KINDERGARTEN AND FIRST GRADE TEACHERS' KNOWLEDGE OF READING AND ASSOCIATIONS WITH TEACHER CHARACTERISTICS AND INSTRUCTIONAL PRACTICES AT RURAL LOW-WEALTH SCHOOLS

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ABSTRACT

Rebecca Lee Payne Jordan: Kindergarten and First Grade Teachers' Knowledge of Reading and Associations with Teacher Characteristics and Instructional Practices at Rural Low-Wealth Schools
(Under the direction of Harriet Able and Lynne Vernon-Feagans)

The notably low level of reading proficiency across the United States, combined with the known importance of teachers for student success, necessitates improved understanding of teachers' knowledge, how it is acquired, and its role in instruction. This study had four goals: (1) identify whether domains of content knowledge and pedagogical content knowledge could be separately assessed in a measure of teacher knowledge; (2) assess the level of overall knowledge, content knowledge, and pedagogical content knowledge; (3) examine content knowledge and pedagogical content knowledge in relation to coursework, education, and experience; and (4) examine the relationship between content knowledge and pedagogical content knowledge and self-reported reading instructional practices. Using data from the Targeted Reading Intervention, factor analyses and multiple linear regressions were conducted on questionnaire data from sixty-six kindergarten and first grade teachers who were assigned to the control group in the original study. The findings illustrated teacher knowledge of reading is composed of content knowledge and pedagogical content knowledge. The levels of knowledge across domains were roughly equal. Experience was the only characteristic to be significantly associated with knowledge; however, knowledge was also significantly associated with instructional practices consistent with a comprehensive instructional approach. These findings illustrate the need to consider the domains that compose teacher knowledge in both teacher education programs and subsequent

research. They also provide support for an emphasis on experiential learning and internships in teacher education programs.

This dissertation is dedicated to all kindergarten and first grade teachers.

Not only does your knowledge matter, so do you!

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CHAPTER ONE

Statement of the Problem

Reading is a fundamental skill that is required to function fully in today's society. Reading is necessary to understand road signs, fill out job applications, read directions on medicine bottles, and engage in many other daily activities. Teachers must be prepared to teach reading well so that students can learn to read well early in school. However, the most recent National Assessment of Educational Progress (National Center for Education Statistics, 2015) indicated 60% of fourth grade students are not receiving the education necessary to read at the proficient level.

Teachers who are highly knowledgeable are often thought to be better able to create higher achieving students (Darling-Hammond, 2013). Though Darling-Hammond (2013) has focused on more general aspects of teacher knowledge, the evidence on the importance of teacher knowledge in early reading is mixed (Garet et al., 2008; McCutchen, Abbott, et al., 2002; McCutchen, Harry, et al., 2002; Piasta, Connor, Fishman, & Morrison, 2009). One possible reason for the conflicting findings is that teacher knowledge, while often thought of as one construct, has been proposed to constitute multiple domains (Shulman, 1986). Improved understanding of what constitutes teacher knowledge of reading could lead to a better understanding of the ways in which knowledge may matter for early reading. Thus, it is important to understand what composes teacher knowledge of early reading. Similarly, understanding the predictors of teacher knowledge of early reading could allow for the creation of more knowledgeable teachers. How teacher knowledge might relate to instructional practices

is also critical because, if knowledge is not associated with practices, then perhaps there is another more immediate driver of instructional decisions. On the other hand, if knowledge is associated with instructional practices, efforts could be enhanced to ensure the most knowledgeable teacher workforce is being created. The remainder of this chapter provides an overview of the relevant research on teacher knowledge of early reading conducted to date. First, proposed domains of teacher knowledge and the levels of teacher knowledge, which have been demonstrated in various samples of early elementary classroom teachers, are discussed. Next, a brief overview of the relationships between teacher characteristics and knowledge, and the relationship between teacher knowledge and instructional practices are presented. Then, the importance of the context when investigating early reading knowledge and the specific context of rural low-wealth communities are each addressed. Finally, the aims of this study and research questions are provided.

Domains of Teacher Knowledge of Early Reading

Teacher knowledge is a global term referring to a variety of facts, information, or skills teachers possess. To better understand what comprises teacher knowledge, Shulman (1986) proposed multiple domains, which he considered teacher knowledge to encompass across subject areas. Only two of these domains have been investigated in early reading: *content knowledge* and *pedagogical content knowledge*. Content knowledge can be understood as knowledge of the subject matter, while pedagogical content knowledge is the knowledge of how to teach the subject matter. C*ontent knowledge* in early reading includes basic linguistic concepts, such as the ability to manipulate phonemes (units of sound, e.g. /b/); understanding of the relationships among word structure (the admissible formation of words), syntax (grammatical rules of sentence structure), and semantics (the meaning of a word, phrase, sentence, or text); and the

ability to explain text organization (how a text is structured; International Dyslexia Association, 2010; International Reading Association, 2007, 2010; McCutchen & Berninger, 1999). *Pedagogical content knowledge* for early reading instruction includes the possession of multiple decoding and comprehension instructional strategies, knowledge of how best to design instruction, as well as an understanding of the most appropriate ways to respond to student misunderstandings (International Dyslexia Association, 2010; International Reading Association, 2007, 2010). While it is understood that teacher knowledge regarding early reading is likely multifaceted, there are no known empirical investigations of the domains composing teacher knowledge of early reading.

Knowledge Levels of Classroom Teachers of Early Reading

Previous research has examined the levels of teacher reading knowledge in early elementary classrooms, though this research has primarily been conducted in urban and suburban settings. Teachers have been able to answer as few as 32% of questions designed to assess their level of knowledge, and as many as 68% (Bos, Mather, Dickson, Podhajski, & Chard, 2001; McCutchen, Harry, et al., 2002). The level of knowledge in rural low-wealth communities has not previously been investigated, nor have there been investigations of the ways knowledge might vary across the domains proposed by Shulman (1986).

Knowledge Acquisition

Understanding how teachers acquire knowledge regarding early reading is critical to support teachers in becoming highly knowledgeable. Various teacher characteristics have been proposed to lead to greater knowledge, including reading methods coursework, level of education, and experience teaching. Other factors have also been proposed, such as the quality of the teacher education program, licensure test scores, and certification (Buddin & Zamarro,

2009; Clotfelter, Ladd, & Vigdor, 2007; Darling-Hammond, 2000; Harris & Sass, 2011; Wayne & Youngs, 2003), but this study specifically examined the relationships between reading methods coursework, education, experience, and knowledge. While many studies related these teacher characteristics to student outcomes (Buddin & Zamarro, 2009; Clotfelter et al., 2007; Darling-Hammond, 2000; Harris & Sass, 2011; Wayne & Youngs, 2003), only one study could be found that directly related any of these teacher characteristics to knowledge (Piasta et al., 2009). In that study, Piasta et al. (2009) found experience to be the only teacher characteristic that was significantly associated with teacher knowledge. They did not find any significant association between level of education and knowledge; however, this study did not examine the effects of reading methods coursework.

Relationship between Knowledge and Instruction

How knowledge relates to practices may also be critical to consider given the need for knowledge to be enacted in the practice of reading instruction (Guskey, 1986, 2002). Guskey created the seminal theory on teacher knowledge positing that any true change in teachers' knowledge does not occur until after knowledge is incorporated into practice. Several studies have supported the relationship between knowledge and practice by identifying an association between teachers' reading knowledge and the amount of time spent providing direct instruction in early reading (McCutchen, Abbott, et al., 2002; McCutchen, Harry, et al., 2002; Piasta et al., 2009). Importantly, at least one study presumed teacher knowledge was important in improving student outcomes, but the study included knowledge as a covariate rather than directly investigating the effects of knowledge on student outcomes (Garet et al., 2008). No published studies could be identified that examined the effects of knowledge on student outcomes. Nonetheless, increased understanding of how knowledge influences instructional practices has

been proposed as a critical missing element in the teacher knowledge literature (Piasta et al., 2009).

While the majority of studies on instructional practice have used observational evidence, the use of self-reported instructional practices using the survey of instructional practices from the Early Childhood Longitudinal Study (ECLS-K; National Center for Education Statistics, 2000) has also been demonstrated to be a valid and reliable measure (Guarino, Hamilton, Lockwood, & Rathbun, 2006; Palardy & Rumberger, 2008; Xue & Meisels, 2004). The fact that self-reported instructional practices have been related to student achievement in multiple studies indicates that this approach can be useful in quantifying teacher practices. However, it is important to recognize the limits of teacher self-report given the lack of correlation demonstrated between self-reported practice and observations of practice (Pianta & Hamre, 2009).

Importance of Investigating Early Reading

The knowledge of classroom teachers teaching reading in early elementary school is critical to investigate because it is the basis for later reading and success in school (Snow, Burns, & Griffin, 1998). The nature of children's early reading acquisition presents unique challenges for classroom teachers because it requires a unique knowledge base composed of several disparate skills, in spite of the fact that reading is sometimes viewed as a single task (Adams, 1990). Proficient reading requires a variety of complex skills, including oral language development, the ability to decode text, and concepts of word and print (Whitehurst & Lonigan, 1998). In early reading, students must learn each of these skills, as well as how to coordinate them. The multiplicity of skills needed to be enacted concurrently in reading makes it a difficult skill both to teach and learn, and, thus, requires highly knowledgeable teachers.

It is important to note, however, reading is more than a skill base. It is a complex social process requiring cognitive, linguistic, and social skills involving abstraction, reflection, interpretation, cross-cultural understanding, and critical thinking (Gee, 1990). Nevertheless, basic skills, while not sufficient, are necessary. Therefore, the knowledge required to teach the skills basis of reading, and its relationship with teacher characteristics and instructional practices, were the focus of this current study.

Challenges in Rural Low-Wealth Communities

Teaching early reading presents numerous challenges; however, the challenges are increased in rural low-wealth communities. No Child Left Behind (2002) specifically required states to ensure there was no disparity in the number of highly-qualified teachers in low-wealth and high-wealth communities. Yet, several studies highlighted differences in teacher quality in rural low-wealth communities (Lee & Burkam, 2002; Provasnik et al., 2007; Vernon-Feagans et al., 2012; Vernon-Feagans, Kainz, Hedrick, Ginsberg, & Amendum, 2013). Teachers in rural low-wealth communities tended to be less educated, but have more years of experience, than their urban and suburban counterparts (Amendum, Vernon-Feagans, & Ginsberg, 2011; Vernon-Feagans et al., 2012; Vernon-Feagans et al., 2013). These differences may be attributable to the geographic isolation of many rural low-wealth areas. Geographic isolation is associated with diminished access to professional development, higher education, and technology, which can all impact the knowledge level of rural low-wealth teachers (Duncan, 1999; Provasnik et al., 2007). Findings such as these, and others, which will be further explored in the following chapter, compel the examination of the reading knowledge of rural low-wealth early elementary classroom teachers. Previous studies on teacher knowledge have predominately been conducted in urban and suburban environments, albeit also in low-wealth environments (Foorman et al.,

2006; McCutchen, Harry, et al., 2002; Moats & Foorman, 2003). However, given the differences in teacher education and experience in rural low-wealth communities compared to those of teachers in urban and suburban low-wealth communities, the findings from previous studies may not generalize to rural low-wealth populations.

Aims of the Current Study

In addition to the previously under-researched rural low-wealth context, there are other gaps in the research base on early elementary classroom teachers' reading knowledge, which this study aimed to address.

Research question 1: What is the factor structure of the Teacher Knowledge Survey as demonstrated among kindergarten and first grade teachers in rural low-wealth schools? This study aimed to identify the factor structure of the Teacher Knowledge Survey (TKS) using confirmatory factor analysis. The TKS is composed of thirty-three true/false and multiple-choice questions and is the composite of two previously created measures (Moats, 1994; Piasta et al., 2009). Many domains have been theoretically proposed to underlie teacher knowledge, though the domains being assessed by this instrument have yet to be empirically demonstrated. Theoretically, this instrument has been considered by the authors of its individual components to "assess teachers' understanding of English phonology, orthography, and morphology, as well as important concepts of literacy acquisition and instruction" (Piasta et al., 2009, p. 232) and "to assess the knowledge teachers have of speech sounds, their identity in words, correspondence between sounds and symbols, concepts of language, and presence of morphemic units in words" (Moats, 1994, p. 89). Given the purposes of this measure and the types of questions included (which will be discussed in chapter three and can be seen in appendix A), it was hypothesized the TKS would primarily reflect domains of content knowledge and pedagogical content knowledge.

Identifying the factor structure allowed associations to be made between each domain and other constructs, such as teachers' characteristics and instructional practices.

Research question 2: What is the overall level of teacher knowledge among kindergarten and first grade classroom teachers in rural low-wealth schools, and what are the different levels of teacher knowledge using the information from the above factor analysis? This study aimed to use descriptive statistics to assess the level of reading knowledge of early elementary classroom teachers employed in rural low-wealth schools, both overall and on the factors identified in the confirmatory factor analysis. Previous examinations have neither addressed how knowledge levels may vary across the factor structure nor what level of knowledge may be present among teachers in rural low-wealth schools. Given the under-researched nature of teacher knowledge in rural low-wealth areas, and the predominance of lesser qualified teachers who work in rural low-wealth schools (Provasnik et al., 2007), the hypothesis was put forth that teachers were expected to correctly answer fewer questions on average than has been reported in previous studies of teachers in suburban and urban areas.

Research question 3: How do the number of reading methods courses, education level, and years of experience of kindergarten and first grade classroom teachers in rural low-wealth schools relate to the overall level of teacher knowledge, overall and level of knowledge on each factor identified in question one? This study aimed to examine the relationships between teachers' reading methods coursework, education, and experience, and teachers' knowledge using hierarchical multiple regression. Given Piasta et al.'s (2009) initial findings, the hypothesis was put forth that experience, but not coursework or educational level, was expected to significantly associate with teacher knowledge, after accounting for teacher age, race, and grade taught.

Research question 4: How do overall teacher knowledge and the factors identified in question one relate to self-reported instructional practices of kindergarten and first grade teachers in rural low-wealth schools? This study aimed to extend the examination of the relationship between early elementary classroom teachers' reading knowledge and instructional practices using hierarchical multiple regression. This relationship has been posited to be a critical missing factor in previous research on teacher knowledge (Piasta et al., 2009). It was anticipated that teachers with greater knowledge would report engaging more frequently in highly important instructional practices, such as phonemic awareness, phonics, fluency, vocabulary, and comprehension, after controlling for teacher age, race, grade taught, number of reading methods courses, education level, and experience, given the wide-spread findings demonstrating the importance of these practices (National Early Literacy Panel, 2008; National Reading Panel, 2000).

CHAPTER TWO

A Review of the Literature

Teacher knowledge may be one teacher attribute that can contribute to our understanding of teacher quality and instruction in the classroom. Teacher knowledge may be related to teacher characteristics and instructional practices. However, research specifically focused on teacher knowledge of early reading and its relationship to teacher characteristics and instructional practices is limited. Nonetheless, the fact that 60% of fourth grade students are not able to read proficiently across the United States (National Center for Education Statistics, 2015), combined with the fact that teachers are the most important school-based factor for student success (Rivkin, Hanushek, & Kain, 2005; Rowan, Correnti, & Miller, 2002), necessitates improved understanding of teacher knowledge, how it is acquired, and its role in instruction.

Shulman (1986) proposed teacher knowledge consisted of multiple domains. Unfortunately, in research on teacher knowledge of early reading, knowledge is often treated as though it were one construct (McCutchen, Abbott, et al., 2002; McCutchen, Harry, et al., 2002; Moats, 1994, 1999; Moats & Foorman, 2003; Piasta et al., 2009). Thus, an in-depth investigation into teacher reading knowledge, which acknowledges there may be multiple domains that can be separately assessed, is required. Moreover, the dearth of research in rural low-wealth communities where teacher quality has been noted to be lesser than other locales (Amendum et al., 2011; Lee & Burkam, 2002; Provasnik et al., 2007; Vernon-Feagans et al., 2012; Vernon-Feagans et al., 2013; Vernon-Feagans, Odom, Panscofar, & Kainz, 2008) compels an investigation in this context. It is important to note, however, this study cannot identify all

domains of knowledge related to early reading instruction because it examines the knowledge needed to teach the skills of reading, and skills instruction alone is not sufficient if all students are going to become readers (Gee, 1990; Hall, 2012).

In this chapter, the literature relevant to the reading-related knowledge and practices of kindergarten and first grade classroom teachers in rural low-wealth schools is reviewed. Specifically, the proposed domains of teacher knowledge relevant to early reading instruction will be delineated. Next, the level of reading knowledge of early elementary classroom teachers identified in previous studies will be explored. Then, research examining teacher characteristics and their relationship to classroom teachers' reading knowledge will be presented. Consideration will then be given to research conducted on instructional practices, focusing on studies using self-report, exploring the relationship between knowledge and instruction, and illustrating effective instructional practices to understand what knowledgeable teachers might be expected to do. Finally, research depicting the need for this examination in rural low-wealth communities will be explored. To end this chapter, gaps in the previous research and the specific research questions and hypotheses that were addressed in the present study are presented.

Factors Influencing Teacher Knowledge

Teacher knowledge has been a subject of investigation since Shulman's seminal work in the mid-1980s. In his early work, Shulman (1986) concluded that there were six primary knowledge areas for teachers, though two have been frequently investigated in relation to early elementary classroom teachers: *content knowledge* and *pedagogical content knowledge*. These two domains may be the most frequently investigated due to their critical nature. One cannot teach without knowledge of the subject (content knowledge) and an understanding of how to use that knowledge to teach others (pedagogical content knowledge). Each of these domains will be discussed in turn, including how they apply to early reading instruction.

C*ontent knowledge* is knowledge of the subject matter material. Importantly, Shulman (1986) emphasized that the teacher "need not only understand *that* something is so; the teacher must further understand *why it is so*" (p. 6). The content knowledge for teachers of reading includes basic linguistic concepts, such as: (a) the ability to count and manipulate phonemes (smallest unit of sound in words, e.g., /b/); (b) morphological knowledge (smallest meaning unit in language); (c) knowledge of syntax (grammatical rules of sentence structure); (d) semantic knowledge (the meaning of a word, phrase, sentence, or text); and (e) the ability to explain text organization (how a text is structured). It should also include knowledge of effective instructional practices.

Professional organizations have set forth the essential reading-related knowledge of early elementary classroom teachers. The International Literacy Association (ILA; 2007, 2010) and the International Dyslexia Association (IDA; 2010) expect teachers of reading to have foundational content knowledge of the research on language and reading development. Both organizations suggest that early elementary classroom teachers of reading should be knowledgeable about phonological awareness (recognition that words are made up of a variety of sound units, including phonemes, syllables, and rimes), phonemic awareness (ability to identify and manipulate phonemes), orthography (spelling system), the alphabetic principle (understanding that words are made up of letters and letters represent sounds in words), and morphological awareness (understanding that base words, prefixes, and suffixes carry significance). For example, early elementary classroom teachers must understand the difference between phonemic awareness, phonological awareness, and phonics (method of teaching beginning readers to connect the sounds of spoken language with letters), and that the alphabetic principle is critical for early reading. Overall, both the ILA and IDA state that it is necessary for teachers to have the

content knowledge necessary to understand both the linguistic basis of reading as well as how reading develops. While there are many aspects of early reading content knowledge, the ones examined within this study were phonemic awareness and phonological awareness.

Pedagogical content knowledge, on the other hand, is the knowledge of the "ways of representing and formulating the subject that makes it comprehensible to others," as well as knowledge of common student errors and how to respond to them (Shulman, 1986, pp. 6-7). For early elementary classroom teachers, pedagogical content knowledge should include knowing how best to present instruction and how to respond to errors in reading and understanding words. For example, an early elementary classroom teacher employing pedagogical content knowledge might determine the appropriate first step in a sequence of instruction or identify why a student mispronounced a word in a particular way and then determine the appropriate instructional response.

Both the ILA (2007, 2010) and IDA (2010) expect teachers to have the pedagogical content knowledge to know word-level and text-level instructional strategies. This familiarity is required so teachers have multiple research-based strategies upon which they can draw, such as engaging students in a picture walk (previewing a book to familiarize the student with the story before introducing the text; Briggs & Forbes, 2009), echo reading (repeating phrases of a fluent reader; Morra & Tracey, 2006), or reciprocal teaching (students summarize, generate questions, clarify, and predict sections of text while reading; Palincsar & Brown, 1986). As such, teachers must understand the use of syntax and semantics as aids for word recognition and comprehension, and the ways vocabulary and fluency facilitate comprehension (International Dyslexia Association, 2010). Moreover, the ILA (2007, 2010) emphasizes the need for early elementary classroom teachers to be familiar with a variety of instructional approaches.

Teachers must have a variety of strategies to accommodate each student's individual learning differences.

The complexity of the relationship between oral and written language may contribute to the critical nature of content and pedagogical content knowledge in early reading. As one example of the necessity of these domains in early reading instruction, the teacher must have the content knowledge to know the difference between digraphs (a combination of two letters representing one sound; e.g., ch, th, sh) and blends (a combination of two letters representing two sounds; e.g., bl, tr, st), as well as be able to provide examples of them. If a teacher does not have the content knowledge to understand this difference, a student may read "this" as /t/ /h/ /is/ or "shell" as /s/ /h/ /ell/, and accuracy, rate, and comprehension would all be negatively impacted. Content knowledge though, while necessary, is not sufficient. Pedagogical content knowledge extends beyond initial teaching to responding appropriately to a child who misreads words or misunderstands text. For example, in order to support the student in the example above, the teacher would need to realize that the mispronunciations indicated the child understood the alphabetic principle (the understanding that words are made up of letters and letters represent sounds in words) but did not yet understand the fact that multiple letters can represent one sound. Furthermore, the teacher would need to correct the misunderstanding of –th or –sh as a blend to an understanding of these letter combinations as a digraph (which only represent one sound, though comprised of two letters). Finally, the teacher must have the pedagogical content knowledge to determine the appropriate instructional sequence and strategies that would be most effective in providing this understanding. The above scenario is only one example of a wide realm of content and pedagogical content knowledge that is needed by early elementary classroom teachers.

Both the ILA (2007, 2010) and IDA (2010) state that teachers who possess the above qualities will increase the reading achievement of students in their classes. Significantly, each emphasizes the importance of reading development and English linguistic knowledge in the areas of phonology, orthography, and morphology, and instructional techniques, related both to word-level and text-level instruction. This emphasis on reading development and English linguistic knowledge seems to form the backbone of content knowledge, while the knowledge of when and how to employ instructional techniques appears to be the underpinning of pedagogical content knowledge. While each of these sources provides a delineation of the essential reading-related knowledge of early elementary classroom teachers, others have examined the level and impact of this knowledge. As such, the following section details the work conducted to date examining the levels of early elementary classroom teachers' reading knowledge.

Levels of Teacher Knowledge

Given the emphasis by the ILA (2007, 2010) and IDA (2010) on the importance of teacher knowledge, determining the level of knowledge possessed by teachers has been an important topic of research. Several measures have been used to investigate the level of knowledge possessed by various samples of teachers, including the Informal Survey of Linguistic Knowledge (ISLK; Moats, 1994), the Teacher Knowledge Assessment: Structure of Language (TKA:SL; Bos, Mather, Dickson, Podhajski, & Chard, 2001), the Teacher Knowledge Survey (TKS; Moats & Foorman, 2003), and the Teacher Knowledge Assessment (TKA; Piasta et al., 2009). The ISLK and the TKA:SL each examined knowledge of word structure and ability to manipulate words to identify various elements (e.g., the second phoneme). The TKS and TKA included items that presented teachers with vignettes of classroom scenarios and asked them to select the most appropriate response. Each of these measures was built from the ones that came

before it, so while there is some content overlap between these assessments, there are also many unique items on each. The levels of knowledge found in samples of early elementary classroom teachers using each of these measures will be discussed next.

Using the ISLK, Moats (1994) examined the early reading knowledge of a diverse group of eighty-nine elementary educators who included reading specialists, classroom teachers, and special education teachers. She found these teachers were largely unable to answer most questions accurately. On average, only 36% of items were answered correctly. Specifically, many teachers did not understand basic terminology, such as phoneme. Additionally, while many participants had heard of phonological awareness (the ability to distinguish individual phonemes in spoken words), they could not distinguish the phonemes in individual words themselves. Furthermore, they had poor basic phonics knowledge – approximately 85% were unable to consistently identify consonant blends in written words. Overall, there were large gaps in teachers' understanding of the relationship between oral and written language.

Using the ISLK, McCutchen, Harry, et al. (2002) examined the knowledge level of fifty-nine kindergarten and first grade teachers who volunteered to participate. The findings of McCutchen, Harry, et al. (2002) were not largely different than the findings of Moats (1994). They averaged 32% correct on the ISLK. Importantly, the fact that the participants in this study volunteered suggests that the general population of early elementary classroom teachers may have had even less early reading content knowledge. Teachers who were willing to volunteer for a research project likely had, or believed they had, more knowledge than their peers.

Bos et al. (1999) used the TKA to examine teachers' knowledge as part of the federally funded Reading Instructional Methods of Efficacy (RIME) project. Within this project, 286 elementary teachers from approximately twenty school districts completed the TKA. The TKA

revealed these early elementary classroom teachers were able to accurately answer an average of 60% of the items, which was much higher than had been reported in previous research (McCutchen, Harry, et al., 2002; Moats, 1994). Nonetheless, many teachers demonstrated misunderstandings of terminology (e.g., phonics) and mistook teaching phonological awareness with teaching letter-sound correspondences. In contrast to what many of these teachers indicated, phonological awareness is the recognition that words are made up of a variety of sound units, including onsets, rimes, and syllables. Phonological awareness enables students to segment and blend words, and to identify rhymes. It does not deal with sound/symbol relationships; phonics does. Furthermore, these teachers were unable to respond accurately to questions about silent letters and digraphs, could not segment words that had more than three sounds, and could not identify specified phonemes within words.

To verify the generalizability of these findings, Mather, Bos, and Babur (2001) conducted another investigation of the TKA with a different sample of in-service teachers. Within this follow-up study, 131 kindergarten through third grade teachers at ten schools in the southwestern United States were administered the TKA. While these teachers performed slightly better overall than the previous sample assessed with the TKA (Bos et al., 2001), on average these early elementary classroom teachers were only able to answer approximately two-thirds of the questions correctly (68%). Many teachers were still unaware of basic terminology, such as blend, digraph, or schwa (an unstressed central vowel that can be represented by any vowel letter). Again, many participants did not know the meaning of phonics and confused teaching phonological awareness with teaching phonics. Most teachers were, however, able to count syllables and accurately label the phonological task (e.g., deletion, segmentation).

Similar gaps in most teachers' understandings of the linguistic underpinnings of words were found in studies using the TKS (Moats & Foorman, 2003). Specifically, gaps were found in teachers' ability to count syllables, phonemes, and graphemes, and to match phonemes to graphemes. Teachers also exhibited misunderstandings about the relationship between listening and reading comprehension, the appropriateness of particular instructional strategies, and an inability to make appropriate pedagogical decisions when presented with student responses (e.g., selecting instructional strategies focused on comprehension when presented with student responses indicating phonics instruction was necessary).

Finally, Piasta et al. (2009) examined the knowledge level present in a sample of forty-two early elementary classroom teachers using the TKA. In line with the other research presented on teacher knowledge, the well-educated and experienced teachers in this sample, all of whom possessed a bachelor's degree, a third of whom held an advanced degree, and who collectively had an average of greater than eleven years of experience teaching, averaged only 52% correct on the TKA.

Unfortunately, the reasons why early elementary classroom teachers are largely unable to answer most reading-related questions correctly across research studies, assessment tools, and geographic locales remains unclear. Certain teacher characteristics, such as coursework, education level, and experience, have been proposed to relate to early elementary classroom teachers' reading knowledge, but the nature of these relationships are not yet understood. The following section will review key studies that have attempted to associate teacher characteristics with early elementary classroom teachers' reading knowledge.

Teacher Characteristics Impact on Teacher Knowledge

Several characteristics that may impact teacher knowledge have been proposed, including education level, coursework, and experience. Unfortunately, only one study was found that examined the connection between these teacher characteristics and any measures of early elementary classroom teachers' reading knowledge. As such, there is a need to increase the field's knowledge of this relationship.

The one study that explicitly examined the relationship between teacher knowledge and teacher characteristics used correlations among measures. Piasta et al. (2009) examined correlations among the TKA with the possession of a Master's degree, total years of experience, and years of experience teaching first grade with a sample of forty-two first grade teachers in the Southeast. They found teacher knowledge was not related to possession of a Master's degree or overall experience, but did find a positive association with years teaching first grade. A negative, but insignificant relationship was found with possession of a Master's degree (-.143), an almost nonexistent relationship was found with total years teaching (.084), and a moderate and significant relationship (.410) was found with years teaching first grade.

Recently, however, the relationships between teacher characteristics and knowledge may have changed substantially. Many states have enacted requirements that teacher candidates pass reading instruction-specific assessments before being granted teaching licenses. These assessments are designed to assess teachers' knowledge of reading. Six states (California, Mississippi, New Mexico, Ohio, Oklahoma, Virginia) use a state test, three (Alabama, Tennessee, West Virginia) use the Praxis Teaching Reading test, and five (Connecticut, Massachusetts, New Hampshire, North Carolina, Wisconsin) use the Foundations of Reading test (Rowland, 2015). These tests assess proficiency and depth of understanding of reading and

writing development, and are now required for entering teachers in each of the above-named states. The knowledge of teachers who were required to pass these tests may be different than teachers who acquired licensure prior to the introduction of these assessments or in states that do not require them.

While there may be only one known study that explored the relationship between teacher characteristics and knowledge, there are several theoretical reasons why coursework, education, and experience may be associated with teacher knowledge. For example, teachers who have advanced degrees may be more knowledgeable than their peers with Bachelor's degrees since the advanced degree is indicative of increased time spent gaining knowledge (Buddin & Zamarro, 2009; Clotfelter et al., 2007; Darling-Hammond, 2000; Harris & Sass, 2011; Wayne & Youngs, 2003). For the same reason, teachers who have increased subject-specific coursework may have increased knowledge given the additional time devoted to increasing their knowledge in a particular area. In fact, it is possible that content-specific coursework may have a better relationship with teacher knowledge than educational level. Overall degree also represents elective courses and general education requirements, while reading methods coursework distills the measure to the number of courses taken that are specifically relevant to reading instruction (Croninger, Rice, Rathbun, & Nishio, 2007; Darling-Hammond, 2000; Harris & Sass, 2011; Wayne & Youngs, 2003). Finally, experience may be related to knowledge given the experiential component of learning (Kolb, 1984). Kolb posited a four stage learning cycle during which individuals first have an experience, reflect on the experience, learn from the experience, and then implement what they have learned. Transaction between the person (i.e., teacher) and the environment (i.e., classroom) is necessary for learning to take place. For teachers, these experiences interacting with their classrooms, which accumulate over time spent teaching, may

increase teachers' knowledge. Based on Kolb's theory, it is likely teachers with more experience have more knowledge.

In addition to the theoretical associations among coursework, education, and experience, and knowledge, there have been several studies that have used these characteristics as proxy measures for teacher knowledge to examine their impact on student outcomes. While the current study did not investigate the connection between teacher knowledge and student outcomes, the findings of these extant studies may provide insight into the relationships that exist among teacher characteristics and knowledge. For example, if a teacher characteristic is highly related to student outcomes, then it is likely that it will also be related to high knowledge levels. Unfortunately, only two studies have examined this relationship in the context of reading.

Within the two reading-specific studies that used teacher characteristics as a proxy measure for teacher knowledge, Clotfelter, Ladd, and Vigdor (2007) found positive effects on student achievement for increased years of experience and for possession of an advanced degree, while Croninger, Rice, Rathbun, and Nishio (2007) found positive effects on student achievement for the increased reading methods coursework. These studies implied that higher levels of knowledge are associated with coursework, education level, and experience, which, in turn, promoted more positive student outcomes. However, this connection is tenuous, as it is possible that coursework, education level, and experience do not increase teacher knowledge.

Whether or not reading methods coursework, education level, or years of experience increases teacher knowledge of early reading matters little, if it is not enacted in practice. Teachers must have knowledge of the linguistic underpinning of reading (content knowledge) and an ability to employ instructional practices appropriately (pedagogical content knowledge) to

help students read successfully. The following section examines various reading-related instructional practices often employed in early elementary classrooms.

Teacher Knowledge Impact on Instructional Practices

Self-reported data historically came under scrutiny due to social desirability or inaccurate memory (Cook & Campbell, 1979), but recent research demonstrated that it can be a reliable information source (Chan, 2009). With the use of well-validated measures, self-reported data can be embraced and offer insights about the instructional practices that are not possible through observational data collected at a few time points over a year. The following section examines research demonstrating the validity of self-reported instructional practices in studies investigating early elementary classroom teachers.

One of the most widely used measures of self-reported instructional practice is the Early Childhood Longitudinal Study (ECLS-K). The ECLS-K program has included two longitudinal studies investigating child development, school readiness, and early school experiences. The ECLS-K has documented the educational progress of a nationally representative sample of children and has been widely used to investigate a number of research questions. Many of these research questions have incorporated teachers' instructional practices since ECLS-K includes a measure of the self-reported practices in which teachers engage. The measure of teacher instructional practices included in ECLS-K data asks teachers to report how often particular instructional practices (e.g., working on learning the names of the letters, discussing new or difficult vocabulary, writing stories in journals, retelling stories) occur in their classrooms using a six-point Likert scale ranging from "never" to "daily." This measure has been used in multiple studies investigating teacher practices, and is used in the current study.

Palardy and Rumberger (2008) looked at the frequency of twenty instructional practices and found three (frequency of phonics instruction, frequency of silent reading, and frequency of writing from diction) had statistically significant associations with improvement in student reading achievement. When Palardy and Rumberger considered the teachers' self-reported instructional practices in conjunction with their attitudes, the prediction of the outcome was improved to the extent that together they accounted for 14.1% of the classroom-level variance in reading achievement. Similarly, Guarino, Hamilton, Lockwood, and Rathbun (2006) demonstrated self-reported instructional practices of kindergarten teachers could be associated with student outcomes. They used exploratory factor analysis to extract instructional factors and found teachers' self-report of their practices positively predicted students' reading achievement. Particularly, practices focusing on reading and writing skills, didactic instruction, phonics, and reading and writing activities were positively associated with reading achievement.

Xue and Meisels (2004) also investigated the relative impact of skills-based and whole language instruction on kindergarten student reading outcomes using ECLS-K data. They created composite measures of skills-based and whole language instruction using exploratory factor analysis of instructional practice items. These composite measures, in conjunction with student outcome data, indicated that the students of teachers who used both whole language and phonics instruction performed significantly better than the students of teachers who predominately focused on one or the other. Therefore, these results demonstrate the significant predictive capability of self-reported instructional practices by both kindergarten and first grade classroom teachers. Importantly, the self-reported instructional practices could be related to student achievement.

The ability of the self-reported instructional practices to relate to student achievement in multiple studies indicates the usefulness of this measure in quantifying teacher practices. While observational data may provide a more objective view of a teacher's instructional practices, it may not represent what occurs predominately across the school year. Self-report may be liable to inaccuracies due to social desirability. Fortunately, it is also more likely to generalize to non-observed teaching since it requires teachers to generalize the frequency of their practice on average. In all, the use of self-reported instructional practices in research design is a validated means of measuring what occurs instructionally in classrooms. However, it is important to recognize that it is limited given the lack of correlation demonstrated between self-reported practice and observations of practice (Pianta & Hamre, 2009).

Relationship between knowledge and instructional practices. No studies could be found that related knowledge to instructional practices using self-reported measures, and only a few studies were identified that directly explored the relationship between knowledge and practice (McCutchen, Abbott, et al., 2002; McCutchen, Harry, et al., 2002; Piasta et al., 2009). More frequently, studies have used knowledge as a covariate when examining the effects of professional development on teachers' instructional practice (e.g., Garet et al., 2008). The frequent lack of simultaneous attention to teacher knowledge and instructional practice has been posited to be a critical factor in the conflicting findings on the importance of early elementary classroom teachers' reading knowledge (Piasta et al., 2009). Instructional practices may be critical to consider given the need for knowledge to be enacted. The following section provides an overview of studies examining the relationship between early elementary classroom teachers' reading knowledge and their instructional practices.

McCutchen's research team has conducted two of the three known studies examining the effects of reading knowledge on practice. McCutchen, Abbott, et al. (2002) examined the effects of knowledge on practice among forty-four kindergarten and first grade teachers from a large metropolitan area in the western United States. Teachers in the experimental group received a two-week instructional institute primarily focused on phonology and phonological awareness. Before and after the institute teachers took the ISLK (Moats, 1994). Equivalence in knowledge across experimental and control group teachers at pre-test was found. At post-test, however, the difference in knowledge across groups was statistically significant. Therefore, experimental teachers were considered to have higher-knowledge than the control group teachers. Structured observations indicated the higher-knowledge teachers were more explicit in their instruction overall, which demonstrated knowledge positively affects the explicitness of instruction. Similarly, McCutchen, Harry, et al. (2002) demonstrated that teacher knowledge impacted the explicitness of teachers' instructional practice. Using some of the teachers who participated in McCutchen, Abbott, et al. (2002) as well as some new teachers, McCutchen, Harry, et al. (2002) also found a significant correlation between teachers' reading knowledge and the provision of explicit phonological instruction. The relationship between knowledge and explicit instruction may be because teachers who are more knowledgeable may better understand the importance of explicit instruction (content knowledge) and may also be better able to provide explicit instruction (pedagogical content knowledge).

To continue to investigate the ways knowledge and practice relate, Piasta et al. (2009) examined the interactions among knowledge, practice, and student outcomes. They hypothesized that knowledge alone did not impact student outcomes, but knowledge interacted with teachers' instructional practices to impact student outcomes. The authors assessed teacher

knowledge using the TKA, and found that teachers who were more knowledgeable provided more explicit instruction. They found no main effects for teacher knowledge or for explicit decoding instruction on student achievement, but did find the hypothesized interaction effects. The substantial observational evidence revealed early elementary classroom teachers who demonstrated lower-knowledge frequently provided inaccurate examples (e.g., offering words containing the schwa sound as examples of short vowel words) and responded less effectively to student errors than higher-knowledge teachers. Furthermore, lower-knowledge teachers focused predominately on grapheme-phoneme correspondences, while higher-knowledge teachers were able to draw on a larger range of strategies (e.g., word families and analogies). From these findings, the authors came to the conclusion that instructional practice is the mechanism through which teacher knowledge is demonstrated.

Each of the previous studies coded for explicitness of instruction rather than type of instructional practice, even though explicit instruction can be used with a variety of instructional practices. Though no studies could be found that examined the relationship between teacher knowledge and particular instructional practices, knowledgeable teachers may be expected to be more aware of evidence-based instructional practices. The following section will examine which instructional practices have been demonstrated to be the most effective.

Effective instructional practices. There are a variety of instructional practices from which teachers can choose. Given the plethora of instructional practices that exist, meta-analyses have been conducted to understand which instructional practices the body of existing research as a whole best supports. Meta-analysis is the statistical analysis of the results of a number of studies with the goal of integrating the findings (Glass, 1976). To identify which practices are the most beneficial, Congress convened the National Reading Panel (2000) in 1997

to review the available research on how children learn to read and determine whether a select set of instructional foci and methods are supported by research. In all, the NRP reviewed 450 studies on teaching children to read, out of the approximately 100,000 studies on reading published since 1966, which fit their methodological parameters of using an experimental or quasi-experimental design. Guided by the previous findings of the National Research Council (Snow et al., 1998), they investigated specific areas of reading instruction, and found phonemic awareness, phonics, fluency, vocabulary, and comprehension have a profound impact on students' reading outcomes. They deemed their rigorous methodological requirements as that which are "universally accepted or used in reading education research" (National Institute of Child Health and Human Development, 2000, p. 1:5). As a result, however, only a fraction of available reading research literature could be included and a second reading war has resulted between proponents of quantitative research who support the findings of the NRP and proponents of qualitative and mixed-methods research who predominantly dismiss the findings of this panel as not considering the realm of available reading research when they came to their conclusions. Only one member of the NRP, Joanne Yatvin, submitted a dissenting view, however. She objected to the narrow view of reading research taken by the panel, which excluded any examination of language or literature, the effects of home culture on literacy development, the impact of child characteristics, and the lack of consideration of the realities of schools and classrooms (National Institute of Child Health and Human Development, 2000). She states in her dissenting view that "the work of the NRP is not of poor quality; it is just unbalanced" (National Institute of Child Health and Human Development, 2000, p. Minority View:3). Nevertheless, the NRP's (2000) findings on the critical importance of phonemic awareness,

phonics, fluency, vocabulary, and comprehension illustrate the key pillars of quality reading instruction for young students.

For each of the critical areas of reading instruction the NRP (2000) identified, they also offered stipulations. For example, they emphasized the importance of phonemic instruction, but also caution that a total of eighteen hours of instruction is sufficient for most children and an increased quantity beyond mastery does not equate to increased ability. In regards to phonics, they found systematic explicit instruction was the most effective, but the effect of phonics instruction is strongest in kindergarten and first grade and the effects diminish thereafter. Furthermore, the panel found guided repeated oral reading incorporating assistance from knowledgeable others had a positive effect on word recognition, fluency, and comprehension, but note it is critical to emphasize all three aspects of fluency: accuracy, rate, and prosody. The panel found vocabulary could be taught both directly and indirectly and that students should be actively involved in learning. The panel noted, "reading comprehension is a cognitive process that integrates complex skills" (National Institute of Child Health and Human Development, 2000, p. 4:1) and requires strategic processes that are active and interactive. Finally, they note that the thorough preparation of teachers to teach comprehension is critical.

In spite of the caveats offered, the findings of the NRP (2000) have been misrepresented and misused in many schools, as Yatvin feared. Richard Allington (2013) critiques the extreme emphasis that has been placed on phonics instruction in spite of the NRP's warning against such immoderations. He notes the neglect that has been paid to their warning that phonics instruction should only be a small part of kindergarten and first grade reading instruction and that "no significant positive effects for decoding emphasis lessons were found for students, including struggling readers, beyond first grade" (Allington, 2013, p. 521). He refers specifically to the

lack of authentic and sustained wide reading practices in schools, and emphasizes the necessity for flexibility in approaches to find an appropriate instructional match for each child. Additionally, he notes "almost no schools in the United States have anything in place that much looks like what the research says young children need to become engaged readers" (Allington, 2013, p. 520). In spite of a lack of wide-spread conversion to practice, the NRP's (2000) findings on the critical importance of what has come to be known as the big five - phonemic awareness, phonics, fluency, vocabulary, and comprehension - illustrate the key pillars of quality reading instruction for young students. Though, as critics of the NRP's (2000) narrow methodological view advanced, there are other elements, such as child characteristics and teacher-child interactions that also effect whether a given child will be successful with a particular instruction technique.

While engaging in comprehensive instruction that targets each of the Big Five in reading has been a hot topic since the NRP (2000) report was published (Cassidy & Ortlieb, 2013); recently, a sixth pillar of reading instruction has been identified - knowledge (Cervetti & Hiebert, 2015). Knowledge has been shown to be a critical component in the reading process. Priebe, Keenan, and Miller (2012) demonstrated students with more knowledge of a topic make fewer errors when reading aloud. Students with greater knowledge of a topic also comprehend more (Best, Floyd, & McNamara, 2008; Tarchi, 2010), perhaps because they have more attentional resources available to be devoted to comprehension. Teachers can improve students' knowledge through discussion (Murphy, Wilkinson, Soter, Hennessey, & Alexander, 2009), and by engaging students with multiple texts focused on a single topic (Cerdan & Vidal-Abarca, 2008). In all, instructional practices focused on developing students' topical knowledge seem as important for students' reading development as skills-focused instruction.

In addition to the role of knowledge, oral language has also been considered to be an important contributor to reading development (Whitehurst & Lonigan, 2001). There have been many mixed findings on the role of oral language, however. For example, Morris et al. (1998) found few oral language differences between subtypes of children who struggled with reading, though Scull (2013) and Catts, Fey, Zhang, and Tomblin (1999) each found oral language to support reading development. These differing findings may be the result of the different skills subsumed under oral language that various studies assess, including receptive and expressive vocabulary, word retrieval, and comprehension and production of morphological and syntactical rules (Speece, Ritchey, Cooper, Roth, & Schatschneider, 2004). It may also be driven by the changing role of oral language as reading development progresses (Cooper, Roth, Speece, & Schatschneider, 2002; Nation & Snowling, 1998; Roth, Speece, & Cooper, 2002; Speece, Roth, Cooper, & De la Paz, 1999). That is, oral language appears to play a strong role both in preschool as students develop emergent literacy and in late elementary school as students begin to comprehend larger units of text, but seems to play a lesser role in early elementary school as students are learning to crack the reading code. One explanation for the role of oral language in reading development may be that it is an essential component, albeit one with an indirect effect (Storch & Whitehurst, 2002).

Notably, studies to date investigating the relationship between early elementary classroom teachers' reading practices and knowledge have all been conducted in non-rural settings. For example, McCutchen, Harry, et al. (2002) and McCutchen, Abbott, et al. (2002) were conducted in a large metropolitan setting, while Piasta et al. (2009) took place in an urban district. While Piasta et al. (2009) was conducted in a low-wealth community, its urban locale prohibits generalizations to a rural low-wealth context. Therefore, it is important to continue to

investigate early elementary classroom teachers' reading knowledge and practices, particularly in the under-researched context of rural low-wealth communities, as previous findings may not generalize to this context. The following section provides an overview of the work that has been conducted on rural low-wealth communities to illustrate the aspects of this context that make it unique. These features are important to understand as they may impact the generalizability of findings conducted in other settings, even in other low-wealth settings or in other rural settings that are not both rural and low-wealth.

Challenges in Rural Low-Wealth Communities

Teaching in rural low-wealth communities appears to be different than teaching in other locales, including other rural settings that are not low-wealth or other low-wealth settings that are not rural. Several studies have reported educational differences in rural low-wealth communities (Lee & Burkam, 2002; Provasnik et al., 2007; Vernon-Feagans et al., 2012; Vernon-Feagans et al., 2013). These differences may be influenced by the fact that rural poverty tends to be deeper and more generational in nature than urban poverty (Vernon-Feagans et al., 2008), which may place the children in rural low-wealth communities at even greater need for high-quality instruction than their peers in other low-wealth communities.

In addition to the unique nature of rural poverty, rural low-wealth communities also have to contend with many of the features of both other rural areas as well as other low-wealth areas. For example, within K-12 schooling, rural teachers tend to be less qualified than teachers employed in urban and suburban schools (Provasnik et al., 2007). In general, rural teachers are more experienced than urban teachers but have less advanced education (Amendum et al., 2011; Lee & Burkam, 2002; Vernon-Feagans et al., 2012; Vernon-Feagans et al., 2013). In addition, teachers in rural areas are less likely to receive high-quality professional development, given

their geographic isolation (Government Accountability Office, 2004). It has also been noted to be more difficult to recruit and retain teachers in rural settings (Kaiser, 2011).

Rural low-wealth communities also have to contend with differences in teacher quality that are constant across all low-wealth contexts. For example, Peske and Haycock (2006) examined differences in the incidence of teachers not meeting federal definitions of highly qualified across low- and high-wealth schools. They found one in eight teachers in low-wealth elementary schools did not meet federal definitions of being highly qualified, while only one in sixty-seven teachers did not meet the criteria in high-wealth schools. Similarly, twice the number of teachers in low-wealth schools failed their initial licensure exam at least once. Given that many people have considered experience to be an important teacher quality, Peske and Haycock (2006) explored the relationship between years of experience and employment in high- or low-wealth schools. They found children in low-wealth schools are assigned to novice teachers almost twice as often as children in high-wealth schools. Specifically, forty percent of the teachers in low-wealth schools had less than six years of experience, while only twenty-five percent of the teachers in high-wealth schools had less than six years of experience. It has been suggested that these teachers move on from more impoverished districts to wealthier districts with higher pay. This disparity in experience may mean that the teachers in low-wealth schools have less practice employing evidence-based practices and responding to student misunderstandings. Therefore, they may be able to do so less effectively than their more experienced colleagues.

Using singular measures of teacher quality may be inappropriate, however, given that teachers low on one measure may be high on another. For example, teachers without much experience may possess an advanced degree and, as such, possess a high level of knowledge

through their degree acquisition. Therefore, Presley, White, and Gong (2005) created the Teacher Quality Index (TQI) to look at teacher distribution patterns in a more authentic manner. They created a composite measure using five teacher attributes: the percentage of teachers with Bachelor's degrees from competitive institutions, the percentage of teachers with less than four years of experience, the percentage of teachers with emergency or provisional licensure, the percentage of teachers who failed the Basic Skills test on the first attempt, and the average ACT composite score of teachers. They then divided the schools into quartiles by weighting each measure and assigning each school a TQI rating. Their composite measure resulted in a distribution that was similar to distributions in previous research that looked at singular measures. Schools in the top quartile had teachers with more experience, full certification, better undergraduate education, and stronger academic ability than teachers in the bottom quartile. For the lowest-wealth schools, eighty-four percent were in the bottom quartile, and more than half of those were in the bottom ten percent. In contrast, only one percent of the lowest-wealth schools fell in the top quartile. Such a stark contrast on a composite measure such as the TQI highlights teacher differences across communities.

Similar to the unequal distribution of teachers in low-wealth communities, eighty-eight percent of schools with a high percentage of minority students had TQIs that fell in the bottom quartile of the distribution. To compare, only eleven percent of the schools with the fewest minority students were in the bottom quartile. This finding is likely related to the high concentration of minority individuals in low-wealth communities (Akerlof, Kranton, Akerlof, & Kranton, 2010; Gradin, 2012). Research performed using the TQI, therefore, seems to support previous research indicating there is a difference in teachers employed across high- and low-wealth schools.

Given the above findings, it is imperative to examine the teacher quality of rural low-wealth teachers, particularly in regards to their reading knowledge and practices. Unfortunately, previous studies on early elementary classroom teachers' reading knowledge have not been conducted in rural low-wealth communities (Cunningham, Perry, Stanovich, & Stanovich, 2004; Foorman et al., 2006; McCutchen, Harry, et al., 2002; Moats & Foorman, 2003). Given research indicating schools are highly associated with teacher knowledge differences (specifically, up to twenty-seven percent of the variation in teachers' knowledge is attributable to school differences), any analysis that disregards the significance of context may be misleading (Kelcey, 2011). Therefore, teacher knowledge must also be investigated in rural low-wealth communities.

Gaps in Existing Research

In addition to the limited research regarding rural low-wealth contexts, other gaps in the research base regarding early elementary classroom teachers' reading knowledge include limited research regarding: (a) the domains being assessed by measures of early elementary classroom teachers' reading knowledge; (b) the relationship between early elementary classroom teachers' reading knowledge and characteristics, such as their education level, experience, and coursework; (c) self-reported instructional practice items; and (d) early elementary classroom teachers' reading knowledge in rural low-wealth communities. In the following section, the gaps in the existing research in each of these areas will be discussed in turn.

It is critical that we empirically determine which domains of early reading knowledge available instruments are assessing. Shulman (1986) made significant conceptual contributions to the understanding of the theoretical domains underlying teacher knowledge when he distinguished content knowledge from pedagogical content knowledge. However, there is a need to understand if these domains of knowledge can be reliably measured. Without an empirical

validation of the domains of teacher knowledge being measured by current instruments, we cannot understand how knowledge level may vary by domain nor can we come to clear conclusions about the impact of each individual domain of teacher knowledge. Therefore, it is critical that the domains of early elementary classroom teachers' reading knowledge as measured by current instruments be empirically determined, via methods such as factor analysis.

In addition to the need to empirically understand the domains of teacher knowledge of reading assessed by current instruments, research that explicitly examines the relationship between early elementary classroom teachers' reading knowledge and characteristics, such as their coursework, education level, and experience, should be undertaken. While early elementary classroom teachers' education level, experience, and reading methods coursework have all been used as proxy measures of teacher knowledge (e.g., Clotfelter et al., 2007; Croninger et al., 2007), the association between teacher characteristics and teacher reading knowledge levels has only been examined in one existing study (Piasta et al., 2009) and it did not examine the impact of coursework. A more refined understanding of the relationship between teacher characteristics and domains of knowledge might lend important support for the use of teacher characteristics as proxy measures for knowledge. Alternatively, it may reveal subdomains of content and pedagogical knowledge that are more closely related to teacher characteristics than others.

The research to date examining the relationship between early elementary classroom teachers' reading knowledge and instructional practices has occurred through observational data collection. While self-reported practices, using ECLS-K, can be used to predict student outcomes, no studies could be found that investigated the relationship between early elementary classroom teachers' reading knowledge and instructional practices using self-reported data.

Given their effectiveness (Guarino et al., 2006; Palardy & Rumberger, 2008; Xue & Meisels, 2004), self-reported instructional practices may be a viable means of understanding how teachers use the knowledge they possess to select the instructional activities in which they engage their students. Increased knowledge of the relationship between early elementary classroom teachers' reading knowledge and instructional practices may, as Piasta et al. (2009) put forth, be the missing link in understanding how early elementary classroom teachers' knowledge matters.

Finally, most of the work on teacher knowledge to date has not been conducted in rural low-wealth schools. Given the research indicating the deep and generational poverty often found in rural areas (Duncan, 1999), the noted difficulties in recruiting and retaining rural teachers (Keiser, 2011), and the preponderance of lesser qualified teachers often employed in rural schools (Monk, 2007), it is likely the level of teacher knowledge in these communities may be quite different than has been reported previously. Thus, given the vital role of context, it is critical the work on teacher knowledge be extended to rural low-wealth settings.

The Present Study

More information is needed on the role of knowledge in teaching reading, particularly in rural low-wealth environments. The purpose of this study was to examine the domains underlying the construct of knowledge and, subsequently, examine how teacher characteristics relate to knowledge and how knowledge relates to teachers' instructional practices. This study addressed the following research questions:

Research question 1: What is the factor structure of the Teacher Knowledge Survey as demonstrated among kindergarten and first grade teachers in rural low-wealth schools? This study aimed to identify the factor structure of the Teacher Knowledge Survey (TKS) using confirmatory factor analysis. The TKS is composed of thirty-three true/false and multiple-choice

questions (Moats, 1994; Piasta et al., 2009). Many domains have been theoretically proposed to underlie teacher knowledge, though the domains being assessed by this instrument have yet to be empirically demonstrated. Theoretically, this instrument has been considered by the authors of its individual components to "assess teachers' understanding of English phonology, orthography, and morphology, as well as important concepts of literacy acquisition and instruction" (Piasta et al., 2009, p. 232) and "to assess the knowledge teachers have of speech sounds, their identity in words, correspondence between sounds and symbols, concepts of language, and presence of morphemic units in words" (Moats, 1994, p. 89). Given the purposes of this measure and the types of questions included (which will be discussed in chapter three and can be seen in Appendix A), it was hypothesized the TKS would primarily reflect domains of content knowledge and pedagogical content knowledge. Identifying the factor structure allowed associations to be made between each domain and other constructs, such as teachers' characteristics and instructional practices.

Research question 2: What is the overall level of teacher knowledge among kindergarten and first grade classroom teachers in rural low-wealth schools, and what are the different levels of teacher knowledge using the information from the above factor analysis? This study aimed to use descriptive statistics to assess the level of reading knowledge of early elementary classroom teachers employed in rural low-wealth schools, both overall and on the factors identified in the confirmatory factor analysis. Previous examinations have neither addressed how knowledge levels may vary across the factor structure nor what level of knowledge may be present among teachers in rural low-wealth schools. Given the under-researched nature of teacher knowledge in rural low-wealth areas, and the predominance of lesser qualified teachers who work in rural low-wealth schools (Provasnik et al., 2007), study

participants were expected to correctly answer fewer questions on average than has been reported in previous studies.

Research question 3: How do the number of reading methods courses, education level, and years of experience of kindergarten and first grade classroom teachers in rural low-wealth schools relate to teacher knowledge, overall and on each factor identified in question one? This study aimed to examine the relationships between teachers' reading methods coursework, education, and experience, and teachers' knowledge using hierarchical multiple regression. Given Piasta et al.'s (2009) initial findings, it was hypothesized that experience, but not coursework or educational level, would significantly associate with teacher knowledge, after accounting for teacher age, race, and grade taught.

Research question 4: How do overall teacher knowledge and the factors identified in question one relate to self-reported instructional practices of kindergarten and first grade teachers in rural low-wealth schools? This study aimed to extend the examination of the relationship between early elementary classroom teachers' reading knowledge and instructional practices using hierarchical multiple regression. This relationship has been posited to be a critical missing factor in previous research on teacher knowledge (Piasta et al., 2009). It was anticipated that teachers with greater knowledge would report engaging more frequently in highly important instructional practices, such as phonemic awareness, phonics, fluency, vocabulary, and comprehension, after controlling for teacher age, race, grade taught, number of reading methods courses, education level, and experience.

CHAPTER THREE

Method

This study was a secondary data analysis that used existing data from the Targeted Reading Intervention (TRI; Vernon-Feagans et al., 2012; Vernon-Feagans et al., 2013). TRI was a randomized controlled trial examining the effectiveness of a web-based coaching model intended to enhance the reading outcomes of kindergarten and first grade students. The TRI was funded by the Institute of Education Sciences (IES), and was conducted from 2011-2014 in rural eastern North Carolina with teachers in Title I schools. Title I is a federal program that provides funds to schools with a high percentage of children from low-income families with the goal of ensuring all children are successful. All kindergarten and first grade teachers and their students in ten Title I schools located within three school districts in rural North Carolina participated in the study. For the purposes of the current study, only teacher data were used from the control group teachers.

Sample and Design

Each of the schools involved in this project was identified as a Title I school. Title I schools are those where at least 40% of the student population are from low-income families (NCLB, 2002). As reflected in Table 1, the students in the schools are mostly minority, low-income children. Districts were selected for inclusion in this study based on federal definitions of rural districts, including data on Beale codes, distance from large cities, and number of towns in the counties where the schools were located (Office of Management and Budget, 2000).

Within the larger study, the intent was to recruit one hundred classrooms within ten schools that could be randomized at the classroom level. Thus, experimental and control teachers were in the same schools.

Table 1

School Demographics

School pseudonym	Percent free/reduced price lunch	Percent minority
District One		
S1 (n = 4)	59%	45%
S2 (n = 4)	75%	67%
S3 (n = 2)	55%	44%
District Two		
S4 (n = 12)	78%	78%
S5 (n = 9)	85%	98%
S6 (n = 1)	88%	94%
S7 (n = 10)	30%	22%
S8 (n = 6)	96%	96%
S9 (n = 6)	40%	55%
District Three		
S10 (n = 12)	49%	81%

Analysis sample. The data used for this study included only the control teachers from the larger study to avoid confounding data regarding teacher knowledge, characteristics, and practices with the training and coaching provided to the treatment teachers from the larger study. One teacher who changed treatment conditions and grade level during the study was excluded from analysis. The inclusion of only control group teachers yielded a sample size of sixty-six unique teachers assigned to the control condition with no missing data on any variables of interest.

Teachers in the control condition received a laptop or iPad and a computerized math curriculum known as Building Blocks (Clements & Sarama, 2007), but did not receive any reading materials, training, or coaching. The provision of a math curriculum was not anticipated

to affect the findings of this study as the analysis was restricted to reading knowledge and reading instructional practices. In addition to receiving the laptop/iPad and math curriculum, control teachers were also compensated $50 for questionnaire completion.

The teachers involved in this study were predominately female, white, non-Hispanic, and younger than forty. The study was split almost evenly between kindergarten and first grade teachers with slightly more first grade teachers participating than kindergarten teachers. All of the teachers in this sample possessed a Bachelor's degree. Only one-quarter of the sample teachers had a Master's degree in Education. Of note, approximately two-thirds of teachers reported having taken more than two reading methods courses. This finding is of special importance given the lack of requirement in North Carolina for elementary education teachers to take any reading methods courses. However, while each of these teachers did teach in North Carolina at the time of this study, it is unknown where they received their degrees. One-third of the teachers in this sample had been teaching for less than three years. The majority (63%) of the teachers had been teaching for ten years or less. Thus, teachers included in this sample did not have much teaching experience, had only taken a few reading methods courses, and a small number possessed advanced degrees. This finding is in line with teacher characteristics reported by many others (Amendum et al., 2011; Lee & Burkam, 2002; Provasnik et al., 2007; Vernon-Feagans et al., 2013). Table 2 depicts the gender, race, ethnicity, age, grade taught, highest degree possessed, years of experience, and number of reading methods courses taken by the teachers included in this study.

Procedures

Teacher knowledge, characteristics, and instructional practice data were collected using online versions of the TKS and Teacher Questionnaire (Appendices A and B). They include

Table 2

Teacher Demographics (N = 66)

Variable	%
Gender	
Male	1.52
Female	98.48
Race	
American Indian or Alaska Native	1.52
Asian	0.00
Black or African American	19.70
Native Hawaiian or Other Pacific Islander	1.52
White	77.27
Ethnicity	
Hispanic	3.03
Non-Hispanic	96.97
Age	
<30	40.91
30-39	18.18
40-49	28.79
<50	12.12
Grade Taught	
Kindergarten	45.45
1st Grade	54.54
Education	
Bachelor's in non-Education field	7.58
Bachelor's in Education	54.55
At least one year beyond a Bachelor's	9.09
Master's in Education	25.76
Education Specialist	1.52
Other	1.52
Number of Years Teaching	
<3	33.33
3-5	22.73
6-10	7.58
11-20	21.21
>20	15.15
Number of Reading Method Courses	
0	4.55
1	12.12
2	15.15
3	16.67
4	22.73
5	10.61
6+	18.18

information about the teachers' professional backgrounds, knowledge, and classroom practices. Both the TKS and Teacher Questionnaire are described in the following section.

A letter was provided to teachers including directions explaining how to complete the online forms, the form link, and each teacher's individual login username and password. Teachers had a period of approximately two weeks to complete the forms, were able to contact the TRI research staff if there were any technology-related concerns, and were paid $50 upon submitting completed forms. If teachers were not able to access the online forms, paper copies were provided.

Teachers completed these self-administered forms twice per year, in the fall and spring. However, only the spring administration of the first year of each teacher's participation in the project was included. The spring administration was selected for analysis as it was believed that the information on teacher practices would yield the most accurate representation of actual classroom practices completed over the course of the previous year. Fall forms might more accurately represent what teachers plan to do, rather than those practices that actually occurred in daily classroom life. For the teachers who had missing data in the first year of participation, their second year data were used in its entirety. This inclusion was not anticipated to affect findings, since only control teachers were included in analyses.

Measures

The TKS and the Teacher Questionnaire, which measured demographic characteristics and instructional practice frequency, were the two instruments used in the current investigation.

Teacher Knowledge Survey (TKS). The TKS (Moats, 1994; Piasta et al., 2009) was completed online using the procedures described above. This survey took an average of fifteen to twenty minutes to complete. It included a sequence of questions designed to assess teachers'

knowledge about the teaching of reading. It is composed of true/false and multiple choice items from previous research conducted by Moats (1994) and Piasta et al. (2009). These sets of items were developed separately and have previously been used separately. However, they were combined in this study to include the foundational work done by Moats (1994), as well as the newer work of Piasta et al. (2009), which incorporated more recent research.

The seven true/false items on the TKS were created by Moats (1994). The theoretical intent of the portion of the TKS created by Moats (1994) was "to assess the knowledge teachers have of speech sounds, their identity in words, correspondence between sounds and symbols, concepts of language, and presence of morphemic units in words" (p. 89). The theoretical constructs intended to be assessed by the twenty-five multiple choice items developed by Piasta et al. (2009) were "teachers' understanding of English phonology, orthography, and morphology, as well as important concepts of literacy acquisition and instruction" (p. 232). Together, the two sections were developed to assess the foundational aspects of the structure of written English, the field has determined is important for effective early reading instruction (e.g., McCutchen, Abbott, et al., 2002; McCutchen, Harry, et al., 2002; Moats & Foorman, 2003; Piasta et al., 2009). In addition, the Piasta et al. (2009) questions were also intended to measure the concepts underlying effective reading instruction, such as teachers' ability to respond to vignettes depicting early reading instructional scenarios.

For each item, responses were coded as correct (1) and incorrect (0). Correct responses to all true/false and multiple-choice items were then summed to create the composite variable, *total knowledge*. The total possible range of scores of total knowledge was 0 to 32. For this sample, the mean total knowledge score was 17.66 (SD = 4.46) with a range of 6 to 24. The

means and standard deviations of the individual items can be seen in Table 3. The means represent the proportion of correct responses among respondents.

Table 3

Teacher Knowledge Survey Responses (N = 66)

Item	*M*	*SD*
Item 1	0.64	0.49
Item 2	0.88	0.33
Item 3	0.41	0.50
Item 4	0.61	0.49
Item 5	0.47	0.50
Item 6	0.36	0.49
Item 7	0.52	0.50
Item 8	0.39	0.49
Item 9	0.83	0.38
Item 10	0.56	0.50
Item 11	0.24	0.43
Item 12	0.97	0.17
Item 13	0.94	0.24
Item 14	0.96	0.21
Item 15	0.46	0.50
Item 16	0.62	0.49
Item 17	0.52	0.50
Item 18	0.96	0.21
Item 19	0.85	0.36
Item 20	0.65	0.48
Item 21	0.80	0.40
Item 22	0.32	0.47
Item 23	0.76	0.43
Item 24	0.59	0.60
Item 25	0.83	0.38
Item 26	0.61	0.49
Item 27	0.83	0.38
Item 28	0.50	0.50
Item 29	0.23	0.46
Item 30	0.94	0.24
Item 31	0.74	0.44
Item 32	0.80	0.40
Item 33	0.79	0.41

For the current sample, the TKS had a Cronbach's alpha of .78. While Moats (2009) did not report a Cronbach's alpha for the true/false questions included in the TKS; Piasta et al. (2009) reported a Cronbach's alpha of .87.

Teacher Questionnaire. The teacher questionnaire was completed electronically, using the procedures outlined in the previous section. It was developed using items from the ECLS-K studies. It includes questions about teachers' educational background, student demographics, their attitudes toward teaching, and teaching practices. Selected variables related to teachers' educational characteristics and teaching practices were used in the current investigation. These variables will be delineated below, beginning with the teacher characteristic data and continuing with the instructional practice data.

Teacher characteristics. The teacher educational characteristics captured include reading methods coursework, highest degree possessed, and total years of experience teaching. These items were all originally created for ECLS-K, but the item addressing total years teaching was created for the TRI study from which data for the current study were drawn.

The variable, *number of methods of teaching reading courses*, measured how many reading methods courses a teacher reported having taken. It was presented on a scale with seven-levels ranging from 0-6+. For this sample, the mean number of reading methods courses was 3.45 (SD = 1.78) with a range of 0 to 6. The variable of *education* measured the highest degree possessed by the teacher on a scale with ten levels ranging from "High School Diploma or GED" to "Doctorate," and also provided teachers with a write in option under "Other." Table 4 describes the scale used for education level. For this sample, the mean educational level was 4.91 (SD = 1.43) with a range of 3 to 8. There was only one response of "other" which included a write-in response of "BS in early childhood." This response was recoded as a four (Bachelor's

degree in education). Given the small number of responses in many of the categories, education was recoded into the binary variable: possessing a Bachelor's degree (0) or a Master's degree (1). The variable of *total years teaching* measured experience and was recorded as a continuous variable. Teachers were asked to respond to the closest half year. For this sample, the mean total years of experience was 8.75 (*SD* = 8.49) with a range of 0 to 32.

Table 4

Education Level Scale

Level	Description
1	High School Diploma or GED
2	Associate's Degree
3	Bachelor's Degree in a non-education field
4	Bachelor's Degree in education
5	At least one year of coursework beyond a Bachelor's but no additional degree
6	Master's in a non-education field
7	Master's in Education
8	Education Specialist or other professional degree based on at least one year of coursework past a Master's degree
9	Doctorate
10	Other; Write-in

Instructional practices. The teacher instructional practice questions measured how frequently teachers reported engaging in particular instructional practices. These items were originally created for the ECLS-K, which has been previously discussed. It included twenty-eight items that were measured on a Likert scale with six levels, ranging from "never" to "daily," with intervening levels of "once a month or less," "two or three times a month," "once or twice a week," and "three or four times a week." The instructional practice items measured how frequently teachers engaged students in particular types of activities. Sample questions included "work on learning the names of the letters," "discuss new or difficult vocabulary," and "read text with patterned or predictable text." A full list of items can be seen in appendix B. In addition to

being extracted from the ECLS-K, Cronbach's alpha for the instructional practice items was .88 for this sample. The means, standard deviations, and ranges of each instructional practice item can be seen in Table 5.

Table 5

Instructional Practice Item Responses (N = 66)

Item	*M*	*SD*	Range
1. Work on learning the names of the letters	4.18	2.08	1-6
2. Practice writing the letters of the alphabet	4.33	2.03	1-6
3. Discuss new or difficult vocabulary	5.35	0.87	3-6
4. Dictate stories to a teacher, aide, or volunteer	4.09	1.54	1-6
5. Work on phonics	5.65	0.71	3-6
6. Listen to you read stories where they see the print (e.g., Big Books)	4.77	1.54	1-6
7. Listen to you read stories but they don't see the print	4.61	1.68	1-6
8. Retell stories	4.86	0.99	3-6
9. Read aloud	5.09	1.16	1-6
10. Read silently	5.36	1.08	1-6
11. Work in a reading workbook or on a worksheet	4.47	1.53	1-6
12. Write words from dictation, to improve spelling	4.23	1.47	1-6
13. Write with encouragement to use invented spellings, if needed	5.50	0.73	3-6
14. Read books they have chosen for themselves	5.36	0.97	3-6
15. Read text with controlled vocabulary	4.83	1.22	1-6
16. Read text with strong phonetic patterns	4.97	0.99	1-6
17. Read text with patterned or predictable text	4.94	0.99	2-6
18. Read thematic or literature based text	4.96	0.90	3-6
19. Compose and write stories or reports	4.42	1.47	1-6
20. Do an activity or project related to a book or story	3.92	1.39	1-6
21. Publish their own writing	3.08	1.33	1-6
22. Perform plays and skits	2.18	1.12	1-6
23. Write stories in a journal	4.03	1.66	1-6
24. See/hear stories from story tellers or other artists	2.36	1.39	1-6
25. Work in mixed-achievement groups on language arts activities	4.17	1.59	1-6
26. Peer tutoring	3.94	1.31	1-6
27. Work on projects in small groups	3.21	1.33	1-6
28. Work on long term projects (at least a week long)	1.79	1.07	1-6

Variables. For the first research question (What is the factor structure of the Teacher Knowledge Survey as demonstrated among kindergarten and first grade teachers in rural low-wealth schools?), a confirmatory factor analysis (CFA) was used. CFA does not use either

predictor or outcome variables. Instead, there are observed and latent variables. The observed variables are the individual items (i.e., questions) on the TKS. The latent variables are the factors identified (i.e., content knowledge and pedagogical content knowledge).

For the second research question (What is the overall level of teacher knowledge among kindergarten and first grade classroom teachers in rural low-wealth schools, and what are the different levels of teacher knowledge using the information from the above factor analysis?), univariate descriptive statistics were used to identify the levels of teacher knowledge overall and on each factor. For the remaining research questions, each of the variables are described, in the order of variables of interest, outcome variables, and control variables, in the following section.

Variables of interest and outcome variables. For the third and fourth research questions, the predictor and outcome variables changed function. For the third research question (How do number of reading methods courses, education level, and years of experience relate to teacher knowledge, overall and on each factor identified in question one, of kindergarten and first grade classroom teachers in rural low-wealth schools?), teachers' reading methods coursework, education level, and years of experience were variables of interest. The factors from the TKS (i.e., content knowledge and pedagogical content knowledge) identified in question one were outcome variables. Theoretically, coursework, education level, and experience were presumed to be antecedents to knowledge. In contrast, for the fourth research question (How do overall teacher knowledge and the factors identified in question one relate to self-reported instructional practices of kindergarten and first grade teachers in rural low-wealth schools?), the factor scores from the TKS (i.e., content knowledge and pedagogical content knowledge) identified in question one became variables of interest. The instructional practice items were outcome variables. Theoretically, knowledge was presumed to be antecedent to practice.

Control variables. For regression analyses, teacher age, race, and grade taught were used as controls. Teacher age was coded as a continuous variable in years. Teachers were asked to report their year of birth as well as the date they completed the questionnaire. Age was calculated using year of completion of the questionnaire and year of birth. For this sample, the mean age was 36.17 (*SD* = 10.10) with a range of 22 to 59. Race was recorded in six categories: (a) American Indian or Alaska Native, (b) Asian, (c) Black or African American, (d) Native Hawaiian or Other Pacific Islander, (e) White, and (f) other. Teachers who responded "other" were asked to specify the race with which they identified. For this sample, no teachers responded "other." Only one respondent (1.52%) identified as an American Indian or Alaska Native, 21.21% of the sample identified as Black or African American, and 77.27% identified as white. Given the small number of respondents who neither identified as black or African American or white, race was recoded to represent white (0) and non-white (1). Grade taught was recoded as kindergarten, coded 0, or first grade, coded 1.

Analysis

All analyses were completed in SAS 9.2, except the factor analysis of the dichotomous teacher knowledge items, which was completed in MPlus 7. Before beginning this study, univariate statistics were examined to analyze means, standard deviations, and ranges to ensure the reasonableness of the data. No unexpected values were found. Based on that preliminary examination, the following analyses were conducted to answer each research question.

Research question 1: What is the factor structure of the Teacher Knowledge Survey as demonstrated among kindergarten and first grade teachers in rural low-wealth schools? Confirmatory factory analysis (CFA) was conducted on the Teacher Knowledge Survey (TKS) to empirically determine the underlying domains of teacher knowledge measured by this

assessment. Given that the TKS was designed to assess content knowledge and pedagogical content knowledge (Moats, 1994; Piasta et al., 2009), CFA was conducted to confirm whether these items were empirically assessing these two factors. CFA is a type of structural equation modeling that deals specifically with the relationships between observed variables and underlying factors. Factor analysis presumes that the observable variables can be concentrated into fewer latent unobserved variables, that is factors, that share a common variance (Bartholomew, Knotts, & Moustaki, 2011). A factor is an unobserved latent variable that influences multiple observed variables. The goal of CFA is to define the number and nature of factors that account for the shared variance among the observed variables (Yong & Pearce, 2013).

To confirm the theoretical domains of content knowledge and pedagogical content knowledge in the TKS, the model was first estimated, and then the model fit was assessed. Model estimation is a mathematical process used to minimize the difference between the sample and model-implied variance-covariance matrices (Brown & Moore, 2012). With dichotomous variables, as in this study, a weighted least squares means and variance adjusted (WLSMV) estimator is recommended (Mislevy, 1986; Shrout & Parides, 1992; Takane & Deleeuw, 1987). WLSMV uses a tetrachoric correlation matrix for model estimation. The WLSMV is considered the most appropriate estimator for modeling categorical data, as in this study, because it is a robust estimator that does not assume normally distributed variables (Brown, 2015). Furthermore, Beauducel and Herzberg (2006) have shown WLSMV to more precisely estimate loading magnitudes and better correspond to expected rejection rates than other estimators. After estimating the model, fit indices were then examined to determine the goodness of fit. The most widely accepted fit indices include the chi-square test of model fit, the root mean square error of

approximation (RMSEA), the comparative fit index (CFI), and the Tucker-Lewis index (TLI). Each of these statistics was examined and reported since they each provide different information about model fit. The chi-square test of goodness of fit is an absolute fit index. That is, it does not use an alternative model for comparison. It describes the similarity of the observed and expected matrices. It is highly sensitive to sample size, however. When interpreting the chi-square test of goodness of fit, a non-significant *p*-value is sought since the null hypothesis is that the expected and observed matrices do not differ. RMSEA is a non-centrality based index that is able to account for sample size. It also adjusts for parsimony by using a built-in correction for model complexity. RMSEA values should be less than .05. CFI is also a non-centrality based index. It measures the improvement in fit between the researcher's model and a null model, which presumes no covariance among the observed variables. CFI values should be .95 or greater. Finally, TLI is a relative fit index that penalizes additional parameters. It is non-standardized, however, so values can fall outside of the zero to one range. Similar to CFI, TLI values should be .95 or greater (Brown & Moore, 2012).

Items were first divided theoretically into two groups: (a) items measuring content knowledge and (b) items measuring pedagogical content knowledge. While the authors did not originally define each item, they did specify that they anticipated the items to measure both content knowledge and pedagogical content knowledge (Moats, 1994; Piasta et al., 2009). Items thought to assess content knowledge assessed understanding of linguistics (e.g., Which word contains a short vowel sound; item 12) and assessment terms (e.g., What type of task would this be? I am going to say a word and then I want you to break the word apart. Tell me each of the sounds in the word *dog*; item 15), as well as theoretical understanding of reading development (e.g., Students must be able to orally segment and blend the phonemes in complex syllables

before they can benefit from instruction in letter-sound correspondence; item 1) and ability to apply content knowledge apart from instruction (e.g., Circle the word that is a real word when you sound it out; item 33). Items thought to assess pedagogical content knowledge presented vignettes of instructional scenarios and asked for the best response to achieve a stated goal (e.g., Mrs. Pink has assigned her students a short story to read independently. She wants to practice a strategy with her students in order to enhance their comprehension during reading. Mrs. Pink should instruct her students to; item 23), identify instructional activities designed to meet particular goals (e.g. One example of an activity that teachers can use to assist with multi-strategy instruction is; item 29), and demonstrate an understanding of evidence-based truths (e.g., According to research, the least effective way to teach vocabulary to students is through the use of; item 22). This item division can be seen in appendix C.

To answer subsequent research questions, factor scores were created in MPlus7 for both the content knowledge factor and the pedagogical content knowledge factors. Factor scores are computed scores for the individuals in the analysis on the extracted factors. That is, factor scores are an estimate of how an individual would score on the factors derived (Grice, 2001). Factor scores can be computed in a variety of ways, including both non-refined and refined calculation methods. Refined methods create linear combinations of the observed variables that considers what the shared variance between the item and the factor is, as well as the uniqueness (that is, the error term variance) of each item (Gorsuch, 1983). Refined methods maximize validity by creating factor scores that are highly correlated with a given factor and are unbiased estimates of the true factor scores. Refined methods also maintain the relationships between factors (Gorsuch, 1983). There are a variety of refined methods that can be used, including regression scores, Bartlett scores, Anderson-Rubin scores, and maximum a posteriori (MAP) scores

(DiStefano, Zhu, & Mindrila, 2009; Estabrook & Neale, 2013). Given the dichotomous nature of the variables under consideration, the MAP method to create factor scores for categorical outcomes with WLSMV estimation was used in MPlus 7 for this analysis. MAP estimates factor scores as the maximum of the posterior distribution of the factor. Estabrook and Neale (2013) found this method, along with all others they simulated, performed well with complete data, as is the case in this study. Therefore, the factor scores generated, and used in subsequent analyses, can be considered to be accurate representations of the underlying factors.

Research question 2: What is the overall level of teacher knowledge among kindergarten and first grade classroom teachers in rural low-wealth schools, and what are the different levels of teacher knowledge using the information from the above factor analysis? The levels of teacher knowledge overall and on each factor identified (i.e., content knowledge and pedagogical content knowledge) were examined using descriptive statistics. The overall level of knowledge, calculated as a percentage of correct responses, was averaged across teachers included in the sample. To identify the levels of content knowledge and pedagogical content knowledge, the questions that loaded onto content knowledge and pedagogical content knowledge, respectively, were grouped. Then, an average score across items loading onto each of these factors was calculated for each participant. Finally, the level of knowledge on each factor was averaged across teachers included in the sample.

Research question 3: How do number of reading methods courses, education level, and years of experience relate to teacher knowledge, overall and on each factor identified in question one, of kindergarten and first grade classroom teachers in rural low-wealth schools? This question was examined using hierarchical multiple regressions. Six regression analyses were conducted given a two-step model for each of the three outcome variables (overall

knowledge, content knowledge, and pedagogical content knowledge). Each measure of teacher knowledge was examined in separate analyses, given the potential collinearity issues. The first model in each regression contained only the control variables (age, race, and grade taught), while the second contained both the control variables and variables of interest (coursework, education, and experience). The issue of potential teacher nesting was considered. However, given only ten schools at level two, accounting for nesting would prevent the model from converging (Bell, Morgan, Kromrey, & Ferron, 2010). For each model, the *F*-statistic and the change in R^2 were examined, while the *B* coefficients were examined for each variable of interest separately. Effect sizes were also calculated for all significant findings using Cohen's *d* (Cohen, 1988).

Research question 4: How do overall teacher knowledge and the factors identified in question one relate to self-reported instructional practices of kindergarten and first grade teachers in rural low-wealth schools? Before examining this question, an exploratory factor analysis (EFA) of the twenty-eight instructional practice items was first completed for data reduction purposes and to garner factor scores that could be used in the regression analyses. EFA is used to determine the number of factors influencing variables and to determine which variables are assessing similar underlying content (Beavers et al., 2013). Practically, EFA strives to reduce the number of variables and to examine the relationship between variables (Williams, Brown, & Onsman, 2010). In EFA, a series of mathematically and theoretically justifiable steps must be taken. First, the method of factor extraction must be determined. For this analysis, principal factor analysis was used. Second, the data must be examined for Heywood cases (i.e., cases with a standardized loading larger than one and negative error variances). No Heywood cases were found in this analysis. Third, multiple criteria for determining the number of factors to extract should be employed, such as Kaiser's criteria, Cattell's scree plot, and the cumulative

percent of variance explained (Thompson, 2004). The Kaiser-Guttman rule is important to consider because a factor should account for at least as much variance as an individual variable, and since the average of all eigenvalues is one, factor analysis should extract eigenvalues greater than this average. However, it is known to overestimate the true number of factors (Linn, 1968; Zwick & Velicer, 1986). Therefore, Cattell's scree plot and the percent variance explained were also examined. Fourth, the rotational method used must provide a parsimonious, easily interpretable solution. Rotation maximizes high item loadings and minimizes low item loadings. The correlated nature of the items drove a large part of this decision, as correlated items should be rotated using an oblique rotation while uncorrelated items should be rotated using an orthogonal rotation. Given the purpose of interpretability, the rotation that yielded the most interpretable solution was selected. Finally, the factor analysis was interpreted. During the interpretation stage, the factor loadings were examined to identify the factor for items with a uniquely high loading. Factor loadings are measures of how much the item contributes to the factor. After identifying items that loaded to each factor, the items on the factors were examined to determine a theoretically plausible explanation for why the items loaded to the same factor and each factor was named accordingly.

To answer subsequent research questions, factor scores were created for each of the instructional practice factors. Factor scores were computed for the individuals to estimate how each individual scored on the factors derived (Grice, 2001). A refined method of factor score calculation using regression scores in SAS was employed that predicted the location of each individual on the factor. With this method, predictor variables in the regression are the standardized observed values of the items in the factors. These variables are weighted by regression coefficients, obtained by multiplying the inverse of the observed variable correlation

matrix by the matrix of factor loadings and the factor correlation matrix. Therefore, this factor score method takes into account the inter-factor correlations, the correlations between factors and item loadings, the correlations among observed variables (i.e. items), and the correlations among factors (DiStefano et al., 2009). Thus, it created a linear combinations of the observed variables that considered what the shared variance between the item and the factor was, as well as the uniqueness (that is, the error term variance) of each item to create factor scores that were highly correlated with a given factor, were unbiased estimates of the true factor scores, and maintained the relationships between factors (Gorsuch, 1983). Estabrook and Neale (2013) found this method, along with all others they simulated, performed well with complete data, as is the case in this study. Therefore, the factor scores generated can be considered to be accurate representations of the underlying factors.

Following the EFA of instructional practice items, the relationship between teacher knowledge and instructional practices was investigated using hierarchical multiple regressions. In this question (How do overall teacher knowledge and the factors identified in question one relate to self-reported instructional practices of kindergarten and first grade teachers in rural low-wealth schools?), the teacher knowledge factor scores were the variables of interest while the instructional practice factor scores were the outcome variables. Theoretically, knowledge should influence practice. Fifteen two-step regressions were conducted, given three variables of interest (overall knowledge, content knowledge, and pedagogical content knowledge) and five outcome variables (instructional practice factors). Each variable of interest was examined in separate analyses, given the potential for collinearity. The first step in each regression contained only the control variables (age, race, grade taught, coursework, education, and experience) while the second contained both the control variables and variable of interest. The issue of potential

teacher nesting was considered. However, given only ten schools at level two, accounting for nesting would prevent the model from converging (Bell et al., 2010). For each model, the *F* statistic and the change in R^2 were examined for the model as a whole. Effect sizes were also calculated for all significant findings using Cohen's *d* (Cohen, 1988).

CHAPTER FOUR

Results

The aim of this study was to examine the factor structure of the Teacher Knowledge Survey (TKS) and, subsequently, the relationships among teachers' characteristics, knowledge, and instructional practices. In this chapter, the results of each research question will be presented in succession. The correlations among variables will be examined before the results of questions three and four are presented because the correlation matrix presents the variables used in those analyses.

Research question 1: What is the factor structure of the Teacher Knowledge Survey as demonstrated among kindergarten and first grade teachers in rural low-wealth schools?

After creating a model based on the theoretical delineation between content knowledge and pedagogical content knowledge (Moats, 1994; Piasta et al., 2009; Shulman, 1986), the model was estimated using WSLMV and the fit indices were examined. Initial examinations of the fit indices, when considered overall, indicated the fit was marginal. A chi-square test of goodness-of-fit indicated the model fit well, χ^2 (494) = 536.52, p = 0.09. However, RMSEA provided an estimate of 0.04 with a 90% CI [0.00, 0.06], and the probability that the RMSEA ≤ .05 = 0.86. Finally, CFI = 0.90 and TLI = 0.89. Overall, these fit indices indicated this model could fit better. However, when examining the R^2 values of each item, many were below 0.10, indicating the model was explaining less than 10% of the variance in these items. The items with R^2 values of less than 0.10 were removed from the model as such low R^2 values can be an indication of high levels of error for these items (Hooper, Coughlan, & Mullen, 2008). These items may not

have loaded well to the domains of content knowledge and pedagogical content knowledge because they may be assessing another domain of teacher knowledge not yet researched in early reading, or they may not be accurately assessed by the current sample. For example, one question that did not load to either domain appears to be assessing knowledge of assessment practices while another assesses reading content that is not often taught by kindergarten and first grade teachers. Overall, teachers appeared to respond less accurately to items that were removed than they did to included items. The R^2 values for each item in this model can be seen in Table 6, with the items divided by content knowledge and pedagogical content knowledge.

Subsequently, the two-factor (content knowledge and pedagogical content knowledge) model was rerun with fourteen content knowledge items and ten pedagogical content knowledge items. As before, a WLSMV estimator was used. A chi-square test of goodness-of-fit indicated the model fit well, χ^2 (251) = 267.63, p = 0.23. However, RMSEA provided an estimate of 0.03 with a 90% CI [0.00, 0.06], and the probability that the RMSEA ≤ .05 = 0.83. Finally, CFI = 0.96 and TLI = 0.96. Overall, these fit indices indicated this model fit well, and better than the model with all items included. Furthermore, the two-tailed p-values for each item loading onto its designated factor were all below 0.05. Therefore, the newly created TKS, which excluded nine items, seemed to be composed of two factors measuring content knowledge and pedagogical content knowledge. Only items included on the newly created TKS, those that fit the model well, were included in the remainder of analyses.

Both models included correlations between factors, though error variances of the measured variables both within and across factors were uncorrelated. Table 7 lists the models and their fit statistics. From these CFAs, the reduced measure of teacher knowledge appeared to

demonstrate better fit than the original measure. It also indicated the instrument separately assessed domains of content knowledge and pedagogical content knowledge.

Table 6

Initial CFA Divided by Content Knowledge and Pedagogical Content Knowledge Items

Item	R^2 estimate	Residual variance
Content knowledge		
Item 30	0.90	0.10
Item 31	0.77	0.23
Item 13	0.75	0.26
Item 32	0.69	0.31
Item 14	0.55	0.45
Item 12	0.55	0.45
Item 1	0.53	0.47
Item 9	0.44	0.56
Item 2	0.38	0.62
Item 33	0.30	0.70
Item 10	0.16	0.84
Item 6	0.14	0.86
Item 3	0.12	0.88
Item 11	0.12	0.88
**Item 8	0.09	0.91
**Item 7	0.05	0.96
**Item 16	0.03	0.97
**Item 5	0.02	0.98
**Item 4	0.02	0.98
**Item 17	0.00	0.99
Pedagogical content knowledge		
Item 19	0.84	0.16
Item 21	0.60	0.40
Item 18	0.60	0.40
Item 27	0.52	0.49
Item 28	0.39	0.62
Item 15	0.27	0.73
Item 20	0.26	0.74
Item 23	0.24	0.76
Item 26	0.23	0.77
Item 24	0.15	0.85
**Item 29	0.10	0.90
**Item 22	0.09	0.91
**Item 25	0.02	0.99

Note. ** indicates items that were removed.

Table 7

Goodness of Fit Indices for Alternative Confirmatory Factor Analysis Models (N = 66)

Model (no. factors)	χ^2	*df*	*p*	RMSEA	CFI	TLI
All items (2)	536.52	494	.09	.04	.90	.89
Items above r-squared of .10 (2)	267.63	251	.23	.03	.96	.96

Research question 2: What is the overall level of teacher knowledge among kindergarten and first grade classroom teachers in rural low-wealth schools, and what are the different levels of teacher knowledge using the information from the above factor analysis?

The overall level of teacher knowledge for the rural kindergarten and first grade classroom teachers in this study was 71.02%, not including the nine excluded items. When all items were included, the overall level of knowledge fell to 65.43%. The level of content knowledge in this sample was 71.65%, while the level of pedagogical content knowledge was 70.15%. The levels of knowledge did not vary substantially across factors.

Correlations among variables

The correlations among variables used in both question three, (How does the number of reading methods courses, education level, and years of experience relate to the teacher knowledge, overall and on each factor identified in question one, of kindergarten and first grade classroom teachers in rural low-wealth schools?), and question four, (How do overall teacher knowledge and the factors identified in question one relate to self-reported instructional practices of kindergarten and first grade teachers in rural low-wealth schools?), can be seen in Table 8 for all variables. Each of the knowledge variables was highly correlated. Accordingly, each was examined in separate analyses to avoid potential collinearity issues.

Table 8

Correlations Matrix (N = 66)

Variable	1	2	3	4	5	6	7
1. Teacher Knowledge	1.00	---	---	---	---	---	---
2. Content Knowledge	0.88**	1.00	---	---	---	---	---
3. Pedagogical Content Knowledge	0.89**	0.96**	1.00	---	---	---	---
4. Didactic Instruction	-0.01	-0.05	-0.06	1.00	---	---	---
5. Student-Centered Instruction	-0.20	-0.13	-0.14	0.21	1.00	---	---
6. Print-Focused Instruction	-0.08	-0.05	-0.04	0.23	0.18	1.00	---
7. Comprehensive Instruction	0.34**	0.35**	0.35**	0.33**	0.10	0.17	1.00
8. Collaborative Instruction	-0.13	-0.05	-0.08	0.35**	0.38**	0.08	0.15
9. Coursework	-0.07	<0.01	<0.01	-0.03	-0.01	0.17	0.12
10. Education	0.04	-0.05	-0.06	0.04	0.06	-0.15	0.10
11. Experience	0.08	0.18	0.18	-0.18	0.17	-0.05	0.11
12. Age	-0.18	-0.05	-0.05	0.01	0.09	0.29*	-0.01
13. Race	0.29*	0.28*	0.30*	-0.18	0.10	-0.09	0.14
14. Grade Taught	0.01	0.05	0.05	0.09	0.05	-0.59**	0.03

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

Table 8, cont'd

Correlations Matrix (N = 66)

Variable	8	9	10	11	12	13	14
1. Teacher Knowledge	---	---	---	---	---	---	---
2. Content Knowledge	---	---	---	---	---	---	---
3. Pedagogical Content Knowledge	---	---	---	---	---	---	---
4. Didactic Instruction	---	---	---	---	---	---	---
5. Student-Centered Instruction	---	---	---	---	---	---	---
6. Print-Focused Instruction	---	---	---	---	---	---	---
7. Comprehensive Instruction	---	---	---	---	---	---	---
8. Collaborative Instruction	1.00	---	---	---	---	---	---
9. Coursework	-0.13	1.00	---	---	---	---	---
10. Education	-0.02	0.21	1.00	---	---	---	---
11. Experience	0.05	0.35**	0.16	1.00	---	---	---
12. Age	-0.05	0.26*	0.11**	0.71	1.00	---	---
13. Race	0.06	0.14	-0.21	-0.10	-0.25	1.00	---
14. Grade Taught	0.15	0.14	0.24	-0.08	-0.16	-0.06	1.00

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

Comprehensive Instruction was also highly correlated with each of the knowledge variables. Within the instructional practice factors, *Comprehensive Instruction* and *Didactic Instruction* were highly correlated, as was *Collaborative Instruction* and *Student-centered Instruction*. The correlations among the instructional practice factors necessitated the use of a promax rotation during the exploratory factor analysis to account for overlap in variance among factors.

Research question 3: How does the number of reading methods courses, education level, and years of experience relate to the teacher knowledge, overall and on each factor identified in question one, of kindergarten and first grade classroom teachers in rural low-wealth schools?

Experience was significantly associated with overall knowledge ($B = 0.22$, $p = 0.02$), with content knowledge ($B = 0.05$, $p = 0.01$), and with pedagogical content knowledge ($B = 0.05$, $p = 0.01$). The effect sizes were large for experience with each outcome variable (overall knowledge: $d = 0.61$; content knowledge: $d = 0.64$; and pedagogical content knowledge: $d = 0.62$). The other variables of interest were not significantly associated with overall knowledge (coursework, $B = -0.46$, $p = 0.17$, and education, $B = 1.09$, $p = 0.38$), content knowledge (coursework, $B = -0.08$, $p = 0.30$, and education, $B = -0.07$, $p = 0.80$), or pedagogical content knowledge (coursework, $B = -0.07$, $p = 0.32$, and education, $B = -0.07$, $p = 0.81$). The overall knowledge model, after controlling for teacher age, race, and grade taught, was non-significant, $F(3, 59) = 2.59$, $p = 0.06$, though the variables of interest increased the R^2 by 11%. The content knowledge model, after controlling for teacher age, race, and grade taught, was non-significant, $F(3, 59) = 2.29$, $p = 0.09$, though the variables of interest increased the R^2 by 10%. The pedagogical content knowledge model, after controlling for teacher age, race, and grade taught,

was also non-significant, $F(3, 59) = 2.19$, $p = 0.10$, though the variables of interest increased the R^2 by 9%. Regression results can be found in Table 9.

Table 9

Regressions Examining Teacher Characteristics and Overall Knowledge, Content Knowledge, and Pedagogical Content Knowledge (N = 66)

	Overall Knowledge		CK		PCK	
Variables	*B*	*SE*	*B*	*SE*	*B*	*SE*
Model One						
Race	3.01*	1.35	0.67*	0.31	0.71*	0.31
Grade	-0.04	1.11	0.18	0.25	0.17	0.25
Age	-0.17*	0.08	-0.02	0.02	-0.02	0.02
R^2	0.09		0.08		0.09	
Model Two						
Reading Courses	-0.46	0.33	-0.08	0.07	-0.07	0.07
Education	1.09	1.24	-0.07	0.28	-0.07	0.28
Experience	0.22*	0.09	0.05*	0.02	0.05*	0.02
R^2	0.20		0.18		0.18	
F	2.59		2.29		2.19	

Note. CK = Content Knowledge, PCK = Pedagogical Content Knowledge. Model one refers to controls only, while model two refers to control variables and variables of interest. *$p < .05$, ** $p < .01$, *** $p < .001$.

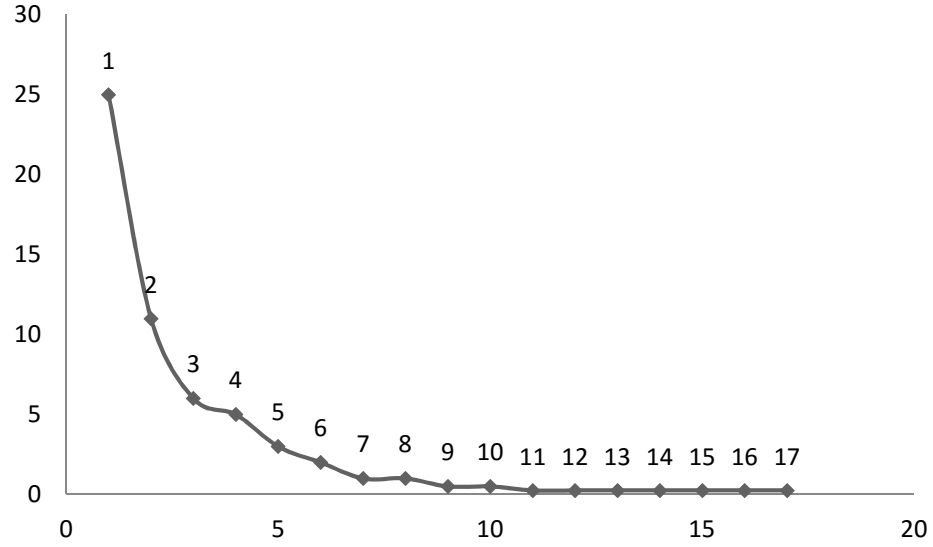
Research question 4: How do overall teacher knowledge and the factors identified in question one relate to self-reported instructional practices of kindergarten and first grade teachers in rural low-wealth schools?

Exploratory factor analysis. Before examining this question, an EFA of the twenty-eight instructional practice items was first completed for data reduction purposes and to garner factor scores that could be used in the regression analyses. The Kaiser-Guttman rule (Guttman, 1954; Kaiser, 1960), which recommends keeping the number of factors equivalent to the number of eigenvalues greater than one, indicated there could be as many as eight factors. However, it is known to overestimate the true number of factors (Linn, 1968; Zwick & Velicer, 1986). Therefore, it was considered likely that there were fewer than eight factors. When looking at Cattell's scree plot, which visually depicts the number of factors by plotting the eigenvalues in

the sequence of the principal factors (Cattell, 1966), the number of factors appeared to be closer to five as that appeared to be the "elbow" of the plot. Cattell's scree plot can be seen in Figure 1. Furthermore, five factors explained 14.82% of the variance, with additional factors beyond five each explaining less than 2% additional variance. Finally, a chi-squared test of whether five factors were significant indicated five factors were sufficient, χ^2 (166) = 171.41, p = 0.37.

Figure 1

Cattell's Scree Plot



After deciding to retain five factors, a promax rotation was selected given the inter-factor correlations. The inter-factor correlations for this dataset can be seen in Table 10. Given several inter-factor correlations exceeding 0.32, a promax rotation was used. As noted by Tabachnick and Fidell (2007), correlations exceeding 0.32 indicate there is at least 10% overlap in variance among factors and require an oblique rotation, such as promax.

Table 11 presents the findings of the factor analysis, with items organized by factor, rank ordered, and only loadings greater than .35 shown. Four activities did not load highly onto any

of the components (i.e., “read aloud,” “write stories in a journal,” “retell stories,” and “dictate stories to a teacher aide/volunteer”) and were not included in subsequent analyses.

Table 10

Inter-Factor Correlations

	Factor One	Factor Two	Factor Three	Factor Four	Factor Five
Factor One	---	---	---	---	---
Factor Two	0.23	---	---	---	---
Factor Three	0.33	0.16	---	---	---
Factor Four	0.44	0.35	0.31	---	---
Factor Five	0.09	0.08	0.06	0.21	---

The first factor was defined as *Didactic Instruction* since it included the following items: (a) “read text with strong phonetic patterns,” (b) “read text with controlled vocabulary,” (c) “read text with patterned or predictable text,” (d) “write words from dictation, to improve spelling,” and (e) “work in a reading workbook or on a worksheet.” The highest-loading item in this component, “read text with strong phonetic patterns” (.95), and the other two items that loaded over .75, “read text with controlled vocabulary” (.82), and “read text with patterned or predictable text” (.75) defined this factor; however, “write words from dictation, to improve spelling” (.48) and “work in a reading workbook or on a worksheet” (.40) also loaded to this factor. The emphasis on traditional and teacher-determined instruction is consistent with the literature on didactic instruction, which labels it as teacher-centered and focused on the passive receipt of knowledge by the learner (Driscoll, 2000; Hickey, Moore, & Pellegrino, 2001; Shuell, 1996; Smerdon, Burkam, & Lee, 1999).

The second factor was defined as *Student-centered Instruction* since it included the following items: (a) “work on long term projects (at least a week long),” (b) “perform plays and skits,” (c) “publish their own writing,” (d) “see/hear stories from story tellers or other artists,”

and (d) “do an activity or project related to a book or story.” Items loading over .50 characterized this factor. These items were: “work on long term projects (at least a week long)” (.74), “perform plays and skits” (.73), “publish their own writing” (.64), “see/hear stories from story tellers or other artists” (.58), and “do an activity or project related to a book or story” (.53). These practices can be considered part of student-centered instruction since it typically focuses on active learning, connecting new learning to prior knowledge, and authentic practices (Bansberg, 2003), such as guided discovery, projects, and inquiry based learning (Felder & Brent, 1996; Rogers & Frieberg, 1994).

The third factor was *Print-focused Instruction* since it included the following items: (a) “work on learning the names of the letters,” (b) “practice writing the letters of the alphabet,” (c) “listen to you read stories where they see the print (e.g., Big Books),” (d) “read silently,” and (e) “listen to you read stories but they don’t see the print.” “Read silently” and “listen to you read stories but they don’t see the print” loaded negatively onto this factor. These negative loadings are conceptually understandable since reading silently and listening to stories without seeing the print are not components of print-focused instruction but instead mark more advanced instruction. Print-focused instruction includes letter naming, learning the sounds of letters, and attending to print when reading, such as through students seeing the print while reading a Big Book (Levin & Aram, 2013; Whitehurst & Lonigan, 2001). Therefore, the positively loading items are consistent with print-focused instruction, as are teachers who reported doing the two negatively loading items infrequently. The two highest-loading items, “work on learning the names of the letters” (.92) and “practice writing the letters of the alphabet” (.87) were the key indicators of *Print-focused Instruction*. The item “listen to you read stories where they see the print (e.g., Big Books)” (.57) was also an indicator for Print-focused Instruction. Additionally,

teachers who reported doing the two negatively loading items (i.e., "read silently," -.40, and "listen to you read stories but they don't see the print," -.39) frequently received low scores on this factor, while, conversely, teachers who reported doing these items infrequently received high scores on this factor.

The fourth factor was *Comprehensive Instruction* since it included the following items: (a) "write with encouragement to use invented spellings, if needed," (.75), (b) "discuss new or difficult vocabulary," (.69), (c) "read thematic or literature based text," (.53), (d) "read books they have chosen for themselves," (.53), and (e) "work on phonics" (.44). These practices taken together represent a comprehensive approach to reading instruction focused on phonics, comprehension, vocabulary, writing, and fluency (Fitzgerald, 1999; Freppon & Dahl, 1998; Frey, Lee, Tollefson, Pass, & Massengill, 2005; Pressley, Roehrig, Bogner, Raphael, & Dolezal, 2002) that emphasizes both the skill-based and the meaning-based aspects of reading. All items loaded over .44 to this factor and taken as a whole can be seen to define it as representing *Comprehensive Instruction*. These items were "write with encouragement to use invented spellings, if needed" (.75), "discuss new or difficult vocabulary" (.69), "read thematic or literature based text" (.53), "read books they have chosen for themselves" (.53), and "work on phonics" (.44). These items represent writing, vocabulary, reading, and working on phonics; therefore, they can be interpreted as taking a comprehensive approach to reading instruction that targets each of these areas.

The fifth factor was defined as *Collaborative Instruction* since it included the following items: (a) "work in mixed-achievement groups on language arts activities," (b) "work on projects in small groups," and (c) "peer tutoring." These practices represent collaborative instruction, defined as students working in small groups to achieve a common goal (Ormrod, 2008). Three

items defined this factor, which all had loadings above .53. These items were: (a) “work in mixed-achievement groups on language arts activities” (.77), (b) “work on projects in small groups” (.55), and (c) “peer tutoring” (.53). Table 11 presents a summary of each factor with items organized by factor, rank ordered, and only loadings greater than .35 shown.

Table 11

Factor Analysis of Instructional Practice Items (N = 66)

Item	Didactic	Student-centered	Print-focused	Comprehensive	Collaborative
16. Read text with strong phonetic patterns	**0.95**				
15. Read text with controlled vocabulary	**0.82**				
17. Read text with patterned or predictable text	**0.75**				
12. Write words from dictation, to improve spelling	**0.48**				0.38
11. Work in a reading workbook or on a worksheet	**0.40**				
28. Work on long term projects (at least a week long)		**0.74**			
22. Perform plays and skits		**0.73**			
21. Publish their own writing		**0.64**			
24. See/hear stories from story tellers or other artists		**0.58**			
20. Do an activity or project related to a book or story		**0.53**			
1. Work on learning the names of the letters			**0.92**		
2. Practice writing the letters of the alphabet			**0.87**		
6. Listen to you read stories where they see the print (e.g., Big Books)			**0.57**		
7. Listen to you read stories but they don't see the print			**-0.39**		
10. Read silently			**-0.40**		
13. Write with encouragement to use invented spellings, if needed				**0.75**	
3. Discuss new or difficult vocabulary				**0.69**	
18. Read thematic or literature based text	0.40			**0.53**	
14. Read books they have chosen for themselves				**0.53**	
5. Work on phonics				**0.44**	
25. Work in mixed-achievement groups on language arts activities	0.35				**0.77**
27. Work on projects in small groups					**0.55**
26. Peer tutoring					**0.53**

Note. Bold loadings indicate loading to the factor.

Regression analyses. In this section, the regression results for each knowledge measure being associated with each factor will be examined in succession. The instructional practice factors will be discussed in order of *Didactic Instruction*, *Student-centered Instruction*, *Print-focused Instruction*, *Comprehensive Instruction*, and *Collaborative Instruction*. Within each instructional factor, the knowledge measures will be discussed in terms of overall knowledge, content knowledge, and pedagogical content knowledge. It is important to keep in mind results from the measure of overall knowledge will not provide anything above and beyond the measures of content knowledge and pedagogical content knowledge since it is the composite of these two measures. However, overall knowledge results are presented because it is the measure that has typically been reported in prior examinations of the relationship between teacher knowledge and instructional practice. The regression results can be seen in Table 12.

Overall knowledge ($F(1, 64) = 0.04$, $p = 0.85$), content knowledge ($F(1, 64) = 0.03$, $p = 0.87$), and pedagogical content knowledge ($F(1, 64) = 0.03$, $p = 0.87$) were not significantly associated with *Didactic Instruction*. Additionally, there was very little change in R^2, indicating the measures of knowledge did not explain any additional variance in practices found in the *Didactic Instruction* factor above and beyond the control variables (age, race, grade taught, reading methods coursework, education, and experience).

Overall knowledge ($F(1, 64) = 2.32$, $p = 0.13$), content knowledge ($F(1, 64) = 1.02$, $p = 0.32$), and pedagogical content knowledge ($F(1, 64) = 1.30$, $p = 0.26$) were not significantly associated with *Student-centered Instruction*. Additionally, there was very little change in R^2, indicating the measures of knowledge did not explain additional variance in *Student-centered Instruction* above and beyond the control variables (age, race, grade taught, reading methods coursework, education, and experience).

Overall knowledge ($F(1, 64) = 0.01$, $p = 0.90$), content knowledge ($F(1, 64) = 0.01$, $p = 0.91$), and pedagogical content knowledge ($F(1, 64) = 0.04$, $p = 0.85$) were not significantly associated with *Print-focused Instruction*. Additionally, there was no change in R^2, indicating the measures of knowledge did not explain any additional variance in practices found in the *Print-focused Instruction* factor above and beyond the control variables (age, race, grade taught, reading methods coursework, education, and experience).

Overall knowledge ($F(1, 64) = 5.62$, $p = 0.02$), content knowledge ($F(1, 64) = 5.95$, $p = 0.02$), and pedagogical content knowledge ($F(1, 64) = 6.14$, $p = 0.02$) were significantly associated with *Comprehensive Instruction*. Overall knowledge had an effect size of $d = 0.59$ on Comprehensive Instruction, while content knowledge had an effect size of $d = 0.61$, and pedagogical content knowledge had an effect size of $d = 0.62$, each corresponding to medium to large effects (Cohen, 1988). For the associations between each knowledge measure and the *Comprehensive Instruction* factor, the R^2 values were much larger, indicating each measure of knowledge explained more than double the variance among practices found on the *Comprehensive Instruction* factor than the control variables alone.

Overall knowledge ($F(1, 64) = 0.74$, $p = 0.39$), content knowledge ($F(1, 64) = 0.06$, $p = 0.81$), and pedagogical content knowledge ($F(1, 64) = 0.27$, $p = 0.60$) were not significantly associated with *Collaborative Instruction*. Additionally, there was little change in R^2, indicating the measures of knowledge explained little additional variance in practices associated with the *Collaborative Instruction* factor above and beyond the control variables (age, race, grade taught, reading methods coursework, education, and experience).

Therefore, overall teacher knowledge, content knowledge, and pedagogical content knowledge were each significantly associated with reporting engaging in practices that loaded on

the *Comprehensive Instruction* factor. However, none of the knowledge measures were significantly associated with the factors *Didactic Instruction*, *Student-centered Instruction*, *Print-focused Instruction*, or *Collaborative Instruction*.

Summary

In summary, results indicated the TKS separately assessed domains of content knowledge and pedagogical content knowledge, after nine items were removed from the complete set of items. Teachers were able to answer approximately 71% of questions on the TKS correctly, without the nine excluded items, overall and across domains. Further, experience was significantly related to knowledge, overall and across domains, though reading methods coursework and education level were not. Finally, knowledge, overall and across domains, was significantly associated with practices that loaded on the *Comprehensive Instruction* factor, though not with *Didactic Instruction*, *Print-focused Instruction*, *Student-centered Instruction*, or *Collaborative Instruction*.

Table 12

Regressions Examining Knowledge and Instructional Practice Factors (N = 66)

	Didactic		Student-Centered		Print-Focused		Comprehensive		Collaborative	
Variables	*B*	*SE*	*B*	*SE*	*B*	*SE*	*B*	*SE*	*B*	*SE*
Model One										
Race	-0.29	0.34	0.41	0.32	-0.23	0.27	0.11	0.30	0.18	0.32
Grade	0.22	0.27	0.12	0.25	-1.08***	0.21	-0.04	0.24	0.30	0.25
Age	0.01	0.02	0.02	0.02	0.02	0.01	-0.01	0.02	0.01	0.02
Reading Courses	-0.11	0.08	0.07	0.07	0.01	0.06	0.04	0.07	0.03	0.07
Education	0.05	0.30	0.10	0.27	-0.12	0.23	0.23	0.26	-0.08	0.28
Experience	0.01	0.02	-0.02	0.02	-0.01	0.02	0.01	0.02	-0.02	0.02
R^2	0.07		0.07		0.40		0.06		0.06	
Model Two, Step 1										
Overall Knowledge	0.01	0.03	-0.04	0.03	0.00	0.02	0.07*	0.03	-0.02	0.03
R^2	0.07		0.11		0.40		0.14		0.07	
F	0.04		2.32		0.01		5.62*		0.74	
Model Two, Step 2										
Content Knowledge	-0.02	0.14	-0.13	0.13	0.01	0.11	0.30*	0.12	-0.03	0.13
R^2	0.07		0.09		0.40		0.15		0.06	
F	0.03		1.02		0.01		5.95*		0.06	
Model Two, Step 3										
PCK	-0.02	0.14	-0.15	0.13	0.02	0.11	0.30*	0.12	-0.07	0.13
R^2	0.07		0.09		0.40		0.15		0.06	
F	0.03		1.30		0.04		6.14*		0.27	

Note. Model one refers to controls only, while model two refers to control variables and variables of interest. PCK = Pedagogical Content Knowledge. *$p < .05$, ** $p < .01$, *** $< .001$

CHAPTER FIVE

Discussion

The aim of this study was to examine the factor structure of the Teacher Knowledge Survey (TKS; Moats, 1994; Piasta et al., 2009) and, subsequently, the relationships among teachers' characteristics, knowledge, and instructional practices. The TKS, (Moats, 1994; Piasta et al., 2009), a questionnaire composed of thirty-three items, was demonstrated to be composed of domains of content knowledge and pedagogical content knowledge when nine of the items were removed. On each of these domains and overall, teachers answered approximately 70% of questions correctly. Years of experience was the only teacher characteristic that was significantly associated with the overall knowledge score on the TKS, as well as sub-scores on the domains of content knowledge and pedagogical content knowledge. Coursework and education were not significantly associated with any measure of teacher knowledge. Finally, a measure of instructional practices originally developed for Early Childhood Longitudinal Study was factor analyzed. Five factors resulted. They were *Didactic Instruction*, *Student-centered Instruction*, *Print-focused Instruction*, *Comprehensive Instruction*, and *Collaborative Instruction*. Of these five factors, overall knowledge, content knowledge, and pedagogical content knowledge were only significantly associated with engaging in practices that loaded on the *Comprehensive Instruction* factor.

This chapter, organized by research question, will examine the results positioned in the context of prior research findings and the implications for future research. First, each research question will be discussed, including a summary of the results and how the results of this study

relate to and extend the existing research literature on teacher knowledge of early reading. Next, the limitations of the study will be examined. Finally, directions for future research will be discussed.

Composition of Teacher Knowledge of Early Reading

This study examined the teacher knowledge of kindergarten and first grade classroom teachers in rural low-wealth schools. Teacher knowledge was assessed using the TKS, which was originally created by Moats (1994) and Piasta et al (2009). To enhance model fit, nine items, which did not load to either domain, were not included in subsequent analyses. These items may load to other domains proposed by Shulman not measured in this study. The newly created twenty-four item TKS was demonstrated to be separately assessing domains of content knowledge and pedagogical content knowledge. Interestingly, the items developed by Moats (1994) only loaded to content knowledge. In contrast, the items developed by Piasta et al. (2009) loaded to both content knowledge and pedagogical content knowledge. This difference may be an indicator of the more recent understanding the field has come to about the importance of pedagogical content knowledge. These domains have been theoretically proposed and posited to be critical for teachers (Shulman, 1986), but have not previously been empirically demonstrated. While the authors of the survey intended for it to assess each of these domains (Moats, 1994; Piasta et al., 2009), this study represents the first empirical demonstration that content knowledge and pedagogical content knowledge can be independently assessed. However, the removed items may represent other domains when included in a measure with more similar items. Similarly, other questionnaires measuring teacher knowledge of early reading may not assess these domains, or may assess only one of them. Nevertheless, the finding that content

knowledge and pedagogical content knowledge can be separately assessed extends the field's understanding of teacher knowledge of early reading.

Levels of Teacher Knowledge of Early Reading

The overall level of teacher knowledge among kindergarten and first grade classroom teachers in rural low-wealth schools in this sample was 71%. That is, teachers in this sample were able to answer 71% of the items on the TKS correctly on average. However, this overall level of knowledge fell to 65% when all items were included. This level of knowledge is higher than what has been reported in other studies conducted with early elementary teachers in non-rural low-wealth environments (Bos et al., 2001; Mather, Bos, & Babur, 2001; McCutchen, Abbott, et al., 2002; McCutchen, Harry, et al., 2002; Moats & Foorman, 2003; Piasta et al., 2009). Given findings that rural low-wealth teachers are often lesser qualified than their urban and suburban peers (Amendum et al., 2011; Lee & Burkam, 2002; Provasnik et al., 2007; Vernon-Feagans et al., 2012; Vernon-Feagans et al., 2013), the hypothesis was that teacher knowledge would be less than previously reported. This hypothesis was not supported.

The level of content knowledge in this sample was 72%, while the level of pedagogical content knowledge was 70%. The level of knowledge does not appear to vary much across factors. Nonetheless, this study represents the first attempt to examine how teacher knowledge might vary across domains.

Teacher Characteristics and Teacher Knowledge of Early Reading

This study examined the relationship between number of reading methods courses, level of education, years of experience, and teacher knowledge. Of these teacher characteristic variables, only experience had a significant association with overall knowledge, content knowledge, and pedagogical content knowledge. While Piasta et al. (2009) was the only study

that could be found that directly associated any teacher characteristics with knowledge, the current study does corroborate their findings that experience was significantly correlated with teacher knowledge. Interestingly, Piasta et al. (2009) found experience teaching first grade was associated with teacher knowledge, while the current study demonstrates overall teaching experience was significantly associated with knowledge. This finding may mean that teachers can move between grade levels taking knowledge gained through experience with them. While no significant association was found between coursework and knowledge, this current study extends current understandings in the field by being the first to include reading methods coursework as a variable of interest in an examination of teacher knowledge. Of note, there are important quality dimensions of coursework and education that were not captured in the current study. Neither the content of reading methods coursework nor the type of pre-service training received by teachers were able to be examined as no information was collected on where teachers received their degrees or the content of their reading methods courses. These more detailed measures might be more predictive than education degree and number of methods classes. Furthermore, the items removed from the TKS, and the domains to which they may load, may uniquely relate to teacher characteristics in ways content knowledge and pedagogical content knowledge do not.

Teacher Knowledge of Early Reading and Instructional Practices

Finally, this study determined how teacher overall knowledge, content knowledge, and pedagogical content knowledge related to the self-reported instructional practices of kindergarten and first grade teachers in rural low-wealth schools. The factors identified in this study were: *Didactic Instruction*, *Student-Centered Instruction*, *Print-Focused Instruction*, *Comprehensive Instruction*, and *Collaborative Instruction*. These five factors were developed in an exploratory

approach that was guided by previous research using EFA on this measure. The factors identified in this study as a whole were unique to the teachers in the sample, though each had previously been salient in at least another study. Therefore, the ways teacher knowledge may relate to these self-reported practices may differ in future studies, given the influence of sample when using EFA.

Of the instructional practice factors identified, overall knowledge, content knowledge, and pedagogical content knowledge were significantly associated with the factor named *Comprehensive Instruction*. NELP (2008) and NRP (2000) both indicate the impact on student outcomes of providing instruction across the Big Five of reading (phonemic awareness, phonics, fluency, vocabulary, and comprehension), termed comprehensive instruction in this study. The wide dissemination of these reports makes it likely that teachers who are more knowledgeable would be aware of the findings contained in these reports. Thus, it is understandable why teachers who are more knowledgeable are more likely to report engaging in comprehensive instruction.

The lack of significant associations with the remaining instructional practice factors could be due to the nature of the instructional practice items comprising each factor. Each may be more related to teacher beliefs than teacher knowledge. For example, didactic instruction may be more related to teacher beliefs about student ability, or their own instructional efficacy beliefs. That is, teachers who do not view themselves as effective teachers, or who do not believe students can make autonomous decisions about which book to read or what to write may revert to teacher-directed instructional activities, regardless of their knowledge level. Student-centered instruction may be more related to teacher beliefs about student behavior that may not allow for this type of independent instruction. Print-focused instruction may be more related to teacher

beliefs about student ability and the type of instruction appropriate for them, as well as being associated with grade taught. Collaborative instruction may also be more related to teacher beliefs about student behavior that they may believe presents this type of interactive instruction. That is, teachers' beliefs about their ability and their students' abilities may drive didactic, student-centered, print-focused, and collaborative instructional practices more than teacher knowledge of reading. Overall, teacher knowledge cannot be viewed as the sole driver of all teacher instructional practices, but is an important component in the reported provision of comprehensive literacy instruction.

These analyses extend the work of some (McCutchen, Harry, et al., 2002; McCutchen, Abbott, et al., 2002) but contradict the findings of others (Piasta et al., 2009). The work the current study corroborates (McCutchen, Harry et al., 2002; McCutchen, Abbott, et al., 2002) demonstrates that teacher knowledge is significantly associated with particular instructional practices. Piasta et al. (2009) believed their contradictory findings might be due to their observational coding system, which they termed as "intentionally simplistic" (pp. 244-245). Thus, the use of self-reported practices may help to explain conflicting findings in the literature by allowing for an understanding of how teachers envision their own practices.

Moreover, each of these previous studies associated knowledge with explicitness of instruction, whereas this current study associated knowledge with teachers' instructional style, determined through exploratory factor analysis of a self-report of individual practices. This is the first study to examine how teacher knowledge may relate to instructional practices beyond the degree of explicitness of instruction.

Limitations

A number of considerations must be taken into account when interpreting these findings. First and foremost, this study examined the skills needed for reading instruction without attending to the sociocultural realm of reading. Reading, however, is much more than a skill base. It is a complex social process that requires cognitive, linguistic, and social skills. It involves abstraction, reflection, interpretation, cross-cultural understanding, and critical thinking (Gee, 1990). Skills instruction alone is not sufficient and should never be taught to the exclusion of either meaning-based instruction or socioculturally relevant instruction. Nevertheless, basic skills, while not sufficient, are necessary. Therefore, the skills required for reading were the focus of this current study.

The correlational nature of this research further restricts the conclusions that can be drawn because no causal relationship can be determined with non-experimental data. Therefore, we must be careful not to make causal connections as we consider implications. Similarly, interpretations should be made cautiously given the many questions currently being raised about the reliability and validity of NCES measures, such as the one used to report instructional practices in this study. Furthermore, given the context of rural low-wealth schools, the results found will only be generalizable to similar contexts. This context is critical, however, because previous research on early reading knowledge has not focused on rural low-wealth settings. Although, the rural low-wealth context is a strength of this study, having few previous findings to compare with these results makes interpreting them difficult.

Moreover, given the confines of this study to an existing dataset, the investigation into the domains underlying the concept of teacher knowledge is necessarily restricted to those being measured by the assessment used, the TKS. Additionally, the TKS (Moats, 1994; Piasta et al.,

2009) is not the only assessment of the reading knowledge of early elementary classroom teachers that exists. Other measures of teacher knowledge may capture domains of teacher knowledge other than those captured on the TKS, such as case knowledge or strategic knowledge.

The current sample also entered teaching before states began requiring teachers to pass exams, such as The Foundations of Reading test. The Foundations of Reading test assesses proficiency and depth of understanding of reading and writing development and reflects evidence-based reading practices (Rowland, 2015). Teachers who were required to pass tests like the Foundations of Reading test may exhibit greater overall knowledge, content knowledge, and pedagogical content knowledge than teachers included in this study who were not required to pass such an exam prior to licensure.

Further, the correlations between overall knowledge, content knowledge, and pedagogical content knowledge were high. While these were always analyzed separately to avoid collinearity, the individual effects of either of the knowledge factors were not apparent. Similarly, some of the variables captured, such as education and race, had too little variation. For example, education was reduced to Bachelor's or Master's degree, and race was restricted to white or non-white. The sample size of this study necessitated these restricted ranges as otherwise there would have been too little variation to conduct analyses. Finally, the instructional practices analyzed are self-reported. It is possible teachers inaccurately portrayed their instructional practices, particularly given the lack of correlation between observed and self-reported practices (Pianta & Hamre, 2009).

Future Research

In the future, creating variables that capture the broad range of experiences teachers are likely to have, while also using a large enough sample size to have sufficient teachers who report similar experiences will be important. In future work on this topic, studies should use larger samples in order to potentially account for more variance in teachers' characteristics. To mitigate some of the issues in measuring teachers' instructional practices, future work may want to observe teachers directly. Using both observation and self-reported instructional practices would allow for a broader picture of classroom instructional practices. Moreover, this study did not examine why teachers chose particular instructional practices. Qualitative research, that includes participant observation, interviews, and the examination of classroom artifacts might reveal how teacher knowledge influences instructional decision making is important. This research could be conducted by observing classroom instruction over time, and engaging in formal and informal interviews to determine how teachers select their instructional practices, the role knowledge plays, and what knowledge is being relied on (e.g., content knowledge, pedagogical content knowledge, knowledge of what the principal or district want to occur, or knowledge of the students' needs). It would also allow for the examination of classroom artifacts including lesson plans, instructional materials, and student work samples in order to determine how knowledge and instructional decisions play out in practice.

The finding that measures of teacher knowledge can separately assess content knowledge and pedagogical content knowledge allows for further investigation of how each domain of teacher knowledge relates to other constructs of interest. The items that did not load to either content knowledge or pedagogical content knowledge may be assessing another domain. Whether this interpretation is viable, and what domain they may be assessing, should be

investigated in future studies by including more items that are similar to these on future measures of teacher knowledge, and then engaging in factor analysis. Within courses that intend to affect teachers' content knowledge or pedagogical content knowledge, teacher educators could provide a pre- and post-measure to determine teacher candidates' growth in each domain. Subsequently, the ways each domain separately relates to teachers' practices and to other constructs of interest, such as students' outcomes, can be investigated. It is important to include student outcomes in future research since higher knowledge teachers ought to help students progress most in reading. It may be that knowledge is a mediator of instructional practices.

Further, fourteen states recently enacted requirements that teacher candidates pass reading instruction-specific assessments before being granted teaching licenses. These assessments are designed to demonstrate teachers' knowledge in line with current reading research. Teachers who were required to pass these tests may exhibit greater overall knowledge, content knowledge, and pedagogical content knowledge than teachers, such as those included in this study, who were not required to take this exam. Furthermore, the knowledge of teachers across states may vary depending on which test of reading knowledge is required. Future work should analyze a sample of teachers who were required to pass each of these exams. Similarly, the relationship between education and knowledge should continue to be investigated in future studies. North Carolina, where this data was collected, ended salary incentives for teachers who obtained a Master's degree in 2014. Thus, the relationship between education and knowledge identified in this study may be quite different than what may be found in future studies since teachers who received their Master's after salary incentives ended are likely different than those who received it while the salary incentive was still in place. Additionally, knowing when teachers received their degree would be an important variable to capture in future studies.

Perhaps the most critical next step is to engage in research that establishes the threshold of knowledge necessary to be effective. This research would seek to determine how much experience is necessary to be more knowledgeable, and how much knowledge is necessary to engage in evidence-based instructional practices. Knowing how much knowledge and what type of knowledge is necessary to engage effectively in evidence-based practices could be critical in ensuring the appropriate amount of instructional time in teacher education programs is directed to achieving this knowledge.

Finally, this research should be expanded to include student outcomes. The current study indicates more experienced teachers are more knowledgeable and more likely to report engaging in comprehensive instructional practices, but it does not address teacher effectiveness with respect to student outcomes. It is critical to determine whether teacher knowledge has a direct effect on student outcomes. While Piasta et al. (2009) did not find a direct relationship between teacher knowledge and student outcomes, they did hypothesize there may be an interaction between knowledge and practice that is significantly associated with student outcomes. Future research should continue to evaluate this pathway.

Conclusion

Continued attention to teacher effectiveness necessitates understanding the relationship among teachers' characteristics, knowledge, and instructional practices. Previous research on the knowledge of early elementary classroom teachers of reading has not been conducted in rural low-wealth schools. The present study contributes to the literature both by investigating this context and by examining the relationships among teachers' reading methods coursework, education, and years of experience, knowledge, and self-reported instructional practices for teachers employed in rural low-wealth schools. In addition, the underlying domains of teacher

knowledge had not previously been empirically demonstrated. Furthermore, previously the relationships among teacher characteristics and teacher knowledge had only been investigated using correlations among measures, and without looking at coursework, so this study further informs the field by providing insight into the importance of experience. Finally, this study represents an initial examination of the relationship between teachers' knowledge and their self-reported instructional practices. The inclusion of self-reported instructional practices was important as it allowed for the examination of teachers' internal concepts of both their knowledge and their practices.

The critical findings from this study are that teacher knowledge is composed of domains of content knowledge and pedagogical content knowledge, though they are highly related; that experience is significantly related to teacher knowledge; and that teacher knowledge is significantly associated with comprehensive instructional practices as reported by teachers. Therefore, schools of education and other professional development providers must attend to the domains of knowledge they are targeting. Furthermore, emphasis must be placed on in-school learning opportunities, as experience was the only statistically significant relationship found among teacher characteristics and knowledge. Ways to provide teachers with increased experience, while acknowledging the reality that experience is acquired over time, will be critical to develop and implement. Providing pre-service teachers with opportunities to observe and engage in experiential learning, such as supervised internships in local schools, will be important for increased knowledge. Local education agencies, schools, and other professional development providers may also feel confident in their allocation of funds to increase teachers' knowledge in the hopes of impacting their use of evidence-based instructional practices. Since knowledge was significantly associated with comprehensive instructional practices, as reported by teachers,

professional development initiatives that aim to increase teacher knowledge may also influence their instruction. In sum, knowledge does seem to be composed of content knowledge and pedagogical content knowledge, experience is associated with knowledge, and knowledge is associated with engaging in comprehensive instructional practices as reported by teachers.

APPENDIX A: TEACHER KNOWLEDGE SURVEY

1. Students must be able to orally segment and blend the phonemes in complex syllables before they can benefit from instruction in letter-sound correspondence.
T **F**

2. If a student is "glued to print", reading slowly word-by-word, the student should be told to read faster and to stop spending so much effort to decode.
T **F**

3. Screening at the end of kindergarten can be efficient, reliable, and valid for predicting a child's silent passage reading comprehension at the end of third grade.
T F

4. The best remedy for a weakness in nonsense word reading is lots of practice reading nonsense words.
T **F**

5. Timed letter naming on DIBELS is a good risk-indicator for later reading comprehension.
T F

6. Phonological awareness exercises should always include letters or print.
T **F**

7. A closed syllable always begins with a consonant.
T **F**

8. A schwa sound is found in the word:
(a) resume
(b) bread
(c) look
(d) about
(e) flirt

9. Which word contains a short vowel sound?
(a) treat
(b) start
(c) slip
(d) paw
(e) father

10. A diphthong is found in the word:
(a) coat
(b) boy
(c) battle
(d) sing
(e) been

11. A voiced consonant digraph is in the word:
(a) think
(b) ship
(c) whip
(d) the
(e) photo

12. What type of task would this be? "I am going to say a word and then I want you to break the word apart. Tell me each of the sounds in the word *dog*."

(a) blending
(c) segmentation
(b) rhyming
(d) deletion

13. What type of task would this be? "I am going to say some sounds that will make one word when you put them together. What does /sh/ /oe/ say?"

(a) blending
(c) segmentation
(b) rhyming
(d) manipulation

14. Count the number of syllables for the word *unbelievable*.

(a) four
(c) six
(b) five
(d) seven

15. For skilled readers, listening and reading comprehension are usually about equal. For developing readers in K-3, it is true that:

(a) Reading comprehension is better than listening comprehension.
(b) **Listening comprehension is better than reading comprehension.**
(c) Reading and listening comprehension are comparable, about the same.
(d) There is no systematic relationship between reading comprehension and listening comprehension.

16. How many morphemes are in the word *unbelievable*?

(a) one
(c) three
(b) two
(d) four

17. How many morphemes are in the word *pies*?

(a) zero
(c) two
(b) one
(d) three

18. Mr. Drake recently read two nonfiction books to his class. One of the books was about ants and the other about spiders. Which of the following tools would be most useful in allowing his students to compare and contrast the characteristics presented in the two books?

(a) semantic map
(b) story map
(c) KWL chart
(d) **Venn diagram**

19. According to research, the <u>least</u> effective way to teach vocabulary to students is through the use of:

(a) **ask students to write definitions of new vocabulary words**
(b) teach new terms in context of subject-matter lesson
(c) identify examples related to the word's meaning
(d) discuss synonyms for new vocabulary words

20. Mrs. Pink has assigned her students a short story to read independently. She wants to practice a strategy with her students in order to enhance their comprehension during reading. Mrs. Pink should instruct her students to:
(a) ask her a question when they do not understand
(b) when they come across a word that do not know, stop reading and look it up in the dictionary
(c) **scan the text and prewrite questions that they want to have answered as they read**
(d) write a reflection in their literacy journals immediately after reading the text

21. You plan time during your literacy block for students to engage in a reading activity that will improve fluency. Which of the following activities would be most effective in achieving this goal?
(a) Students independently read a text and then answer a series of literal and inferential comprehension questions.
(b) As a whole class, each student will take a turn reading a paragraph from a text related to your current curriculum. While one student in reading, the other students listen and read along silently in their own text. (Round-robin reading)
(c) **The teacher reads a passage aloud to model fluent reading and then students reread the text independently. (Guided oral reading)**
(d) In pairs, students are assigned a list of words for which they are asked to write definitions and sample sentences.

22. Ms. Jones' students say they understand the text that they are reading in their science textbooks, but they are unable to correctly answer questions about the content. What comprehension strategy would best help her students to realize they may not understand the content as they read?
(a) **self-monitoring and fix-up strategies**
(b) making mental pictures of the text
(c) activating their background knowledge
(d) answering questions at the end of the chapter

23. You observe your student teacher asking students to think about things that happened to them that are similar to what happened to the character in the story. This is an example of:
(a) predicting
(b) summarizing
(c) **activating prior knowledge**
(d) building background knowledge

24. After you read a story to your students, you ask your students to recall important details from the story. This is an example of:
(a) **highlighting**
(b) monitoring
(c) generating questions
(d) inferencing

25. You plan to read a story to your students about a rainbow. You want to be sure that your students will understand the story so you first provide them with a brief explanation of how a rainbow forms before you read the story. This is an example of:
(a) building story structure
(b) predicting
(c) **building background knowledge**
(d) making connections

26. One example of an activity that teachers can use to assist with multi-strategy instruction is:
(a) explicit instruction
(b) **reciprocal teaching**
(c) sustained silent reading
(d) journal writing

27. As you read a passage from a book about ants, you are telling the students what you are doing and why, as you do it. This is an example of:
(a) monitoring comprehension
(b) **using a think aloud strategy**
(c) inferencing
(d) highlighting

28. Kyle, one of Mrs. Valcourt's first-grade students, reads the sentence, "The hot dog tasted great!" However, Greg pronounced the word *great* as *greet*. What should Mrs. Valcourt say?
(a) Tell me the sound of each letter, then tell me the whole word.
(b) Think, what do the first part and the last part of the word say? Now put them together.
(c) Think what sound the *ea* spelling pattern makes. Now say the whole word.
(d) **This word doesn't follow the rules. This is the word 'great.'**

29. Mrs. Frank is teaching her students to identify multi-syllable words. Which is an appropriate first step for her to do?
(a) **model analyzing words for familiar prefixes and suffixes**
(b) show students how to blend individual letter-sounds, left-to-right
(c) model how to look for little words in big words
(d) demonstrate sequentially blending onsets and rimes

30. Circle the word that is a real word when you sound it out:
(a) churbit
(b) wolide
(c) candadett
(d) rigfap

31. Circle the word that is a real word when you sound it out:
(a) vareaunt
(b) reatloid
(c) lofam
(d) foutray

32. Circle the word that is a real word when you sound it out:
(a) napsate
(b) pagbo
(c) plizzle
(d) beekahz

33. Circle the word that is a real word when you sound it out:
(a) zipanewnew
(b) agritolnal
(c) bewtiphul
(d) isengraneal

APPENDIX B: INSTRUCTIONAL PRACTICE ITEMS FROM THE TEACHER KNOWLEDGE QUESTIONNAIRE

10. How often do children in this class do each of the following READING and LANGUAGE ARTS activities?

	Never	Once a month or less	Two or three times a month	Once or twice a week	Three of four times a week	Daily
1. Work on learning the names of the letters	1	2	3	4	5	6
2. Practice writing the letters of the alphabet	1	2	3	4	5	6
3. Discuss new or difficult vocabulary	1	2	3	4	5	6
4. Dictate stories to a teacher, aide, or volunteer	1	2	3	4	5	6
5. Work on phonics	1	2	3	4	5	6
6. Listen to you read stories where they see the print (e.g., Big Books)	1	2	3	4	5	6
7. Listen to you read stories but they don't see the print	1	2	3	4	5	6
8. Retell stories	1	2	3	4	5	6

9. Read aloud	1	2	3	4	5	6
10. Read silently	1	2	3	4	5	6
11. Work in a reading workbook or on a worksheet	1	2	3	4	5	6
12. Write words from dictation, to improve spelling	1	2	3	4	5	6
13. Write with encouragement to use invented spellings, if needed	1	2	3	4	5	6
14. Read books they have chosen for themselves	1	2	3	4	5	6
15. Read text with controlled vocabulary	1	2	3	4	5	6
16. Read text with strong phonetic patterns	1	2	3	4	5	6
17. Read text with patterned or predictable text	1	2	3	4	5	6
18. Read thematic or literature based text	1	2	3	4	5	6

19. Compose and write stories or reports	1	2	3	4	5	6
20. Do an activity or project related to a book or story	1	2	3	4	5	6
21. Publish their own writing	1	2	3	4	5	6
22. Perform plays and skits	1	2	3	4	5	6
23. Write stories in a journal	1	2	3	4	5	6
24. See/hear stories from story tellers or other artists	1	2	3	4	5	6
25. Work in mixed-achievement groups on language arts activities	1	2	3	4	5	6
26. Peer tutoring	1	2	3	4	5	6
27. Work on projects in small groups	1	2	3	4	5	6
28. Work on long term projects (at least a week long)	1	2	3	4	5	6

APPENDIX C: TEACHER KNOWLEDGE SURVEY ITEM DIVISION

Item	Domain
1. Students must be able to orally segment and blend the phonemes in complex syllables before they can benefit from instruction in letter-sound correspondence. T **F**	Content knowledge
2. If a student is "glued to print", reading slowly word-by-word, the student should be told to read faster and to stop spending so much effort to decode. T **F**	Content knowledge
3. Screening at the end of kindergarten can be efficient, reliable, and valid for predicting a child's silent passage reading comprehension at the end of third grade. **T** F	Content knowledge
4. The best remedy for a weakness in nonsense word reading is lots of practice reading nonsense words. T **F**	Content knowledge
5. Timed letter naming on DIBELS is a good risk-indicator for later reading comprehension. **T** F	Content knowledge
6. Phonological awareness exercises should always include letters or print. T **F**	Content knowledge
7. A closed syllable always begins with a consonant. T **F**	Content knowledge
8. A schwa sound is found in the word: (a) resume **(d) about** (b) bread (e) flirt (c) look	Content knowledge
9. Which word contains a short vowel sound? (a) treat (d) paw (b) start (e) father **(c) slip**	Content knowledge

10. A diphthong is found in the word: (a) coat (d) sing **(b) boy** (e) been (c) battle	Content knowledge
11. A voiced consonant digraph is in the word: (a) think **(d) the** (b) ship (e) photo (c) whip	Content knowledge
12. What type of task would this be? "I am going to say a word and then I want you to break the word apart. Tell me each of the sounds in the word *dog*." (a) blending **(c) segmentation** (b) rhyming (d) deletion	Content knowledge
13. What type of task would this be? "I am going to say some sounds that will make one word when you put them together. What does /sh/ /oe/ say?" **(a) blending** (c) segmentation (b) rhyming (d) manipulation	Content knowledge
14. Count the number of syllables for the word *unbelievable*. (a) four (c) six **(b) five** (d) seven	Content knowledge
15. For skilled readers, listening and reading comprehension are usually about equal. For developing readers in K-3, it is true that: (e) Reading comprehension is better than listening comprehension. (f) **Listening comprehension is better than reading comprehension.** (g) Reading and listening comprehension are comparable, about the same. (h) There is no systematic relationship between reading comprehension and listening comprehension.	Pedagogical content knowledge
16. How many morphemes are in the word *unbelievable*? (a) one **(c) three** (b) two (d) four	Content knowledge

17. How many morphemes are in the word *pies*? (a) zero (b) one **(c) two** (d) three	Content knowledge
18. Mr. Drake recently read two nonfiction books to his class. One of the books was about ants and the other about spiders. Which of the following tools would be most useful in allowing his students to compare and contrast the characteristics presented in the two books? (e) semantic map (f) story map (g) KWL chart (h) **Venn diagram**	Pedagogical content knowledge
19. According to research, the <u>least</u> effective way to teach vocabulary to students is through the use of: (e) **ask students to write definitions of new vocabulary words** (f) teach new terms in context of subject-matter lesson (g) identify examples related to the word's meaning (h) discuss synonyms for new vocabulary words	Pedagogical content knowledge
20. Mrs. Pink has assigned her students a short story to read independently. She wants to practice a strategy with her students in order to enhance their comprehension <u>during</u> reading. Mrs. Pink should instruct her students to: (e) ask her a question when they do not understand (f) when they come across a word that do not know, stop reading and look it up in the dictionary (g) **scan the text and prewrite questions that they want to have answered as they read** (h) write a reflection in their literacy journals immediately after reading the text	Pedagogical content knowledge
21. You plan time during your literacy block for students to engage in a reading activity that will improve fluency. Which of the following activities would be most effective in achieving this goal? (e) Students independently read a text and then answer a series of literal and inferential comprehension questions. (f) As a whole class, each student will take a turn	Pedagogical content knowledge

reading a paragraph from a text related to your current curriculum. While one student in reading, the other students listen and read along silently in their own text. (Round-robin reading) (g) **The teacher reads a passage aloud to model fluent reading and then students reread the text independently. (Guided oral reading)** (h) In pairs, students are assigned a list of words for which they are asked to write definitions and sample sentences.	
22. Ms. Jones' students say they understand the text that they are reading in their science textbooks, but they are unable to correctly answer questions about the content. What comprehension strategy would best help her students to realize they may not understand the content as they read? (e) **self-monitoring and fix-up strategies** (f) making mental pictures of the text (g) activating their background knowledge (h) answering questions at the end of the chapter	Pedagogical content knowledge
23. You observe your student teacher asking students to think about things that happened to them that are similar to what happened to the character in the story. This is an example of: (e) predicting (f) summarizing (g) **activating prior knowledge** (h) building background knowledge	Pedagogical content knowledge
24. After you read a story to your students, you ask your students to recall important details from the story. This is an example of: (e) **highlighting** (f) monitoring (g) generating questions (h) inferencing	Pedagogical content knowledge
25. You plan to read a story to your students about a rainbow. You want to be sure that your students will understand the story so you first provide them with a brief explanation of how a rainbow forms before you read the story. This is an example of: (e) building story structure (f) predicting	Pedagogical content knowledge

(g) **building background knowledge** (h) making connections	
26. One example of an activity that teachers can use to assist with multi-strategy instruction is: (e) explicit instruction (f) **reciprocal teaching** (g) sustained silent reading (h) journal writing	Pedagogical content knowledge
27. As you read a passage from a book about ants, you are telling the students what you are doing and why, as you do it. This is an example of: (e) monitoring comprehension (f) **using a think aloud strategy** (g) inferencing (h) highlighting	Pedagogical content knowledge
28. Kyle, one of Mrs. Valcourt's first-grade students, reads the sentence, "The hot dog tasted great!" However, Greg pronounced the word *great* as *greet*. What should Mrs. Valcourt say? (e) Tell me the sound of each letter, then tell me the whole word. (f) Think, what do the first part and the last part of the word say? Now put them together. (g) Think what sound the *ea* spelling pattern makes. Now say the whole word. (h) **This word doesn't follow the rules. This is the word 'great.'**	Pedagogical content knowledge
29. Mrs. Frank is teaching her students to identify multi-syllable words. Which is an appropriate first step for her to do? (e) **model analyzing words for familiar prefixes and suffixes** (f) show students how to blend individual letter-sounds, left-to-right (g) model how to look for little words in big words (h) demonstrate sequentially blending onsets and rimes	Pedagogical content knowledge
30. Circle the word that is a real word when you sound it out: (e) churbit (f) wolide	Content knowledge

(g) candadett (h) rigfap	
31. Circle the word that is a real word when you sound it out: **(e) vareaunt** (f) reatloid (g) lofam (h) foutray	Content knowledge
32. Circle the word that is a real word when you sound it out: (e) napsate (f) pagbo (g) plizzle **(h) beekahz**	Content knowledge
33. Circle the word that is a real word when you sound it out: (e) zipanewnew (f) agritolnal **(g) bewtiphul** (h) isengraneal	Content knowledge

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