0.002, p=.522), Time 3 instruction score (γ_{02}=-0.004, p=0.07), and interaction between the Researcher-Developed Measure of Comprehension score and Time 3 instruction score (γ_{03}=0.-0.0001, p=.334) did not significantly relate to students' end of year main idea competency scores.

Table 23
Hierarchical Linear Modeling Results for Relation of Researcher-Developed Measure of Comprehension to Student Reading Comprehension Scores

	GSRT Adjusted Score			Main Idea Competency		
	Coeff	*(SE)*	*p*	Coeff	*(SE)*	*p*
Intercept	12.90	(2.52)	<.001***	1.98	(0.23)	<.001***
Student-level variable						
Grade Level	4.64	(0.52)	<.001***	0.43	(0.05)	<.001***
Classroom-level variable						
Experience (gmc)	0.09	(0.06)	0.13	0.01	(0.01)	0.08
Certification	0.91	(0.85)	0.28	-0.11	(0.08)	0.13
Self-Perception (gmc)	-0.48	(0.53)	0.37	0.08	(0.09)	0.38
Reading-Related PD	-0.38	(0.54)	0.37	-0.06	(0.05)	0.22
Advanced Degree	-1.79	(1.02)	0.08	-0.32	(0.09)	<.001***
FRL level	-20.41	(2.92)	<.001***	-1.52	(0.25)	<.001***
RDMC score (gmc)	-0.03	(0.04)	0.46	0.002	(0.003)	0.52
Time 3 score (gmc)	-0.04	(0.03)	0.10	-0.004	(0.002)	0.07
RDMC x Time 3	-0.001	(0.002)	0.52	-0.001	(0.001)	0.33
Random Effects	Unconditional Model		Final Model	Unconditional Model		Final Model
Teacher level	22.66	(3.85)	3.74 (1.76)	0.144	(0.030)	0.004 (0.014)
Student level	143.78	(3.49)	151.29 (5.43)	1.57	(0.043)	1.48 (0.058)

Note. FRL= school-wide percentage of students participating in free and reduced-price school lunch program; gmc= grand mean centered; RDMC= Researcher-Developed Measure of Comprehension
*p<.05, **p<.01, ***p<.001

CHAPTER V

DISCUSSION AND CONCLUSION

The present dissertation study aimed to investigate teachers' knowledge of reading comprehension in a group of elementary teachers (n=240) who had received professional development focused on evidence-based reading comprehension instruction one year prior to taking part in the study. Moreover, as these teachers had implemented evidence-based reading comprehension instruction for one year, the present dissertation also examined the link between the upper elementary (i.e., Grade 3-5, n=103) teachers' knowledge and skills of reading comprehension, classroom reading comprehension instruction, and student (n= 3,514) reading comprehension achievement. Few studies have empirically examined the connection between teachers' knowledge of reading-related concepts and student reading outcomes, especially regarding teacher knowledge of reading comprehension and student reading comprehension proficiency (Hudson, Moore, et al., 2021). Moreover, few studies of teachers' knowledge have utilized a validated measure or reported the teacher knowledge measure's psychometric properties. Findings revealed that the TKRC has good reliability (Cronbach's α= 0.85) and, accounting for around 57% of the total variance, is a valid measure of teachers' content and pedagogical content knowledge for comprehension. Results from the TKRC and an observation of classroom instruction revealed that while students' reading comprehension scores tended to increase as the quality of classroom instruction increased, there was a significant interaction between teacher knowledge and classroom instruction. Specifically, regardless of grade, school SES level, and teacher characteristics (i.e., years of experience, advanced degree, certification type, self-perception, self-reported amount of prior reading-related professional development), students who received good to excellent instruction from teachers with high knowledge tended to score statistically significantly higher than students provided the same quality of instruction from teachers with low knowledge levels

on a standardized measure of reading comprehension (i.e., the Gray Silent Reading Test). This finding helps validate theoretical accounts alluding to the critical role that teachers' knowledge plays in moderating student reading outcomes.

TKRC Survey

Results from the analysis of the TKRC survey are promising. An examination of the reliability indicated a high internal consistency among the scores (Cronbach's $\alpha = 0.85$). Moreover, item analysis indicated that the reliability would not increase if any items were removed from the TKRC. Further, item difficulty and discrimination indexes often fell within the good and optimal range amongst participants. The non-linear factor analysis of the survey items revealed nine constructs (i.e., *(a) comprehension content knowledge, (b) KAT framework, (c) morphemic awareness and knowledge, (d) signal word knowledge, (e) vocabulary pedagogical content knowledge, (f) basic comprehension knowledge (g) knowledge of oral language comprehension, (h) comprehension pedagogical content knowledge, (i) Tier Two word knowledge and application)*, which together explained approximately 57% of the overall variance. These nine constructs appear to validly represent the PBPD that participants had received one year prior to taking part in the study. Consequently, future research on teachers' knowledge of reading comprehension is encouraged to utilize the TKRC. However, results for the non-linear factor analysis may be strengthened with a larger sample size. Thus, future research may wish to continue evaluating the psychometric properties (e.g., reliability, item difficulty, item discrimination, factor analysis) of the TKRC in order to replicate the findings presented here with a wider population of teachers.

Teacher Knowledge of Reading Comprehension

While the literature on teachers' knowledge of complex constructs related to effective reading instruction is small (Hudson, Moore, et al., 2021), previous findings have suggested that teachers have

a poor understanding of concepts related to evidence-based reading comprehension instruction (Beerwinkle et al., 2018; Leader-Janssen & Rankin-Erickson, 2013; Masters et al., 2010; Reutzel et al., 2016; Spear-Swerling & Cheesman, 2012; Wijekumar, Beerwinkle, et al., 2020). Unlike the very low scores on teacher knowledge measures used in prior studies (e.g., 61-64% in Leader-Janssen & Rankin-Erickson, 2013; 46-47% in Masters et al., 2010; 59% in Spear-Swerling & Zibulsky, 2014), teachers in the present study demonstrated some knowledge of reading comprehension concepts, with approximately half of the participants scoring at or above 70% on the TKRC.

It is important to note, however, that the teachers in this study had received professional development focused on evidence-based reading comprehension instruction one year prior to completing the TKRC. Moreover, follow-up support was offered to participants in monthly meetings and access to an online resource file library. This additional support may help explain why the self-reported amount of prior reading-related professional development was statistically significantly related to teachers' scores on the TKRC, with scores increasing as the amount of training increased. However, further research is needed to disentangle this finding as specific details regarding the type of professional development and topics covered varied widely. Moreover, the quality of the prior professional development attended by these teachers may be highly variable.

Further, given that the teachers in the current study had been expected to participate in an intensive professional development focused on evidence-based reading comprehension instruction, it is interesting that three teachers indicated they had received no prior reading-related professional development. However, these teachers may have been new to the district and, therefore, had not attended the prior training. Similar to previous studies of teacher knowledge (e.g., McCutchen et al., 2002; Piasta et al., 2009; Pittman et al., 2020; Washburn et al., 2011b), no other teacher characteristics, including years of experience, certification type, or advanced degree, statistically significantly

predicted teachers' scores on the TKRC. This finding emphasizes the critical role that professional development can play in building teachers' knowledge of effective reading instruction (Darling-Hammond et al., 2017).

Similar to Porter et al. (2021), participants serving as instructional coaches or specialists scored statistically significantly higher than classroom teachers or special education teachers. This finding is promising as instructional coaches or specialists may be able to partner with teachers for "job-embedded professional learning that enhances teachers' reflection on students, the curriculum, and pedagogy" (Toll, 2014, p. 10), which is not always feasible with traditional professional development due to monetary or time constraints. While not statistically significantly different from classroom teachers, special education teachers performed the poorest on the TKRC measure, with an average score of around 65%. As Porter et al. highlight, students with severe reading difficulties who require explicit, systematic reading instruction are often taught by special education teachers, thus examining the reading-related preparation and professional development that special education teachers receive may be beneficial. However, this finding should be interpreted with caution as the sample's number of special education teachers was relatively small.

A closer analysis of the participants' responses on the TKRC revealed that teachers were largely unfamiliar with the seven reading comprehension strategies outlined by the NRP (NICHHD, 2000) report. Only around 15% of participants correctly identified at least six of the seven NRP recommended comprehension strategies. Given the teachers' professional development and classroom implementation of KAT before taking part in the research, it makes sense that story structure/text structure and summarization were the two most correctly recognized NRP strategies. However, teachers often failed to recognize that evidence-based research supports the use of cooperative learning, question answering, and question generation in reading comprehension instruction. Thus, the present findings, along with

similar outcomes from Masters et al. (2010), Spear-Swerling and Cheesman (2012), and Wijekumar et al. (2019), suggest that there is a disconnect between the NRP guidelines and teachers' knowledge of evidence-based reading comprehension strategies, which may have considerable implications on classroom instruction (Beerwinkle et al., 2018; Spear-Swerling & Zibulsky, 2014). While the NRP report is now over two decades old, Shanahan (2017) highlighted that studies published since the report's circulation continue to confirm the NRP's conclusions. Future professional development and teacher preparation programs are encouraged to explore ways to build teachers' understanding of the NRP supported strategies and how these strategies continue to be backed by the science of reading. Also, as the NRP does not provide suggestions on implementing the supported strategies into classroom practice and elementary school reading textbooks often inadequately address them (Beerwinkle et al., 2021), helping teachers effectively integrate the seven supported strategies into classroom reading comprehension instruction is needed.

Participants' responses also revealed that teachers seemed to perform better on items designed to assess content and pedagogical content knowledge than items designed to assess the application of knowledge, which mirrors the findings of Spear-Swerling and Cheesman (2012). For example, on two separate items, teachers demonstrated difficulty in correctly identifying the genre of a short text (41% and 55% accuracy, respectively). Moreover, teachers who answered these questions incorrectly tended to select a text structure rather than a genre; thereby, confirming that teachers have misunderstandings between text structure and genre (Reutzel et al., 2016; Wijekumar et al., 2019).

Similarly, many teachers struggled to correctly identify the prefixes, roots, and suffixes in a given word (44-63% accuracy). However, recognizing the meaningful parts of words (i.e., morphemic analysis) is often difficult for teachers (e.g., Moats, 1994; Pittman et al., 2020; Washburn et al., 2011a, 2011b, 2016). Additionally, teachers demonstrated misconceptions surrounding vocabulary instruction,

often believing that morphological awareness instruction should not begin until after students have developed proficient decoding and fluency skills. Thus, teacher training devoted specifically to building teachers' knowledge of morphological awareness and how it influences students' reading comprehension and vocabulary (Aaron et al., 2008; Goodwin et al., 2017) may be necessary. Most concerning is teachers' lack of understanding surrounding selecting appropriate words for vocabulary instruction. Beck et al. (2002) suggest that teachers select Tier Two words for explicit instruction, otherwise thought of as sophisticated words that cross academic domains such as wandered or fortunate. Results from the TKRC found that only 25% of participants were familiar with the term "Tier Two" words and, consequently, most teachers struggled to correctly select an appropriate Tier Two word from a piece of text.

Several previous studies have pointed out that there is often a disparity between teachers' perceived level of knowledge in relation to their actual levels of content and pedagogical content knowledge (Cunningham et al., 2004; Leader-Janssen & Rankin-Erickson, 2013; Meeks & Kemp, 2017). The findings from the present study reflect this same discrepancy, as most of the grade 3-5 teachers in the study believed that they held adequate knowledge for teaching reading comprehension, yet their performance on the Researcher-Developed Measure of Comprehension may suggest otherwise. For example, 40% of participants scored in the "Poor Knowledge" range (i.e., 0-3) on the Researcher-Developed Measure of Reading Comprehension, indicating that the main idea statement generated by these teachers failed to include organization and key ideas related to the text's structure. Considering the "Peter Effect" (Binks-Cantrell, Washburn, et al., 2012), it is unlikely that these teachers would be able to teach top-level structures and main idea generation well since they have not mastered it themselves.

Hudson et al. (under review) recently discovered through latent transition class analysis that most participants in a previous study transitioned out of the "Poor Knowledge" category immediately following professional development on text structures. Thus, given that the teachers in the present study had previously received professional development on text structure instruction, the large number of teachers in the "Poor Knowledge" range was surprising. Further research is needed to investigate how to help teachers sustain these initial improvements in knowledge after training has ended, especially since no teacher characteristics, including the amount of reading-related professional development, statistically significantly predicted teachers' performance on the Researcher-Developed Measure of Comprehension.

Teacher Knowledge and Classroom Instruction

Decades of research has demonstrated the benefits of explicit reading comprehension instruction on student outcomes (Chall, 2002; Duffy et al., 1986; Kamil et al., 2008; NICHHD, 2000; Richards-Tutor et al., 2016; Rosenshine & Meister, 1994; Shanahan et al., 2010; Solis et al., 2012). Explicit instruction is often characterized by clear explanations, teacher modeling, and guided practice with frequent feedback (Archer & Hughes, 2010). While the KAT Classroom Fidelity Observation Instrument was designed to capture how well teachers adhered to the KAT framework of instruction, it can also examine the quality of teachers' explicit reading comprehension instruction. For example, at the Time 3 observation utilized in this study, 83% of observed teachers were modeling how to generate a main idea statement using the structure of a text for students. Moreover, of those teachers who explicitly modeled main idea, 82% of them also allowed time for students to practice generating a main idea statement either independently or in small groups.

Research has suggested that teachers' understanding of reading comprehension skills and strategies is necessary to providing explicit comprehension instruction (Reutzel et al., 2016). Thus, it is

surprising that neither the TKRC nor the Researcher-Developed Measure of Reading Comprehension was statistically significantly related to teachers' Time 3 instruction scores. However, Park et al. (2019) also found no significant relationship between special education teachers' fluency knowledge and classroom fluency instruction. This nonsignificant finding may be due to the observation instrument's inability to capture those "in the moment" instructional decisions that knowledgeable teachers make (e.g., responding to student questions, explaining concepts in multiple ways, adjusting to student responses effectively and appropriately).

The lack of connection between teacher knowledge and observed instruction may also be explained through the teachers' use of the KAT framework. Having specific curriculum guidelines that are developed according to reading research, such as KAT, and that direct teachers to provide explicit reading comprehension instruction may have the potential to aid educators with a minimal understanding in providing instruction to students explicitly and systematically. The KAT framework, which 94% of teachers were observed to be following through the use of a completed lesson guide, suggests educators teach comprehension strategies through direct explanation and modeling and allow space for guided and independent practice. Thus, the KAT framework may help teachers provide more effective reading instruction, but future research, such as a randomized control trial, is needed to examine teachers' classroom instruction with and without the framework's support.

Impact on Student Reading Outcomes

The findings of the present study add to the literature emphasizing the important role that teachers' knowledge of literacy concepts plays in students' reading achievement (Brownell et al., 2017; Cash et al., 2015; Ehri & Flugman, 2018; Lane et al., 2008; McCutchen et al., 2002, 2009; Park et al., 2019; Peltier et al., 2020; Piasta et al., 2009; Spear-Swerling & Brucker, 2004). Moreover, the results expand the mounting literature on teachers' knowledge by demonstrating the relationship between

teachers' knowledge of reading comprehension, classroom instruction, and students' reading comprehension outcomes, which has been identified as a gap in the literature (Hudson, Moore, et al., 2021).

Interestingly, the current findings are similar to Piasta et al.'s (2009) findings with Grade 1 teachers' early literacy knowledge, decoding instruction, and students' word reading outcomes. After controlling for teacher characteristics, grade level, and school SES level, results revealed that students provided good to excellent instruction by high knowledge teachers scored statistically significantly higher on a standardized measure of reading comprehension than students given the same quality of instruction by low knowledge teachers. Thus, regardless of grade level, while teachers' content and pedagogical content knowledge are essential, it is the interaction of that specialized knowledge with classroom instruction that appears to make the most difference in students' reading outcomes.

The findings also confirm the complex role that teachers' knowledge plays in students' reading comprehension outcomes (McCutchen et al., 2002; Piasta et al., 2009) and validate theoretical propositions (Aaron et al., 2008; Connor, 2016) that highlight the importance of classroom factors in reading development, such as teachers' ability to plan and manage instructional activity, and the quality of literacy instruction. For example, as Spear-Swerling and Cheesman (2012) suggest, findings revealed that teachers' content knowledge alone might not be enough to positively impact student reading outcomes, as student reading comprehension scores did not differ based on teacher knowledge when poor instruction was provided. Thus, results from the current study verified that teacher knowledge "should be considered within the context of the actual classroom instruction provided" (Piasta et al., 2009, p. 242) because it is not guaranteed that knowledgeable teachers will successfully employ their knowledge when working with students (Spear-Swerling et al., 2005). This may explain why teachers' performance on the Researcher-Developed Measure of Reading Comprehension was not statistically

significantly related to students' reading comprehension outcomes. As teachers sometimes have difficulty in transferring learned knowledge into classroom instruction (Gormley & Ruhl, 2007), it may be that a teacher can utilize the top-level structures of text to generate main ideas yet be unsure of how to apply that knowledge to effectively teach students the steps for using top-level structures as a reading comprehension strategy. Future research should continue to unravel how teacher knowledge and classroom instruction are related to student reading achievement. Goodwin et al.'s (2021) found a significant relationship between fourth and fifth-grade students' standardized reading outcomes and the teachers' ability to provide clear explanations in multiple ways, use academic vocabulary, and ask effective questions throughout a lesson. As these aspects of teachers' talk may be difficult to capture on traditional teacher knowledge measures, researchers should consider ways to accurately capture these in-the-moment moves that play a significant role in students' reading achievements as well as how to better assess teachers' pedagogical content knowledge for teaching reading.

Given the prior success of the KAT framework in promoting positive student reading outcomes (e.g., Wijekumar et al., 2012, 2013, 2014, 2017), it is not surprising that students reading comprehension scores tended to increase as the quality of instruction, which was based on the KAT framework, increased. However, even with a good framework for instruction, teachers with a deeper understanding of reading comprehension skills and strategies, such as main idea and inferences, may be better able to provide accurate examples to students, respond appropriately to student questions, and correct student errors during instruction (Brady et al., 2009; Moats, 2014; Piasta et al., 2009). High-knowledge teachers may also be able to identify more precisely when a student needs further instruction or reteaching (Lane et al., 2008).

Limitations

While this study significantly contributes to the teacher knowledge literature, it is not without its limitations. First, a convenience sample was used rather than a randomly selected sample, and no control group of teachers or students was utilized. Additionally, the study took place in one large district in the South. Thus, the results may not generalize to a larger population of teachers and students. Secondly, the research only utilized a single time point (i.e., end of the year) of teachers' knowledge, classroom instruction, and student reading outcomes, limiting the study's ability to draw causal conclusions.

Similarly, a teacher's quality of instruction was measured by one classroom observation, which may not sufficiently capture the teacher's reading comprehension instruction. Future studies should examine students' reading comprehension growth over the school year in relation to teachers' knowledge levels and include several observations of classroom instruction to gain a more comprehensive picture. Thirdly, the teachers in the study had received professional development focused on evidence-based reading comprehension instruction one year before taking part in the study and therefore may not be representative of teachers in general. Thus, future research is encouraged to investigate the impact of professional development on teachers' knowledge of reading comprehension, classroom instruction, and, ultimately, student reading outcomes. Finally, the web-based text structure instruction (i.e., ITSS) that students received was not accounted for in the present study. Since ITSS has had positive results on students' reading comprehension outcomes in previous studies (e.g., Wijekumar et al., 2012, 2013, 2014; Wijekumar, Meyer, et al., 2020), future studies are encouraged to examine the impact of teachers' knowledge, classroom instruction, and instruction from ITSS to identify how these factors interact with one another to promote student reading achievement.

The study also assumes that the TKRC and Researcher-Developed Measure of Reading Comprehension measures teachers' actual levels of knowledge rather than participants' test-taking skills (i.e., good test-taker, poor test-taker) and that the knowledge assessed by the teacher measures is critical to and associated with effective classroom reading comprehension instruction. Further, participation in the surveys was voluntary. Thus, it is assumed that those who participated in the surveys are representative of the entire population, including those who choose not to participate.

Conclusion

The study presented in this dissertation attempted to address gaps in the field of teacher knowledge by examining teachers' knowledge of a complex construct and linking teachers' knowledge, classroom instruction, and student reading outcomes. The present findings were from a sample of upper-elementary teachers who participated in an intensive professional development focused on evidence-based reading comprehension instruction and had implemented text-structure-based reading comprehension instruction in their classrooms for one year before taking part in the study. Based on the findings, it is suggested that both adequate content and pedagogical content knowledge on the part of the teacher as well as effective instructional practices are critical to facilitating positive student reading outcomes (Castles et al., 2018; Moats, 1994, 2009, 2020; NICHHD, 2000). It is only through a focus on both teacher knowledge and the quality of classroom instruction that proficient reading outcomes for all students may ensue.

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APPENDIX A

Teacher Knowledge of Reading Comprehension (TKRC)

Correct answers indicated with underline. Each item is scored as either correct (1) or incorrect (0).

1. Which of the following statements best describes the relationship between children's oral vocabulary knowledge and their decoding skills?

    a) Accurate decoding is essential for the development of children's oral vocabulary knowledge.
    b) Children must have extensive oral vocabulary knowledge before they can learn basic decoding skills.
    c) Most struggling decoders have limited knowledge of oral vocabulary.
    d) Children's oral vocabulary knowledge allows them to obtain meaning from words they have decoded.
    e) I'm not sure.

2. Students may have a difficult time comprehending words that are not part of their:
    a) Oral vocabulary
    b) Listening vocabulary
    c) Writing vocabulary
    d) Reading vocabulary
    e) I'm not sure

3. Tier 2 vocabulary words refer to:
    a) words that students learn in content areas, such as particle, climate, orbit
    b) words that students learn indirectly while reading, such as often, merely, afterward
    c) words that cross academic disciplines, such as determine, illustrate, and average
    d) words that are not commonly used or arcane, such as thine, facsimile, and terrace
    e) I'm not sure

4. Ms. Loflin has noticed that some of her 4th grade students have had difficulty understanding some of the vocabulary terms. Which of the following is a recommended strategy Ms. Loflin should use to teach vocabulary?
    a) Rely solely on explicit vocabulary instruction to teach children new words
    b) Using dictionary definitions are most effective because they provide the most accurate definition of words
    c) Teach words that are used across a range of academic domains
    d) Pre-teaching vocabulary is discouraged because students should be taught to learn words using context clues to figure out meanings.
    e) I'm not sure.

5. Which of the following should you consider when teaching vocabulary?
    a) Focus on teaching students as many words as possible
    b) Instruction about morphology should be a part of vocabulary instruction
    c) The teaching of synonyms and antonyms should only be for academic or content area terms
    d) Morphology instruction should start after students have developed proficient decoding and fluency skills.
    e) I'm not sure

6. Which of the following is a recommended strategy/principle to consider when teaching vocabulary?

    a) It is more important to focus on breadth as compared to depth of vocabulary knowledge.
    b) Having students learn dictionary definitions is most effective in learning new words.
    c) Incorporating instruction in morphological knowledge in vocabulary teaching is confusing and should be avoided.
    d) It is important to introduce/demonstrate how words are used in multiple contexts in teaching vocabulary.
    e) I'm not sure

7. If you are introducing a new word, *essential*, the best way to define it for students is…
    a) "Discipline is essential in an army"
    b) "Pertaining to the essence of something"
    c) "Most important"
    d) "Pretty crucial"
    e) I'm not sure

8. Please list the prefix, root, and suffix for the word *Undoubtedly* (You may use a dash to represent "none." If two fall under one category, please list both.)

9. Please list the prefix, root, and suffix for the word *Disruption* (You may use a dash to represent "none." If two fall under one category, please list both.)

10. Please list the prefix, root, and suffix for the word *Beautifully* (You may use a dash to represent "none." If two fall under one category, please list both.)

11. If a teacher wanted to help children infer the meaning of the word scarlet from context, which of the following sentences would provide the best example for him to use?
    a) John's face turned scarlet with embarrassment when he realized his mistake.
    b) Mary loved the color scarlet and often bought clothes in that shade.
    c) A scarlet sports car sped along the highway, weaving in and out of traffic.
    d) The two children fought at length over the scarlet crayon, and then Billy decided to use the magenta one instead.
    e) I'm not sure

12. Mr. Chong, a 5th grade English teacher, knows that incorporating morphology into his word study mini-lessons will help his students read and understand multisyllabic words. Therefore, he decides to teach:
    a) Denotations and connotations
    b) Affixes and root words
    c) Parts of speech
    d) Prosody
    e) I'm not sure

13. A fourth-grade science teacher is about to teach a unit on the digestive system. Which of the following types of vocabulary words would be most appropriate to pre-teach?

    a) Multisyllable words related to the topic
    b) Important content words related to the topic
    c) High frequency words
    d) Common phonetically irregular words
    e) I'm not sure.

14. A fifth-grade teacher notices that many of her students seem confused about the meaning of the word incomprehensible, which they have encountered while reading a novel aloud in class. If the teacher wants to help students learn the meaning of the word and extend their vocabulary knowledge to other words, which of the following should she do?

    a) Have students divide the word into syllables orally.
    b) Explain the meaning of the word and ask students to use it correctly in another sentence.
    c) Teach students about common roots and affixes and help them to infer the meaning of the word.
    d) Have the students look the word up independently in the dictionary.
    e) I'm not sure.

15. Ms. Daniels has noticed that some of her 4th grade students have had difficulty understanding some of the vocabulary terms. Which of the following strategies would be the best for Ms. Daniels to use on a consistent basis to help her students learn and use vocabulary terms?
    a) Have students use a dictionary to record definitions of each vocabulary term in a student notebook
    b) Have students write the vocabulary term three times in a student notebook
    c) Have students come up with a "student friendly" definition of each vocabulary term and record it in a student notebook
    d) Have students highlight unknown vocabulary terms in their text
    e) I'm not sure

16. Reading comprehension can be defined as
    a) Extracting and constructing meaning from text
    b) Summarizing the text
    c) Predicting outcomes in the text
    d) Identifying main idea and details
    e) I'm not sure

17. Which of the following statements is the best description of the relationship between children's ability to decode words and their reading comprehension
    a) Reading comprehension and decoding skills develop independently of each other in most children.
    b) Good reading comprehension is essential for the development of decoding skills.
    c) The ability to use context cues is more important to reading comprehension than are accurate decoding skills.
    d) Accurate decoding skills provide a foundation for the development of reading comprehension.
    e) I don't know.

18. Which of the following statements is the best description of the relationship between children's oral reading fluency and their reading comprehension?
    a) Fluent readers have more interest in reading texts than do other children.
    b) Fluent readers can focus more of their attention and mental resources on comprehension.
    c) Fluent readers have extensive background knowledge that enables them to understand the difficult vocabulary in texts.
    d) Fluent readers use context cues to help decode most words, which improves their comprehension of all types of texts.
    e) I don't know

19. Questions that combine background knowledge and text information to create a response describes which of the following:
    a) Inferential comprehension
    b) Literal comprehension
    c) Summarization
    d) Question generating
    e) I'm not sure

20. Students who read words accurately but cannot comprehend:
    a) Are in need of decoding instruction
    b) Have attention issues
    c) Are struggling with language comprehension
    d) All of the above
    e) I'm not sure

21. The signal words *because, resolved, result, so that,* and *consequently* are usually found in the following text structure
    a) Cause-effect
    b) Problem-solution
    c) Sequence
    d) Comparison
    e) I'm not sure

22. The purpose of activating students' prior knowledge is to:
    a) Help students find information quickly when answering questions after reading
    b) Enable students to draw from their own experiences
    c) Enable students to focus on concepts in the text
    d) Allow students to work together
    e) I'm not sure

23. What are the seven comprehension strategies the NRP found to improve students' reading comprehension? Check the seven that apply.
    a) Metacognition
    b) Notice and Note/Annotate the text
    c) Cooperative Learning
    d) Beginning-Middle-End
    e) Somebody-Wanted-But-So
    f) Graphic Organizers
    g) Story Structure/Text Structure
    h) Question Answering
    i) Independent Reading
    j) Question Generation
    k) Multiple-Choice Questions
    l) Summarization

24. A fourth-grade teacher wants her students to compare and contrast different ideas in a text they have read to help them generate the main idea. Which of the following types of graphic organizers would probably be most useful for this purpose?
    a) An outline
    b) A matrix/t-chart
    c) A story map
    d) A time line
    e) I don't know

25. Alyssa, a fifth grader, is able to retell the events of stories she has read and can usually answer questions about details in the stories correctly. However, she has a great deal of difficulty answering questions about characters' motivations and questions about the themes or morals of stories. Moreover, she has the same types of difficulties answering questions even when listening to stories read aloud by the teacher. This pattern of difficulties suggests that Alyssa has problems primarily with:
    a) Inferencing
    b) Metacognitive awareness
    c) Fluency
    d) Literal comprehension
    e) I don't know

26. Which activity could be used in activating a students' prior knowledge:
    a) Telling students the names of the characters in the story
    b) Asking students to draw a picture of the main character in the story
    c) Previewing a text with the students
    d) Modeling a comprehension strategy prior to reading
    e) I'm not sure

27. Which of the following strategies would be best to employ to promote metacognition?
    a) Word Analysis of new vocabulary words
    b) Think Aloud of strategies for finding the main idea
    c) Semantic Mapping to visually display the meaning-based connections between concepts
    d) Repeated Readings to build fluency
    e) I'm not sure

28. A fifth-grade teacher has a number of struggling comprehenders in her class, students who can decode adequately but who have trouble understanding what they have read. The teacher wants to find a way to help the struggling comprehenders be successful in understanding a historical novel set during the Civil War. Of the following activities, which would be best for this purpose?
    a) Have the students in the class construct a story map after they read each chapter, pairing stronger and weaker comprehenders
    b) Have the students in the class construct a story map after they read each chapter, with students working independently
    c) Before students start the book, encourage them to ask any questions they might have about the civil war
    d) Before students start the book, preview key vocabulary and build background knowledge needed for understanding the book
    e) I don't know

29. Using the text structure helps students to:
    a) Find the relationship between key ideas in the text
    b) Mentally organize new information
    c) Understand the hierarchy of information from most important to least important
    d) All of the above
    e) I'm not sure

Use the following passage to answer the below questions:

Elephant and Friends

One day an elephant felt lonely. There were no other elephants where she lived. So she wandered into the forest to try to find new friends. She soon saw a monkey and proceeded to ask, 'Can we be friends, monkey?' The monkey quickly replied, 'You are big and can't swing on trees like I do, so I cannot be your friend.'

Defeated, the elephant continued to search when it stumbled across a rabbit. She proceeded to ask him, 'Can we be friends, rabbit?' The rabbit looked at the elephant and replied, "You are too big to fit inside my burrow. You cannot be my friend."

Then, the elephant continued until she met a frog. She asked, "Will you be my friend, frog?" The frog replied, "You are too big and heavy; you cannot jump like me. I am sorry, but you can't be my friend."

The elephant continued to ask the animals she met on her way, but always received the same reply. The following day, the elephant saw all the forest animals run in fear. She stopped a bear to ask what was happening and was told the tiger was attacking all the small animals. The elephant wanted to save the other animals, so she went to the tiger and said, "Please, sir, leave my friends alone. Do not eat them." The tiger didn't listen. He merely told the elephant to mind her own business.

Although he was reluctant at first, the Elephant saw no other way and made a trumpeting sound with her long trunk. Then she picked up the Tiger with her trunk and threw him into the air. When the Tiger landed, the elephant used her trunk to swat the Tiger on its back side. The frightened tiger ran for his life. Upon hearing of the brave tale, the other animals agreed, "You are just right to be our friend."

30. The genre of this passage is _____.

    a) Cause-Effect
    b) Narrative
    c) Informational
    d) Problem-solution
    e) I'm Not Sure

31. The text structure of this text is _____.
    a) Narrative
    b) Problem-solution
    c) Expository
    d) Comparison
    e) I'm not sure

32. Which question requires higher level reasoning?
    a) Who are the characters in this passage?
    b) What is the elephant's problem?
    c) What would the Tiger do if he wasn't scared away by the Elephant?
    d) Why did the elephant feel lonely?
    e) I'm not sure

33. Mr. Weatherly wants to help his students answer the question "Why does Elephant throw Tiger into the air and swat him?". Which of the following comprehension skills should he provide explicit instruction on?

    a) Reading carefully
    b) Finding the main idea
    c) Making an inference
    d) Knowing word meanings
    e) I'm not sure

34. A teacher wants to help students build their vocabulary knowledge, which of the the following words would most likely be a Tier 2 vocabulary word from the passage and the best to use for explicit vocabulary instruction?
    a) Wandered
    b) Heavy
    c) Burrow
    d) Problem
    e) I'm not sure

35. If you are introducing the word, *reluctant*, the best way to define it for students is…
    a) "Holding back, averse, or unwilling"
    b) "Not sure you want to do something"
    c) "Being hesitant about something"
    d) "Being ready to do something"
    e) I'm not sure

Use the following passage to answer the below questions:

Elephants

Elephants are the largest land animals on Earth, and they are one of the most unique-looking animals, too. There is no other animal with a similar physique with their characteristic long noses or trunks, large, floppy ears, and wide, thick legs. Elephants are social creatures and live in herds. According to the San Diego Zoo, herds are composed of primarily female family members and young calves and include 6 to 20 members, depending on the food supply. When the family gets too large, herds often split into smaller groups that stay within the same area. They are also considered an extremely intelligent species and have been observed showing advanced problem-solving skills and demonstrating empathy, mourning, and self-awareness.

Most experts recognize two species of elephant: the Asian elephant (Elephas maximus) and the African elephant (Loxodonta africana), who live on separate continents and have many unique features. According to National Geographic, African elephants live in sub-Saharan Africa, the rainforests of Central and West Africa, and the Sahel desert in Mali. Asian elephants live in Nepal, India, and Southeast Asia in scrub forests and rainforests.

African elephants are the larger of the two species. According to National Geographic, they grow to between 8.2 and 13 feet (2.5 and 4 meters) tall at the shoulder and weigh 5,000 to 14,000 lbs. (2,268 to 6,350 kilograms). Asian elephants are just a little smaller, growing between 6.6 and 9.8 feet (2 and 3 m) tall at the shoulder and weighing between 4,500 and 11,000 lbs. (2,041 and 4,990 kg). In the wild, African elephants can live up to 70 years, and Asian elephants up to 60 years.

African and Asian elephants also have a few different physical features. For example, the ears of African elephants are larger, weighing about 110 pounds each, and resemble the shape of the African continent, while Asian elephants have smaller, rounder ears. Both species eat all types of vegetation, including a variety of grasses, fruits, leaves, bark and roots. They spend about 16 hours eating, consuming anywhere from 165 to 330 lbs. (75 to 150 kg) of food per day.

36. The genre of this passage is _____.

    a) Comparison
    b) Narrative
    c) Expository
    d) Problem-solution
    e) I'm not sure

37. The text structure of this passage is _____.

a) Narrative
b) Problem-solution
c) Expository
d) Comparison
e) I'm not sure

38. What is the best main idea of the passage, Elephants?

a) Elephants are the largest land animals on Earth and eat all types of vegetation.
b) African and Asian elephants are large land animals, live in herds, and eat all types of vegetation.
c) African and Asian elephants are large land animals; however they live on separate continents and have many unique features.
d) African elephants live in African and Asian elephants live in Asia. African elephants are heavier and live longer than Asian elephants.
e) I'm not sure

39. What is the best summary of the passage?

a) African and Asian elephants are large land animals that live in herds of 6 to 20 members. African and Asian elephants live on separate continents. African elephants are the larger of the two species and live longer. Both species eat all types of vegetation, including a variety of grasses, fruits, leaves, bark and roots

b) Elephants are the largest land animals on Earth. African elephants grow up to 13 feet and Asian elephants grow up to 9.8 feet. Elephants can weigh between 4,500 to 14,000 pounds. African elephants' ears weigh about 110 pounds each.

c) Elephants are the largest land animals on Earth. African elephants have ears that weigh about 110 pounds and are shaped like the African continent. Asian elephants have smaller ears. Both African and Asian elephants eat around 165 to 330 pounds of grasses, fruits, leaves, bark, and roots each day.

d) African and Asian elephants are large land animals. They live in herds of primarily female members and young calves. A herd usually has 6 to 20 members. Elephants are also very smart and show empathy for one another.

e) I'm not sure

Self-Perception Items (Likert-Scale, scored separately from other survey items)

1. How would you rate your ability to teach vocabulary?
    1. minimal
    2. moderate
    3. very good
    4. expert

2. How would you rate your ability to select Tier 2 words for vocabulary instruction?
    1. minimal
    2. moderate
    3. very good
    4. expert

3. How would you rate your ability to teach prefixes, suffixes, and root words?
    1. minimal
    2. moderate
    3. very good
    4. expert

4. How would you rate your ability to provide student friendly definitions?
    1. minimal
    2. moderate
    3. very good
    4. expert

5. How would you rate your ability to teach comprehension?
    1. minimal
    2. moderate
    3. very good
    4. expert

6. How would you rate your ability to teach reading comprehension and vocabulary to typically developing readers?
    a. minimal
    b. moderate
    c. very good
    d. expert

7. How would you rate your ability to teach reading comprehension and vocabulary to below average readers?
    1. minimal
    2. moderate
    3. very good
    4. expert

8. How would you rate your ability to teach reading comprehension and vocabulary to above average readers?
    1. minimal
    2. moderate
    3. very good
    4. expert

9. How would you rate your ability to teach text structures as a reading comprehension strategy?
    1. minimal
    2. moderate
    3. very good
    4. expert

10. How would you rate your ability to teach main idea?
    1. minimal
    2. moderate
    3. very good
    4. expert

11. How would you rate your ability to teach summarization?
    1. minimal
    2. moderate
    3. very good
    4. expert

12. How would you rate your ability to teach inferencing?
    1. minimal
    2. moderate
    3. very good
    4. expert

APPENDIX B

KAT Classroom Fidelity Observation Instrument©

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Please use the following to answer the questions about the classroom being observed:
***= 10 points for Yes or 0 points for No & is included in instruction total score**

1. *Does teacher have Text Structure Lesson Guide completed and on the desk or with her/him or has one on their computer?	**YES / NO**
2. *Teacher introduces lesson mentioning Problem/Solution, Cause/Effect or, Comparison text structures	**YES / NO**
3. *Teacher explains vocabulary items. List words explained:	**YES / NO** _____,_____,_____
4. *Teacher models writing ***Main Idea*** using *Problem/Solution, Cause/Effect, or Comparison* (for observations in weeks 1 to 12 of academic year). If it is past 12 weeks of instruction, then does the teacher model for small groups that are struggling? Write the main idea that the teacher wrote on the wall or verbally explained:	**YES / NO** _____ _____
5. *Teacher asks students to individually write ***main idea*** using Problem/Solution, Cause/Effect, or Comparison in their notebook or other document. *(If students wrote the main idea in small groups, please note that here.)*	**YES / NO**
6. Number of students able to write Problem/Solution, Cause/Effect or Comparison ***main idea*** independently in their notebook If main idea was written in pairs or small groups, please count how many kids wrote it: *(group main ideas)*	_____ ----------___ (Pairs or Small Group Only)

(Observer counts number of students who wrote the main idea with cause/effect… correctly without any help.)	
7. *Teacher presents multiple choice version of ***main idea*** to students	**YES / NO**
8. *Teacher Models writing a ***summary*** by extending the main idea with details. Must still use the Problem/Solution, Cause/Effect, or Comparison text structures.	**YES / NO**
9. Number of students able to independently write a ***summary*** by adding some details and extending the main idea written with Problem/Solution, Cause/Effect or Comparison *(Observer counts number of students who wrote the summary with cause/effect… correctly without any help)*	_____
10. *Teacher presents multiple choice version of ***summary*** to students	**YES / NO**
11. *Does teacher present ***inference*** questions with cause/effect, problem/solution text structures? Note what the inference questions were:	**YES / NO** _____ _____ _____ _____
12. *Does the teacher additional comprehension strategies?	**YES / NO**
13. Describe the strategies presented:	
14. How many students were in attendance for class?	_____
Instruction Score Total	**____/100**