THE DEVELOPMENT AND PILOT OF AN INSTRUMENT TO MEASURE MIDDLE SCHOOL ENGLISH LANGUAGE ARTS TEACHERS' CONTENT AND PEDAGOGICAL KNOWLEDGE OF READING

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Doctor of Philosophy

By

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Abstract

This dissertation study describes the development and pilot study of an instrument to measure middle school English Language Arts (ELA) teachers' knowledge of reading, the Middle School ELA Teacher Reading Knowledge (METoR) Survey. While there are measures of teacher knowledge that have been validated for use with elementary school teachers (e.g., Binks-Cantrell et al., 2011; Davis et al., 2021; Hall et al., 2023), no such measure exists for middle school teachers. The METoR survey seeks to measure teacher knowledge in four domains: (1) word knowledge: content knowledge; (2) word knowledge: pedagogical knowledge; (3) reading comprehension: content knowledge; and (4) reading comprehension: pedagogical knowledge.

Items were created using texts found through a systematic review as a reference for evidence-based practices. Items were then sent out to expert reviewers for feedback and revision. Using the revised items, cognitive interviews were conducted with three teachers to ensure clarity and relevance. The final measure consisted of 49 multiple choice questions across the four domains.

Forty-two teachers completed the METoR survey. The overall instrument measured with acceptable reliability, but the individual domains do not. A lack of correlation was found across items within domains. Confirmatory factor structure revealed that no factor model had acceptable fit. Overall knowledge was not significantly related to education level, teaching experience, certification type, or certification in elementary education. The lack of reliability for the items within the subdomains suggested the need to make revisions.

Dedication

This dissertation is dedicated to my mom and dad, who instilled in me the importance of faith and education.

Mom, you continually show me what it means to balance being strong and kind, always putting your faith into action and remembering our charge to love others. I'm so blessed to have been a recipient of that strength and love time and time again. None of this would have been possible without you, and your constant reminders of my abilities.

Dad, I know you're cheering me on from Heaven. I have felt your love and support every step of the way.

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CHAPTER ONE

INTRODUCTION

Data from the 2024 National Assessment of Educational Progress (NAEP; U.S. Department of Education) report that 70% of eighth grade students are performing at or below a basic level of reading proficiency, meaning that more than half of students entering high school can engage only in surface level literacy practices (e.g., making simple inferences or demonstrate a general understanding of concepts). This is problematic, as the literacy demands on students only increase as they transition from elementary school into middle and high school (Carnegie Council on Advancing Literacy, 2010). A focus on informational text emerges, particularly in content areas, where students encounter technical language and complex vocabulary and language structure (Dahl et al., 2021).

Although research on adolescent literacy, generally defined as the literacy skills of students in grades 4 through 12, is not as robust as that of early literacy (e.g. National Institute of Child Health and Human Development, 2000), there has been an increase in recent years (Biancarosa & Snow, 2006; Carnegie Council on Advancing Literacy, 2010; Faggella-Luby et al., 2009; Kamil et al., 2008; Scammacca et al., 2007; Torgeson et al., 2007; Vaughn et al., 2022). In fact, almost twenty years ago Biancarosa and Snow (2006) stated, “Enough is already know about adolescent literacy - both the nature of the problems of struggling readers and the types of interventions and approaches to address these needs – in order to act immediately on a broad scale” (p. 10).

There are many possible contributors to adolescents’ literacy scores, such as federal and state policies, course requirements of pre-service teaching programs, school culture, and effective leadership among others (Torgeson et al., 2007). In particular, this study is interested in

the potential impact of teacher content and pedagogical knowledge on student achievement. Rowan et al. (2002) found that individual teacher instruction explains significant and substantial variance on reading performance. Therefore, determining what middle school English teachers do and do not know may be the basis for determining a path towards improving adolescent literacy.

Reading Development

The Simple View of Reading (SVR; Gough & Tunmer, 1986; Hover & Gough, 1990), an empirically validated framework for understanding the component skills necessary for reading comprehension, helps delineate the types of knowledge that middle school English Language Arts (ELA) teachers might need to meet the varying needs of their students. The SVR asserts that reading comprehension is the product of decoding and linguistic comprehension. Decoding is defined as reading "isolated words quickly, accurately, and silently" (Gough & Tunmer, 1986, p. 7) and linguistic comprehension is "the process by which, given lexical (i.e., word) information, sentences and discourses are interpreted" (Gough & Tunmer, 1986, p. 7). Integral to the SVR is understanding that decoding and linguistic comprehension are multiplicative. That is, if both decoding and linguistic comprehension are zero, reading comprehension is also zero and if both are one, reading comprehension is also one. Between zero and one are many values that result in varying levels of reading comprehension. Foundational to the theory is that one's reading comprehension is only as strong as their least developed area, decoding or linguistic comprehension.

Since the SVR was introduced, it has been tested empirically across grade levels (e.g., Foorman et al., 2018) and languages (e.g., Cadime et al., 2017; Protopapas et al., 2013)

with some studies reporting a wide range in the variance explained by reading comprehension. Multiple studies (e.g., Adlof et al., 2006; Foorman et al., 2018; Kieffer et al., 2016) have shown that as students age, the unique contribution of decoding to reading comprehension decreases, while the contribution of language comprehension increases. As such, middle school ELA teachers need to have knowledge of both decoding and language comprehension with the understanding that by adolescence, language comprehension, and its sub skills, such as background knowledge and vocabulary knowledge, become increasingly important (Cromley & Azevedo, 2007).

The Needs of Adolescent Readers

Given that most adolescents require reading support (U.S. Department of Education, 2024), it is essential to determine what instruction is necessary to meet their needs. If instruction is not aligned with the needs of students, closing the academic literacy gap is nearly impossible (Brasseur-Hock et al., 2011). In general, readers who have not yet attained proficiency in middle school have difficulties across reading skills, including those related to word reading (i.e., decoding) and meaning making (i.e., language comprehension; Cirino et al., 2013; Hock et al., 2009). They have some basic reading skills, but not enough to complete the transition from "learning to read" to "reading to learn" and to attend to the subject-matter reading demands that they encounter in school (Chall, 1983; Deschler et al., 2007).

To address the needs of the students who are still developing reading skills, teachers must use evidence-based practices in their classrooms that align with the needs of their students (Hock et al., 2011). Extant research indicates specific skills and practices that have been found to improve outcomes for developing adolescent readers. These include: (1) teaching students a routine to decode multisyllabic words utilizing morphemes (i.e., prefixes, suffixes, and roots)

and syllables (Pearson et al., 2020; Scammacca et al., 2007; Vaughn et al., 2022; Strategic Education Research Partnership, 2025); (2) explicitly teaching a few vocabulary words that are essential to understand a text or unit (Kamil et al., 2008; Pearson et al., 2020; Torgesen et al., 2007; Scammacca et al., 2007; Vaughn et al., 2022); (3) utilizing strategies to increase reading fluency (Pearson et al., 2020; Torgesen et al., 2007; Vaughn et al., 2022; Strategic Education Research Partnership, 2025); (4) developing students' world knowledge (Pearson et al., 2020; Torgesen et al., 2007; Vaughn et al., 2022); (5) modeling how to generate inferences from texts (Pearson et al., 2020; Torgesen et al., 2007; Vaughn et al., 2022; Strategic Education Research Partnership, 2025); (6) developing a routine to find and communicate the main ideas in a text (Vaughn et al., 2022; Strategic Education Research Partnership, 2025); and (7) helping students to monitor their own comprehension and modeling strategies that they can use when their understanding breaks down (Pearson et al., 2020; Torgesen et al., 2007; Scammacca et al., 2007; Vaughn et al., 2022; Strategic Education Research Partnership, 2025). These seven practices have been shown to help raise reading achievement levels in adolescents, but only if teachers have knowledge of them and know how to use them effectively.

Existing Measures for Teacher Knowledge

Measuring what middle school ELA teachers know and understand about these practices could be key in aligning classroom instruction to the specific instructional needs of students. Additionally, teacher knowledge surveys can help inform and evaluate professional development efforts and explore the relations between teacher knowledge, instructional practices, and student outcomes.

While validated surveys exist for measuring teacher reading knowledge in elementary school (e.g., Binks-Cantrell et al., 2012; Bos et al., 2001; Davis et al., 2021; Hall et al., 2023;

Moats, 1994; Phelps & Schilling, 2004; Wijekumar et al., 2019), no studies were found that have investigated these constructs with middle school teachers. This is important, as the existing surveys not only include elements that do not pertain to general middle school ELA teachers (e.g., counting phonemes), but also do not include reading comprehension component skills (e.g., monitoring comprehension). This study seeks to fill this need by creating a survey that assesses middle school ELA teacher knowledge in reading practices that have been found to be evidence-based for adolescent readers.

Theoretical Framework

This study is informed by Shulman's domains of teacher knowledge, specifically (1) subject matter content knowledge and (2) pedagogical content knowledge (1986). Subject matter content knowledge is not only the understanding of the content of a subject but also the ability to explain the *why* behind the information. For example, it is not enough for an English teacher to be able to find the main idea of a section of text; they must also be able to understand and explain *why* it is the main idea. Pedagogical content knowledge is knowledge necessary for teaching. This domain encompasses knowing how to teach subject matter in multiple ways that make it understandable to others, understanding what parts of a subject are easy or difficulties and marrying those with scaffolds as necessary, and staying current with evidence-based practices that should be used in the classroom.

Since Shulman (1986) devised this framework, others have worked to further define these constructs. Ball et al. (2008) deconstructed subject matter knowledge and pedagogical content knowledge into three domains each. In their study, Ball and colleagues (2008) operationalized subject matter knowledge in mathematics to include (1) common content knowledge, (2) specialized content knowledge, and (3) horizon content knowledge. Common content knowledge

aligns with the *what* in Shulman's theory (1986; 1987). It includes content knowledge that typical adults might have, such as bring able to find the main idea of a text or make an inference. In contrast, specialized content knowledge aligns with the *why*. Ball and colleagues equate this kind of knowledge to being able to "unpack" the subject area because "teaching involves making features of particular content visible to and learnable by students" (p. 400). This type of knowledge is unique to teaching. In practice, this includes being able to model and verbalize how a main idea is constructed, or understanding the components needed to make an inference. It relies on metacognition. Finally, horizon content knowledge is an awareness of how topics are related over the span of the curriculum. Sixth grade teachers, for example, need to understand what content their students have already been taught as well as what content they will be expected to know in higher grade levels so that they can determine appropriate instruction to prepare their students for those expectations.

In this same framework (Ball et al., 2008), pedagogical content knowledge includes: (1) knowledge of content and students, (2) knowledge of content and teaching, and (3) knowledge of content and curriculum (Ball et al., 2008). Knowledge of content and students is seen as a primary element in Shulman's pedagogical content knowledge construct (Hill et al., 2008) and aligns with the previous description of that domain, where teachers can foresee what content might be easy or difficult and make the necessary adjustments. It is distinct from subject matter knowledge as someone might have a strong understanding of the actual content, but a weaker knowledge of how students learn (Hill et al., 2008). Knowledge of content and teaching is just as it states. It is about knowing *what* to teach as well as *how* to teach it. For example, a teacher might structure content so that it increases in difficulty over time or choose texts to use to model a specific strategy and provide guided practice. Teachers might also listen to a discussion and

decide when to ask for student elaboration or when to follow up with a student later to ensure clarity. All of these require interaction between content and pedagogical knowledge. Finally, knowledge of content and curriculum is not specifically defined by Ball and colleagues (2008), but echoes Shulman's (1986) category of curricular knowledge that encompasses understand what programs and instructional materials are available to teach the content.

Ball and colleagues' (2008) delineation of the domains that are subsumed under Shulman's broader categories are important to consider when developing an instrument meant to measure these domains. Hill and colleagues (2008) developed and piloted a measure to test teachers' knowledge of content and students (KCS), which is situated within the pedagogical content knowledge construct. They found that it was hard to deconstruct the notion of KCS from that of content knowledge, specifically mathematical reasoning. This multidimensionality, which was expected because teachers must first be able to determine *what* mathematical error was made (content knowledge) before figuring out *how* and *why* the students went astray (KCS), led to psychometric issues. Even if teachers possess low KCS, they might have been able to compensate using their mathematical content knowledge and ability to reason. Understanding how these domains are related helps with further refining the survey and interpreting the l psychometric findings.

Present Study

While Ball and colleagues (2008) developed this framework for mathematical knowledge of teaching, it is reasonable that the underlying assumptions hold true for all content areas. This study seeks to develop and pilot an instrument that assesses middle school ELA teacher content and pedagogical knowledge. In the present study content knowledge (CK) is operationalized as

the common and specialized knowledge that teachers need to adequately teach their students reading skills. Pedagogical knowledge (PK) refers to how the content is taught in the classroom.

There are currently only two known surveys that measure aspects of teacher knowledge of adolescent literacy (Duguay et al., 2016; Meyer, 2013), yet neither focus the content and pedagogical knowledge that has consistently been shown in research to be beneficial for teaching adolescent readers. As teacher knowledge measures can be used to determine and evaluate professional development as well as explore relations between teacher knowledge, instructional practices, and student outcomes, such a measure would add a valuable tool to the adolescent literacy field.

Research Questions

The goal of this dissertation is to develop items for a middle school ELA teacher knowledge survey answer the following questions:

1. Does the measure demonstrate adequate reliability?
2. What is the factor structure of the survey?
3. To what extent do teacher characteristics, such as (a) education, (b) certification, (c) years teaching experience, and (d) elementary certification relate to middle school ELA educator knowledge of teaching adolescent reading?

CHAPTER TWO

LITERATURE REVIEW

The Complex Needs of Adolescent Readers

The needs of adolescent readers are varied and nuanced (Cirino et al., 2011; Hock et al., 2009; Hock et al., 2011). To reach higher levels of proficiency students must be able to read longer, more complex texts, acquire vocabulary, build knowledge, and increase stamina (Goldman & Snow, 2015). Additionally, concerns about peer relationships and identity compete with already increasing academic demands, leading to a decline in reading motivation (Gottfried, 1985). While addressing the social and emotional needs of adolescents is beyond the scope of this dissertation, they must be acknowledged as playing a role in the reading development of adolescents.

To explore the needs of adolescent readers, Hock et al. (2009) administered measures of reading to 345 eighth and ninth grade students in the areas of word reading, fluency, vocabulary, and comprehension. Using a comprehension composite score, students were first identified and "proficient" readers (143 students) or "struggling" readers (202 students). It was found that 61% of students who were "struggling" scored statistically lower on every component of reading, including comprehension, and an additional 12% scored low on all reading component measures except word reading.

Brausseur-Hock et al. (2011) then used this same sample (Hock et al., 2009) and performed a latent class analysis. First, they found four empirically different levels of reading comprehension: struggling comprehenders (n=121), low average comprehenders (n = 74), average comprehenders (n = 72), and advanced comprehenders (n = 51). They then further examined the component skill profiles of students who had any level of comprehension

difficulty, identifying five distinct skill profiles. Almost 50% of students who were struggling comprehenders were found to have moderate global weaknesses, meaning they performed below-average on all measures, while about 40% of low average comprehenders were found to have a specific need in fluency. Overall, the low average comprehender group was found to be more heterogenous in performance across assessments than the struggling comprehenders, who were generally found to have difficulties in all areas.

Cirino and colleagues (2013) built on this knowledge base by using latent variables to identify the needs of adolescent readers with reading difficulties. When examining the factor structure of the assessments, a model with four factors had the best fit: decoding, fluency, comprehension, and comprehension/fluency. The assessments that fit into the comprehension/fluency factor were timed and required students to both read silently and show comprehension in some manner. For example, on the Test of Silent Reading Efficiency and Comprehension (Wagner et al., 2010), students have three minutes to read short sentences and decide if the statement is true or false. When analyzing student data, they also found heterogeneity. Overall, 68.2% of students scored below the 25th percentile in more than one domain. For example, 47% of participants displayed difficulties with decoding, yet only 0.83% had *only* a decoding weakness. Comprehension was the most common area of need, but few students (12%) had isolated comprehension deficits.

The needs of adolescents are heterogenous, and each individual student possesses different strengths and needs. As the expectations for reading increase, instruction must match the needs of the students to increase their capacity to read longer, more complex texts and acquire information independently. Extant research helps guide decisions about what areas to

investigate when considering the needs of adolescent learners. Numerous reading theories also provide insight into the component skills necessary for reading comprehension.

Cognitive Theories of Adolescent Reading Development

To help understand the reading process, researchers have developed theories that delineate components necessary for overall text comprehension. The section below describes three empirically tested frameworks that aid in understanding the complex nature of the reading process of the adolescent reader: the simple view of reading (SVR; Gough & Tunmer, 1986; Hoover & Gough, 1990), the direct and indirect effects of reading (DIER; Kim 2017; 2020a), and the direct and inferential medication model of reading (DIME; Cromley & Azevedo, 2007).

Simple View of Reading (SVR)

One model that has withstood empirical testing across contexts is the SVR (Gough & Tunmer, 1986; Hoover & Gough, 1990). The SVR states that reading comprehension is the product of decoding and language comprehension. It also contends that the model provides an explanation for three types of reading difficulties: (1) difficulties with decoding (dyslexia), (2) difficulties with linguistic comprehension (hyperlexia), and (3) difficulties with both (garden-variety reading disability) (Gough & Tunmer, 1986).

Hoover and Gough (1990) first investigated the multiplicative aspect of the SVR by studying a longitudinal sample of students in first through fourth grades, resulting in findings aligning with the SVR. At the end of first grade, decoding skills were relatively low while listening comprehension (a measure for linguistic comprehension) was at a third-grade level. However, average reading comprehension was at the first-grade level, showcasing multiplicative nature of the model. Additionally, they found evidence that the correlation between decoding and

reading comprehension diminishes as student's progress in school and that the correlation between linguistic comprehension and reading comprehension increases.

The SVR has been widely tested. Some studies have shown that decoding and linguistic comprehension almost completely explain the variance in reading comprehension (i.e., Kim, 2017, Kim, 2020c). Others, however, indicate that there is shared variance between decoding and linguistic comprehension that is unaccounted for in the SVR (Foorman & Petscher, 2018; Foorman et al., 2018; Lonigan et al., 2018).

Foorman and colleagues (2018) investigated the unique and shared variance of the SVR components for students in grades one through ten using a structural equation modeling approach. They found considerable shared variance between decoding and linguistic comprehension, ranging from 19% in Grade 4 to 46% in Grade 5. Starting in Grade 3, the unique contribution of decoding to reading comprehension diminished to <5% in Grade 5 and higher, while the contribution of language contribution increased. This is consistent with other findings (Adlof et al., 2006; Foorman et al., 2015; Kieffer et al., 2016).

Researchers have also investigated the suggested shared variance between decoding and linguistic comprehension through the lens of vocabulary (Braze et al., 2007; Braze et al., 2016; Ouellette & Beers, 2010; Protopapas et al., 2013; Tunmer & Chapman, 2012), fluency (Adlof et al., 2006; Kershaw & Schatschneider, 2012; Tumner & Chapman, 2012), and morphological awareness (Kieffer et al., 2016) with mixed results, suggesting that there may be component skills that contribute to both decoding and linguistic comprehension.

Overall, the SVR (Gough & Tunmer, 1986) remains an empirically validated and widely used and accepted framework in reading. However, understanding and recognizing the skills that are encompassed within the two constructs of decoding and linguistic comprehension continue to

be areas of exploration. It is also important to remember that SVR was not intended to be a model used for instructional purposes or to provide a complete theory of all the underlying factors that go into reading comprehension. Rather, it was designed to be "a model of proximal causes of individual differences" (Tunmer & Chapman, 2012, p. 454), which is the basis for which instructional and intervention decisions may be made.

Direct and Indirect Effects Model of Reading (DIER)

While the SVR (Gough & Tunmer, 1986) provides a broad view of what constitutes reading comprehension, the direct and indirect effects model of reading (DIER; Kim, 2017, 2020a) seeks to expand the SVR by identifying the specific skills that are needed for linguistic (listening) comprehension and decoding (word reading). Based on her previous work with component skills for listening comprehension (Kim, 2015; 2016; Kim et al., 2014) and fluency (Kim et al., 2011; Kim et al. 2012; Kim et al., 2014; Kim & Wagner, 2015) as well as extant research in other domains, Kim (2017) hypothesized a model that seeks to extend the SVR by including multiple factors (e.g., working memory, background knowledge, motivation) that research suggests contribute to reading comprehension. Additionally, the model includes a hierarchical structure that shows direct and indirect relations between the various skills and concepts. For example, the distal skills of vocabulary and grammatical knowledge (labeled as Foundational Oral Language) support making inferences, reasoning, perspective taking, and monitoring (labeled as High Order Cognitions & Regulation), which then support the proximal skill of Listening Comprehension. Underlying the whole framework are domain-general cognitions and executive function (see Kim, 2020a, p. 470 for visual).

Kim (2017) developed this model using data from 350 English-speaking students in Grade 2 and extant research. The goal of this study was to examine hypothesized pathways among and between reading comprehension component skills. Four models were tested using structural equation modeling, and the current DIER model was found to be the best fit. Importantly, this study further validated the SVR by finding that "word reading and listening comprehension completely mediated the relations of the language and cognitive component skills to reading comprehension" (p. 325) while also concluding that the component skills that make up each of these constructs are hierarchical and related.

Since the conception of DIER, Kim has worked to further validate this model (Kim 2020a, 2020c, 2023). In one study (Kim 2020c), she found that both listening comprehension and word reading were strongly and similarly related to reading comprehension in Grade 2, while in Grade 4 listening comprehension was strongly correlated to reading comprehension while word reading only had a moderate relation, supporting the SVR. She also found that the indirect effect of vocabulary on reading comprehension increased from Grade 2 to Grade 4, while the indirect effect of grammatical knowledge decreased, showcasing the importance of vocabulary instruction as students progress through school.

In another study, Kim (2023) examined the shared variance between word reading and listening comprehension. She found that, for Grade 1 students, morphological awareness was the sole emergent literacy skill that was independently related to both constructs over and above the other emergent literacy skills and executive functions. This implies that the shared variance between word reading and listening comprehension can be predominantly explained by their mutual dependence on morphological awareness.

Consistent with prior research on adolescent reading comprehension, the DIER framework suggests that inference generation, vocabulary, and comprehension monitoring all have a direct impact on listening comprehension, which then directly affects reading comprehension. Additionally, it shows that background knowledge impacts reading comprehension both directly and indirectly through listening comprehension.

Direct and Inferential Mediation Model of Reading (DIME)

While the DIER model of reading seeks to explain a holistic view of reading comprehension, including working memory and motivation, the direct and inferential mediation model of reading (DIME) seeks to explain the contribution of reading components, such as background knowledge, inference generation, and reading vocabulary on reading comprehension specifically for adolescent readers (Cromley & Azevedo, 2007). It was developed based on a literature search of experimental studies that investigated the mutual effects of these five domains. When building the path diagram for the model, a direct effect had to be supported by at least one true experimental study conducted with adolescents and published in a peer-reviewed journal. Using these criteria, it posits that background knowledge has both a direct and indirect effect on reading comprehension. First, background knowledge is hypothesized to have a direct effect on utilizing strategies and making inferences, which in turn directly impacts reading comprehension. Second, background knowledge correlates with vocabulary and word reading, which both directly impact reading comprehension. The model also demonstrates the interaction across these domains. For example, utilizing comprehension strategies and vocabulary directly affects reading comprehension while also indirectly impacting comprehension through making inferences, which has a direct effect on comprehension. Word reading, which includes fluency, impacts comprehension both directly and indirectly through vocabulary.

To test the DIME model, Cromley and Azevedo (2007) assessed 177 ninth-grade students with a wide-range of reading comprehension proficiency levels. The assessments covered the domains set forth in the model, including a mixture of researcher-created and standardized measures. They then compared the model fit of four different models and found that the original model had the best fit and explained 66% of the variance in read comprehension. Furthermore, in the model, background knowledge and vocabulary made the largest total contributions to reading comprehension. Reading vocabulary had a total effect of .41 and background knowledge had a total effect of .34. Overall, the findings of this study were consistent with prior research in these components.

Ahmed and colleagues (2016) also evaluated the DIME model by giving a battery of assessments to 1196 students in grades 7-12. Replication of the DIME model provided an excellent fit using observed variables. However, since the sample included students across grade-levels, more in-depth analysis was done pertaining to the varying components at the different levels. They found that vocabulary predicted reading comprehension at all grade levels, and inference in all but Grade 11. Background knowledge, utilizing strategies, and word reading were significant at some grade levels but not in others. Additionally, no mediation effects were significant in this model.

The authors then utilized latent variables to attempt to explain the variance in inference-making, as component skills in the original model explained 13-20% (Ahmed et al., 2016). This model explained 70-98% of the variance in inference-making and found, consistent with the other models, that vocabulary and background knowledge make the largest contribution to inference-making. This suggests that students with larger vocabularies and more in-depth

background knowledge are better able to make inferences, which in turn helps overall reading comprehension.

Overall, the DIME model echoes many of the components of the DIER model, but in a more simplistic way that focuses on adolescent learners. Both include background knowledge, inference generation, vocabulary knowledge, strategy use, and word reading as being related, directly or indirectly, to reading comprehension. The overlap in these three theories and the subsequent research help guide what might be essential skills for adolescent readers. Additionally, the components of these models help identify what might be areas of need for striving adolescent readers that are more specific than general reading comprehension.

Evidence-based Content and Pedagogical Knowledge

These theories and extant research suggest that there are component skills, such as background knowledge, generating inferences, and word reading, that contribute to reading comprehension. In addition, standards, such as those set for by the National Board of Teaching Standards and National Council of Teachers of English, help guide what knowledge middle school ELA teachers are expected to know. This section will outline what components are necessary for reading comprehension and why, and what pedagogical knowledge might be integral for student success.

Evidence-based Pedagogy: Explicit Instruction

Explicit instruction, which includes modeling and making ones thinking visible with repeated opportunities for practice and feedback, is the backbone of pedagogical knowledge for ELA teachers. This practice is highlighted across guidance documents for adolescent literacy. For example, Kamil and colleagues (2008) recommend “explicit vocabulary instruction” and “direct and explicit comprehension strategy instruction” (p. iii) as part of their guide on

improving adolescent literacy. Torgeson et al. (2007) recommend that teachers "provide explicit instruction and supportive practice in the use of comprehension strategies" (table of contents) in their guide to instructional practices, and Vaughn and colleagues (2022) use phrases such as "explicitly build" (p. 22), "explicitly model" (p. 26), and "explicitly teach" (p. 37) throughout their practice guide.

Langer's (2001) influential study examined instruction in middle and high schools that were "beating the odds" in terms of high-stakes test performance and schools that were "typically performing" over a 5-year period. During this time, field researchers spent about 5 weeks at each school collecting qualitative data, such as interviews, observations, and documents. Among the findings were that "(a)ll of the more successful teachers overtly taught their students strategies for organizing their thoughts and completing tasks, whereas only 17% of the more typical teachers did so" (p. 868). Similarly, Keene (2002) analyzed teachers in grades 1 through 12 and found that highly effective teachers engaged in explicit instruction utilizing the gradual release of responsibility; in this model, the teacher first models the skill or strategy, then the students and teacher do it together with feedback, and, finally, the students engage with the skill or strategy independently.

More recently, Goodwin and colleagues (2021) utilized data from 8,844 fourth and fifth graders to examine what aspects of classroom talk might impact reading comprehension. They found, based on classroom observations, that higher ratings of teacher explanation and questioning predicted higher scores on reading comprehension assessments. They postulate that this might be because these strategies, explaining and questioning, allow space to "model and scaffold effective language" (p. 40). This study built on the prior work of Michener and colleagues (2018) who reported that teacher explanations and simple follow-up moves, such as

evaluations and explanations, significantly predicted reading comprehension. Most of the observed teacher explanations were rooted in explicit vocabulary instruction. The authors suggest that this type of vocabulary instruction may increase reading comprehension because it is exposing students to academic language and may act as a linguistic scaffold.

While there is breadth and depth in the research base about explicit instruction itself, there is very little research on how teachers are utilizing these practices, and why or why not that may be. Ciullo et al. (2016) found that in middle school classrooms, the most used evidence-based practice used in the classroom was explicit student feedback; however, worksheets and individual student books dominated classroom instruction. Stark and colleagues (2024) report that elements of explicit instruction occurred in almost every observed lesson across content areas in middle schools. The most frequent element of explicit instruction included was providing some form of explicit explanation (86% of lessons), while teacher modeling was the least utilized (37% of lessons). Overall, however, 90% of the observed time students were not engaging with text or being provided with evidence-based literacy instruction. One explanation for the overall lack of explicit instruction is that teachers have difficulty providing instruction in areas where they have little understanding (Moats, 2009). That is, even if a teacher has sound pedagogical knowledge, a lack of content knowledge could still lead to ineffective instruction. Moreover, teachers may not have an understanding in what effective instruction entails. Therefore, it is necessary to define not only *what* middle school ELA teachers should be teaching (i.e., content knowledge), but also *how* (i.e., pedagogical knowledge).

Evidence-based Content and Pedagogy

When considering middle school ELA teacher knowledge of reading, it is important to define the constructs of content knowledge and pedagogical knowledge in this context. Here,

reading is broken into two domains: word knowledge and reading comprehension. Following reading theories (i.e., DIER and DIME) and extant research, each domain then is broken into sub-domains that research suggests contribute to overall text comprehension. Content knowledge is the common and specialized knowledge of English and reading that teachers may need to know to be effective while pedagogical knowledge is how that content is then subsequently taught to students. To help provide context, the following sections provide an overview of the research associated with the domains of requisite ELA teacher knowledge.

Word Knowledge. The word knowledge domain encompasses multisyllabic word decoding, and vocabulary. Morphology is a sub-domain under both word reading and vocabulary in the word knowledge construct.

Morphology: Content Knowledge. As students progress in school, most of the words that they will encounter in texts will be multisyllabic (Anglin, 1993; Nagy & Anderson, 1984). Multisyllabic words are made up of multiple morphemes, the smallest unit of meaning in language. Sixty to eighty percent of words in secondary texts are morphologically complex, meaning that words contain multiple morphemes that carry meaning (e.g., un + kind + ness = unkindness; Anglin, 1993; Nagy & Anderson, 1984). Given the number of individual words that students must learn to comprehend text (170,000 to 200,000), it is imperative that students be able to problem solve words on their own.

Morphological awareness, the understanding that morphemes carry meaning, is linked to both decoding and listening comprehension and is delineated as such in the DIER model of reading (Kim, 2020a). Several studies have demonstrated that morphological awareness contributes positively to word reading in adolescents (Carlisle & Stone, 2005; Deacon et al., 2017; Goodwin et al., 2013; Nagy et al., 2006; Singson et al., 2000). For instance, Carlisle and

Stone (2005) found that both lower and upper elementary students read two-syllable words that were made up of two morphemes (e.g., shady) more accurately than one morpheme words (e.g., lady) when the words were matched on spelling, word length, and word frequency. This suggests that the recognition of common base morphemes may facilitate reading of derived words (i.e., base word with one or more affixes; shade + y = shady). Similarly, Goodwin and colleagues (2013) found that adolescents who were able to read a base word were significantly more likely to be able to read a related derived word. They also found that as the frequency of a base word increased, so did students' ability to read words derived from it. These results suggest that reading accuracy and speed is influenced by the morphological structure of a word and its base frequency (see also Carlise & Katz, 2006; Deacon et al., 2017; Mann & Singson, 2003).

Studies have also shown the morphological awareness may explain shared variance between decoding and listening comprehension (Kieffer et al., 2016; Kim 2023). Deacon and colleagues (2017) sought to understand the contributions that morphological structure awareness (i.e., awareness of morphological structure in words), morphological decoding (i.e. using morphemes to read a word), and morphological analysis (i.e. using morphemes to derive the meaning of the word) make to reading comprehension. They found that, together, all three dimensions accounted for 8% of the variance in students' reading comprehension. Additionally, although morphological decoding and morphological analysis explained unique variance in reading comprehension, morphological structure awareness did not go beyond that of morphological decoding and analysis. The authors concluded that students used morphological decoding to read infrequent words and morphological analysis to understand them.

Research indicates that understanding the morphological composition of words contributes to both decoding and comprehension (Goodwin & Ahn, 2013). Therefore, to provide

morphological instruction teachers should have a working knowledge of (1) what morphemes are, (2) how to decompose words into morphemes, and (3) how to use those morphemes to decode and define words. This knowledge corresponds with the dimensions of morphology that contribute to reading comprehension (Deacon et al., 2017).

Morphology: Pedagogical Knowledge. Bowers et al. (2010) performed a systematic review examining the impact of morphological interventions on lexical levels from pre-school to Grade 8 among 22 studies. They found the strongest effects (d = 0.65) on word part outcomes, with weaker effects on reading (d = 0.41) and vocabulary (d = 0.35). Goodwin and Ahn (2013) examined the effects of morphological instruction on literacy outcomes in students in preschool through Grade 12 and found an effect size for middle school students of d = 0.34. Additionally, they also found that morphological instruction positively and significantly impacts decoding and vocabulary.

While increasing evidence indicates the importance of morphological instruction, there is less consensus in research about what morphological instruction should look like in the classroom. Pacheco and Goodwin (2013) investigated how Grade 7 and 8 students problem solve morphologically complex words. They found that the most widely used strategy was what they call a Parts-to-Whole strategy, where students used multiple morphemes (i.e., prefixes, suffixes, and roots) to derive the meaning of the word.

With this understanding, Goodwin (2016) devised a short-term intervention for grade 5 and 6 students that integrated morphological problem-solving with comprehension strategy instruction. During instruction, students were taught to problem solve unfamiliar words by identifying the individual morphemes in the word and then put those parts together to create meaning. Finally, the students were encouraged to put the word back into context to confirm if

the definition made sense. This was followed with games that reinforced the morphological nature of words, such as *Word Webbing* where students brainstormed words with the same root, and *Find the Imposter* where students were given a target word and asked to circle all the words that shared the same root or affix. After four sessions, students who received this instruction outperformed students who did not in the areas of vocabulary knowledge and generation of morphologically related words. These results highlight the positive impact of using a flexible approach to word learning that includes morphological instruction.

Many multi-component interventions for adolescents also include morphological components. Academic Language Instruction for all Student (ALIAS; Lesaux et al., 2010; Kieffer & Lesaux, 2012; Lesaux et al., 2014) focuses on teaching derivational suffixes, which change the grammatic category of the word (e.g., slow to slowly). Alternatively, Robust Academic Vocabulary Encounters (RAVE; McKeown et al., 2018) focuses on teaching bound Latin roots, such as *fin* in *finite*. These roots are explicitly taught using words that are in the program's texts. These interventions are discussed in more detail in the section on vocabulary, as they are designed to increase academic vocabulary.

While these interventions teach morphology in varying ways, all programs provide explicit instruction in morphemes and support students in problem-solving words by identifying and using those morphemes. While there is no consensus on the best way to teach morphology, research suggests that (1) common prefixes, suffixes, and roots should be explicitly taught, (2) students should be taught to analyze words by breaking them down into their morphological parts, and (3) associations between and among words should be leveraged.

Decoding Multisyllabic Words: Content Knowledge. Being able to read words accurately and fluently is essential to comprehension, yet about one quarter of adolescents lack

the automaticity to do so (Cirino et al., 2012; Hock et al, 2009), and instruction in multisyllabic words is not evident in many classrooms beyond second grade (Toste et al., 2019). This is problematic, as students who are unable to decode proficiently by third grade are likely to continue to have difficulties with reading throughout their lives (Brasseur-Hock et al., 2011; Vaughn et al., 2003). Therefore, it is necessary that teachers understand (1) the need for such instruction, (2) what that instruction entails, and (3) how to provide it.

Older students who are working towards automatically reading multisyllabic words are often able to read single-syllable words accurately and fluently, as well as bisyllabic and trisyllabic words that have phoneme/grapheme correspondence (Bhattacharya, 2020; Toste et al., 2019). However, these same students have more difficulty when they come across words that are morphologically complex and do not have one-to-one phoneme/grapheme correspondence. Students need to be taught how to use both the morphological information (Kearns & Whaley, 2018; Wade-Woolley & Heggie, 2015) and flexible syllabication (Kearns, 2020; Kearns & Whaley, 2018) to read these words.

It then follows that teachers must understand how to morphologically decompose a word as well as how to use flexible syllabication themselves. To do this, educators must know (1) the definition of a syllable and (2) how to divide a word into syllables.

Decoding Multisyllabic Words: Pedagogical Knowledge. To best teach students how to read multisyllabic words, educators should choose a routine that can be used in any context (Vaughn et al., 2022) and includes both morpheme- and syllable-based approaches (Kearns & Whaley, 2019). One such routine is described in the IES Practice Guide on Interventions for Students in Grades 4-9 (Vaughn et al., 2022). First, students find and circle the affixes in a word (**un**reason**able**). They then underline the vowel sounds (**un**r<u>ea</u>s<u>o</u>n**able**). Next, they loop under

each part of the word as they say it (un-rea-son-able) and then finally blend it all together. Having a routine alone is not enough for students to become fluent multisyllabic word readers. In addition, the practice guide states that students should have practice reading word lists, sentences, and longer texts that include the target words. Finally, encoding practice should be included. Spelling practice will help reinforce the patterns that the students are learning (e.g., vowels, prefixes, suffixes, roots).

There is some debate about whether to include syllabication rules when teaching students to read multisyllabic words. They are not included here as Kearns (2020) studied the most common vowel (V) and consonant (C) structures – VCV and VCCV – and whether or not syllable division as they are taught - V|CV and VC|CV – work consistently. Kearns examined 14,844 words that occur in texts for school-age readers and found that while the VCCV pattern followed the syllable division rule most of the time, especially in bisyllabic words, the VCV pattern is more often an exception to its own rule. He concludes that "the data suggest that there is really no V|CV division pattern at all," (p. S153). Students should, instead, he argues, be taught how to use vowels flexibly, including long, short, and reduced vowel sounds.

This is not to say, however, that syllables are not taught. Indeed, Kearns himself suggests using syllables to help students read multisyllabic words (Kearns & Whaley, 2019). However, it is done in a more flexible manner. To identify syllables, two pieces of information are needed. First, syllables almost always have a vowel, so those are identified. Second, every part of the word must look okay. That means that each part needs to start and end like monosyllabic words do. For example, *-ck* stays together, and syllables cannot begin with consonant clusters that monosyllabic words would not start with. For example, monosyllabic words commonly end with *-ck* (e.g. back), but words do not ever begin with -ck in English. From there, students are taught

to try different vowel sounds, including the schwa sound. This aligns with the above suggested routine (Vaughn et al., 2022).

Vocabulary: Content Knowledge. As students become more proficient readers, vocabulary becomes a key contributor to reading comprehension (Torgesen et al., 2007), as there is no understanding if word meanings are unknown. The DIER (Kim, 2020a) and DIME (Cromley & Azevedo, 2007) frameworks hypothesize that vocabulary predicts higher order cognitive tasks, such as making inferences. That is, comprehension of a text cannot exceed known vocabulary. Ahmed and colleagues (2016) reported that vocabulary knowledge predicts reading comprehension at all grade levels. As such, vocabulary knowledge "plays a primary role in explaining individual differences in adolescent reading comprehension" (Oslund et al., 2018, p. 355).

Vocabulary not only impacts reading comprehension directly, but it also impacts reading efficiency (Dixon et al.,1988) and oral reading fluency (Rose & Rouhani, 2012). Dixon and colleagues (1988) studied the relation between known vocabulary, the speed at which that word can be retrieved (i.e., reading efficiency), and skilled reading. They found that a reader's vocabulary continues to be a significant contributor to overall reading, even for skilled readers. Their results suggest that even after a word is learned it can continue to become even more automatic, making its retrieval easier and faster over time. In addition, Rose and Rouhani (2012) found that expressive vocabulary was a significant predictor of oral reading fluency in adolescents. Given the impact of vocabulary on a variety of reading processes, it is important for educators to know and understand how to approach teaching vocabulary in the classroom.

Morphological awareness has been linked to vocabulary growth (Kieffer & Lesaux, 2012; Nagy et al., 2013). There is evidence to suggest that when students are taught to analyze words

using knowledge of morphological units (e.g., prefixes, suffixes, roots), they can problem solve an average of three additional words for each new word learned (Nagy & Anderson, 1984).

Morphological instruction alone is not sufficient. Some words that are integral to understanding texts and topics and should, therefore, be explicitly taught. When considering what words should be taught, teachers should identify Tier Two and Tier Three words (Beck et al., 2002). In this system, Tier One words are those that are very frequent and that students generally have in their oral vocabulary. Tier Two words are those that are less frequent but are used across content areas (e.g., analyze, evaluate, or inform). Tier Three words are those that are content specific that students may need to know to understand a concept (e.g., photosynthesis, inauguration). Beck and colleagues (2002) note that:

> One 'test' of whether a word meets the Tier Two criterion of being a useful addition to students' repertoires is to think about whether the students already have ways to express the concepts represented by the words. Would students be able to explain these words using words that are already well known to them? If that is the case, it suggests that the new words offer students more precise or mature ways of referring to ideas they already know about (p. 212).

Being able to identify Tier Two words is necessary content knowledge for teachers.

Finally, understanding how to use and teach context clues is an important element of vocabulary instruction. Context clues are markers in the text that help readers to determine the meaning of unknown words. Sometimes reading sentences around the unknown word can aid in understanding (Vaughn et al., 2022). Teachers should be able to use context clues themselves so that they are able to model this strategy for their students.

Vocabulary: Pedagogical Knowledge. Many studies have examined how to increase academic vocabulary knowledge, or the specialized vocabulary which is used in educational settings and academic texts. These studies have leveraged both morphological instruction and word-specific instruction (Crosson et al., 2021; Lesaux et al., 2010; Kieffer & Lesaux, 2012; Lesaux et al., 2014; McKeown et al., 2018). ALIAS (Lesaux et al., 2010; Kieffer & Lesaux, 2012; Lesaux et al., 2014) focuses on derivational suffixes and teachers explicitly teach suffixes that are used frequently in academic vocabulary. They introduce the suffix and multiple words that use that same suffix (e.g., -al and -ical with accidental, magical, and musical) and lead the class in a discussion about what the words could mean based on their roots. Next the teacher explicitly states the function of the suffix and models how this new suffix can be combined with previously taught words (e.g., cultural). Finally, students generate or find examples of other words that use the target suffix. After 18-weeks students who received instruction using the ALIAS program outperformed their peers in the areas of meanings of taught vocabulary words, morphological awareness, and word meaning within the context of an expository text (Lesaux et al., 2010).

Additionally, McKeown and colleagues (2018) and Crosson and colleagues (2021) studied the impact of RAVE and English Learner's RAVE (EL-RAVE). Both programs include teaching bound Latin roots (e.g. *fin* in *finite*). Latin roots are prevalent in academic vocabulary, so having knowledge of the roots should, theoretically, increase overall vocabulary knowledge. In this program, words are explicitly taught alongside their roots (e.g., reg in regulate). Overall students who received this instruction were better able to apply the meanings of the roots to infer the meanings of unfamiliar words (McKeown et al., 2018) and improved their overall vocabulary knowledge and morphological analysis skills (Crosson et al., 2021).

Both ALIAS (Lesaux et al., 2010) and RAVE (McKeown et al., 2018) include word-specific vocabulary instruction alongside morphological instruction. Research indicates that once words are chosen for instruction, they need to be explicitly taught with multiple exposure to the words (Swanson et al., 2017; Scammacca et al., 2007; Torgeson et al., 2007). Before reading, teachers should provide a brief, student-friendly definition of the word along with an example, a non-example, or a visual representation of the word (Vaughn et al., 2022). Additionally, students should have multiple exposures to the word throughout the unit for additional practice (Vaughn et al., 2022).

In RAVE (McKeown et al., 2018) the target words are introduced and shown in multiple contexts to show how a word is used in various domains. A student-friendly definition is then used, and students are asked questions about how the meaning of the word fits the context. These words are then encountered in subsequent lessons and activities are designed to build awareness of the words semantic features.

Overall, teachers need an understanding of the morphological structure of words and how it contributes to both word reading and vocabulary. Additionally, they need to be familiar with how to choose word-specific vocabulary words for explicit instruction and evidence-based approaches to teaching generative and word-specific vocabulary.

Evidence-based Content and Pedagogy: Reading Comprehension. The reading comprehension construct encompasses building knowledge, generating inferences, finding the main idea and summarizing, and monitoring comprehension.

Building Knowledge: Content Knowledge. The relationship between background knowledge and reading comprehension is clearly delineated in both the DIER (Kim, 2017) and DIME (Cromley & Azevedo, 2007) models of reading. Additionally, building new knowledge is

highlighted as an essential contribution to reading comprehension in both teaching standards and guides for instruction (Vaughn et al., 2022; Torgeson et al., 2007). Students have difficulty understanding a text if they do not have working knowledge about the topic. Kaakinen and colleagues (2003) examined how prior knowledge and working memory capacity influence text processing. Their results suggest that if prior knowledge and working memory are present, then new text can be put into memory without any extra processing time. However, when participants read texts about subjects that they had no background knowledge on (e.g. an uncommon disease), they were more likely to reread previous parts of the text to gain understanding. Thus, processing is slower and more laborious when there is a lack of background knowledge.

Recht and Leslie (1988) also studied the effect of background knowledge on text comprehension. In their study 64 seventh- and eighth-grade students were divided into four equal sized groups based on reading ability (high or low) and prior knowledge about baseball (high or low). Each participant then read an account of a half inning of baseball. After reading, students were asked to recall what they read both nonverbally, by moving figures, and verbally. They found that there was a significant effect for prior knowledge. On all measures, students who had prior knowledge of baseball recalled more than those who were less knowledgeable. Greater knowledge also resulted in better recognition of important ideas and better written summaries. Importantly, the knowledge x reading ability interaction was not significant. That is, reading ability did not replace prior knowledge. Recht and Leslie conclude that "it appears therefore that knowledge of a content domain is a powerful determinant of the amount and quality of information recalled, powerful enough for poor readers to compensate for their generally low reading ability" (p. 19).

Not only does prior knowledge influence reading speed and comprehension, but it also predicts future knowledge building. Hambrick (2003) conducted a longitudinal study pertaining to basketball knowledge. He found that both interest and knowledge play a role in acquiring new knowledge. The more knowledge a person had about basketball, the more likely they were to be interested in basketball, leading to more basketball related exposure. As a person's interest in a subject increases so does their knowledge due to their engagement in activities surrounding that subject. He also found that people who already knew a lot about basketball tended to remember more about basketball-related news and information, thus suggesting that prior knowledge leads to more understanding and new knowledge.

As knowledge is integral to reading comprehension, teachers may need to understand the importance of building knowledge as well as recognize when they are applying their own knowledge to building new knowledge.

Building Knowledge: Pedagogical Knowledge. Building knowledge for students does not have to be complex. Vaughn et al. (2022) provide a number of pedagogical considerations, including providing a brief introduction to the topic before reading. This can be done by watching a short video clip, listening to a podcast, or showing images. Shorter, easier texts on the topic can also be provided before introducing more complex ones. Teachers may also ask students questions about the topic and given students time to discuss.

Another way to determine what students already know about a topic is to use an anticipation guide (Kozen et al., 2006). Anticipation guides are short statements about a topic or text that encompass the main ideas and are either true or false. They can be completed individually, in pairs, or in groups. The students then engage in reading the text(s) or participating in the unit. After reading, they come back to their anticipation guide and either

maintain or change their original thoughts. However, now they support their thinking using evidence from the text. To create an anticipation guide teachers must be able to determine the most important information or ideas from a unit, identify confusions that student may have, adjust instruction based on the level of background knowledge that students exhibit, and explicitly teach the content.

Background knowledge has been shown to influence other reading comprehension component skills such as generating inferences (Barth & Elleman, 2017; Elbro & Buch-Iversen, 2013) and vocabulary knowledge (Elleman et al., 2009). Given that background knowledge is important for both reading comprehension of a given text and for learning new information, teachers must be knowledgeable about how to both build new background knowledge and leverage knowledge funds that already exist.

***Generating Inferences*: *Content Knowledge*.** Generating inferences involves combining the content presented in a text with ones' background knowledge to understand information that is not explicitly stated in the text or using information to connect parts of a text together. Barth and colleagues (2015) studied the ability of typical and at-risk comprehenders to generate inferences across Grades 6 to 12. They concluded that the ability to make inferences increased as students aged and that it uniquely predicted both sentence-level and passage-level comprehension after controlling for other factors. These findings align with prior research done with adolescent readers (Cromley & Azevedo, 2007; Elleman, 2017; Fritschmann et al., 2007).

When reading, two types of inferences are made: text-based inferences and knowledge-based inferences (McKoon & Ratcliff, 1992). Text-based inferences link new information in the text to what was previously read, while knowledge-based inferences integrate information in the text with one's background knowledge of the topic. Both types of inferences help readers to fill

in the gaps in what is being read and construct both sentence-level and discourse-level meaning (Barth & Elleman, 2017).

Content knowledge here is two-fold. First, teachers are expected to be able to generate both text-based and knowledge-based inferences. Second, teachers need an understanding of what an inference is and the metacognitive process that goes into connecting necessary information to make an inference. If teachers are not aware of this process, they cannot model this for their students, which is an essential part of explicit instruction.

Generating Inferences: Pedagogical Knowledge. To date, there are few known studies that specifically examine the effects of explicit inference instruction on students in Grades 6 to 8 (e.g. Barth & Elleman, 2017; Elbro & Buck-Iversen, 2013; Fritschmann et al., 2007; Hall et al., 2020; Reed & Lynn, 2016). However, there are others that integrate inference generation with other types of instruction (e.g., Dimitrov et al., 2012; Fogarty et al, 2017; Hock et al., 2017). To examine the impact of teaching students with learning disabilities a five-step strategy for answering inferential questions, Frischmann et al. (2007) employed a single-case design. They report that students made significant gains on both criterion-based and standardized measures of reading comprehension, increasing their reading level by an average of 2.8 grade-levels.

Elbro and Buck-Iversen (2013) explored the idea that students have the necessary knowledge to make inferences but do not activate it (see Oakhill & Cain, 2007). To address this, they provided sixth grade general education students with eight sessions on how to activate their background knowledge and marry it with what was in the text to make inferences. This was done using short expository texts and graphic organizers that asked students to supply their own background knowledge and evidence from the text to support inference generation. The

intervention was found to benefit all learners, with an initial average effect size of d = .69 that was maintained five weeks after the treatment.

Barth and Elleman (2017) studied the effects of explicit instruction of inference generation for middle school readers who did not meet state proficiency levels. Explicit instruction was comprised of four categories: (1) using text clues to determine the meaning of unknown words; (2) activating background knowledge to make connections within the text, between texts, and between texts and their own knowledge; (3) making inferences about character motivations; and (4) answering inferential questions. Students received this instruction in small groups for 45 minutes a day over a total of ten days. Results indicate that there were significant treatment effects on a proximal measure of content knowledge and a more distal standardized measure of overall reading comprehension. These findings suggest that inference generation can be taught and maintained in a fairly short period of time, aligning with the previous findings (see Elleman, 2017).

Hall and colleagues (2020) examined the effects of a small group inference generation intervention on Grade 6 and 7 students who were below-average readers, and the majority of whom had limited English proficiency. The intervention utilized the novel *Wonder* (Palacio, 2012) and was conducted over 24 sessions. For the first 10 sessions, students were explicitly taught how to generate different types of inferences and find evidence for their thinking. For the remaining 14 sessions, stopping points were provided in the novel where students would refer to the next inference question. Overall, results showed that students, on average, who participated in the intervention increased their reading comprehension when compared to the comparison group (d = 0.60). This effect size is important, as it is substantially larger than those reported in previous meta-analyses (Scammacca et al., 2015; Hall et al., 2017).

Given the importance of being able to make inferences to understand texts, teachers must have the pedagogical knowledge to instruct their students in devising both text-based and knowledge-based inferences. These studies provide some insight in how to do that. While there is no consensus in the field about what instruction should look like, Elleman (2017) conducted a meta-analysis on inference instruction and found that "(m)any of the studies in this review provided explicit instruction in finding pertinent information in a text and integrating it with prior knowledge to answer inferential questions" (p. 772). To that end, there is consensus that making inferences should be taught explicitly, with scaffolds such as graphic organizers being used as necessary (Barth & Elleman, 2017; Elbro & Buck-Iversen, 2013; Fritschmann et al., 2007; Hall et al., 2020).

When explicitly teaching students to generate inferences, there are a variety of graphic organizers that may be used. One, used in Elbro and Buck-Iversen's study (2013), has boxes that prompt students to write down their own knowledge about a topic as well as literal knowledge from the text. Taken together, students were better able to generate an inference about the topic. Another graphic organizer includes a place for an overarching question, what the text says in relation to the question, what the student already knows about the topic in the questions, and a place for the answer to the question - an inference (Hennessy, 2021).

The important takeaways for teacher content and pedagogical knowledge are that (1) the ability to infer is closely related to one's background knowledge about a topic (Hall, 2016), (2) inference generation is related to reading comprehension, and that relationship increases as students progress in school (Tighe & Schatschneider, 2014), (3) generating inferences can be taught (Barth & Elleman, 2017; Elbro & Buck-Iversen, 2013; Fritschmann et al., 2007; Hall et

al., 2020), and (4) inference instruction should be explicit and integrated with prior knowledge (Elleman, 2017).

***Main Idea and Summarizing*: *Content Knowledge*.** Finding the main idea of a text and subsequently writing a summary is a ubiquitous skill found in almost any set of state standards (e.g. Virginia Standard of Learning 6.6 b: Identify main idea and 6.6 c: Summarize supporting details; Virginia Department of Education, 2022), and has been identified as an effective practice for improving adolescent's reading comprehension (Biancarosa & Snow, 2006; Kamil et al., 2008; Vaughn et al., 2022). Though this skill is taught in multiple grade levels, many students still struggle to make meaning from the text while both determining what is the most important information versus what is irrelevant information (Stevens & Vaughn, 2020).

One review conducted by Stevens and colleagues (2019) found that summarizing and main idea interventions for striving readers in Grades 3 through 12 found an overall mean effect size of 0.97. Of note is that this significantly decreases when accounting for standardized versus unstandardized measures. When considering only standardized measures, the results showed negative, small effects and positive, small effects. This suggests that students are gaining the ability to generate main ideas and summaries but are not yet able to generalize that skill to a broader comprehension measure. The moderator analysis for grade level found no difference in the effectiveness for students in elementary versus middle and high school grades, meaning that this type of instruction is beneficial for all striving adolescent readers. This review also pointed out the potential impact of text structure instruction on improving main idea generation and summarizing.

To effectively teach students how to find the main idea of a text and write a subsequent summary, teachers much be able to not only find the main idea of the text themselves but also be

able to model how to do so for the students. Additionally, teachers must understand where students may struggle and be prepared to provide scaffolds such as using text structure. Finally, educators should be adept at matching this strategy with texts that start out with more apparent main ideas before moving on to texts where the main idea is not as clear.

Main Idea and Summarizing: Pedagogical Knowledge. One specific strategy for main idea generation that has been well researched is called Get the Gist (e.g. Klinger et al., 1998; Stevens et al., 2020; Swanson et al., 2017; Vaughn et al, 2011). Get the Gist is used as part of multicomponent reading intervention (collaborative strategic reading; CSR) that aims to increase students' text comprehension (Klinger et al., 1998; Vaughn et al., 2011; Vaughn et al., 2013). Get the Gist involves paraphrasing sections of the text. Students are asked to stop after one of two paragraphs and ask themselves, "What or who is this section mostly about?" Once they've determined the topic, they then ask themselves, "What is the most important idea about the who or the what?" After they've determined the important information, they put the answers together to for their gist statement (Stevens & Vaughn, 2020).

When Get the Gist was included in instruction for students in Grades 7 and 8, those who received the instruction significantly outperformed their peers who did not on a standardized reading comprehension measure (Vaughn et al., 2011). Additionally, Stevens and colleagues (2020) examined the effects of incorporating text structure instruction and Get the Gist for students with reading disabilities in Grade 4 and 5 and found that utilizing text structure to help determine the gist was effective at increasing students' ability to generate main ideas.

Having the content knowledge of what a main idea is and being able to generate a gist statement is not enough. Teachers must know how to convey the steps for determining the main

idea to their student. It should be clearly modeled and scaffolded with an instructional routine, such as Get the Gist, that can be used across content areas.

Monitoring Comprehension: Content Knowledge. To be successful readers, students should be able to independently gain information from what they are reading. To do this, they need to be aware of their own comprehension and recognize when the text does not make sense (Vaughn et al., 2022). Monitoring comprehension has been shown to increase reading outcomes in adolescents when it is explicitly taught and scaffolded (Fogarty et al., 2017; Kim et al., 2016; Vaughn et al., 2019). Teachers must understand the importance of teaching students how to monitor and use strategies when their understanding is compromised.

Monitoring Comprehension: Pedagogical Knowledge. Teachers are responsible for teaching students to determine if they understand the text. If students do not understand the text, teachers should help students learn the appropriate strategies to make sense of the text (Vaughn et al., 2022). Vaughn and colleagues (2019) investigated the effects of an intervention that included components to help students monitor their comprehension. One of these strategies was to provide shorter sections of a text and prompt students to summarize what they have read. Additionally, after students were done reading, they were prompted to answer comprehension questions and then to reflect on how many questions they thought they got correct based on their perceived level of knowledge. Overall, the results of the intervention were promising.

Fogarty and colleagues (2017) studied the effects of a multicomponent intervention that emphasized comprehension monitoring through strategic self-questioning and inference-making. Students were explicitly taught how to use multiple strategies to monitor their own comprehension throughout the intervention and were also given practice opportunities. For example, students learned how to skim a text and determine how difficult it would be for them.

Based on this, they identified logical breaks in the text. These checkpoints were meant to remind students that they needed to stop and think about what they just read and use fix-up strategies like rereading if necessary. The overall intervention had a significant effect on reading comprehension.

Finally, the Strategic Adolescent Reading Intervention (STARI; Kim et al., 2016) is another multicomponent intervention that includes strategy instruction for monitoring comprehension. Central to STARI's conception is the idea that reading engagement contributes to student achievement. In the program, part of being engaged with the text includes active problem solving while reading. In the program students engage in activities such as partner reading where they are asked to clarify words or phrases they do not understand and construct meaning through scaffolded inference making. Students are also taught how to ask questions while reading. The workbook that accompanies the program walks students through these processes, thereby scaffolding the act of monitoring comprehension. The intervention resulted in a significant increase in students' efficiency of basic reading comprehension.

Research indicates that learning to monitor comprehension can lead to overall reading comprehension gains. This can be done though instructional practices such as chunking texts and asking students to summarize what they have read, scaffolding inference generation while reading, and teaching students to ask themselves questions while they read.

Text Reading Fluency. The relationship between reading fluency and reading comprehension is well documented by researchers (Buck & Torgesen, 2018; Eason et al., 2013; Fuchs et al., 1988; Good et al., 2001; Kershaw & Schatsneider; Tighe & Schatschneider, 2013). Fluency is generally defined as reading at an appropriate rate with accuracy and prosody.

A study examining what skills might predict reading comprehension found that, for Grade 7 students, oral reading fluency is an important predictor for reading comprehension (Tighe & Schatschneider, 2013). Another study by Good and colleagues (2001) found that 96% of students who met the oral reading fluency benchmark in third grade went on to pass the Oregon statewide comprehension outcome measure. This finding was replicated by Buck and Torgeson (2018), who found similar correlations between oral reading rate and the Florida statewide reading assessment. However, many adolescents still have difficulties reading fluently. Cirino and colleagues (2013) found that 46% of the striving readers they assessed showed difficulties with fluency, while Hock and colleagues (2011) designated 29% of their sample of adolescent striving readers as *Dysfluent Readers*, meaning that their language comprehension and word reading accuracy were average, but their fluency skills at both the word and passage levels were below-average.

Text Reading Fluency: Content Knowledge. Eason and colleagues (2013) examined the relationship between reading words in isolation and in context and reading comprehension in students ages 10 to 14. Using both standardized and researcher created measures to assess word reading and contextual reading, they found that reading in context contributed unique variance above and beyond that of isolated word reading to reading comprehension, regardless of type of comprehension measure used. They also found that oral language contributed to contextualized reading, meaning that some students who can read words in isolation may still have difficulties reading words in context and with overall reading comprehension because of discrepancies in their language skills (e.g., vocabulary and semantics).

This finding was further validated by Kim and Wagner's (2014) study that examined how the role of word reading and text reading changed from first to fourth grades. They found that in

Grade 1, text reading did not mediate the relation between word reading and reading comprehension. However, starting Grade 2, text reading completely mediated the relation between word reading and reading comprehension and partially mediated the relation between listening comprehension and reading comprehension. These studies suggest that by the time students are in middle school contextualized reading contributes to reading comprehension, and that understanding vocabulary and semantics may help facilitate this process.

Given the evidence that fluency influences reading comprehension, it is necessary for educators to have the content knowledge of what fluent reading sounds like as well as the components (i.e., rate, accuracy, and prosody) that contribute to fluent reading.

Text Reading Fluency: Pedagogical Knowledge. There are many strategies that can be used to address fluency needs in the classroom. One such strategy is whole-class choral reading (Paige, 2011a), which builds on repeated reading (Therrien, 2004). Paige (2011a) implemented this strategy with Grade 6 students for five days a week for six weeks. A new text was introduced every Monday and was read through daily. Instruction included teacher modeling of the passage, reviewing vocabulary and pronunciation of specific words, and rereading sections for fluency. Students in the treatment condition made significant gains on standardized measures of decoding and oral reading fluency. Additionally, interviews with students revealed that they felt more comfortable reading because the whole class was participating, and that they felt their reading improved with the repeated readings of the text.

Another strategy is to focus on prosody, which refers to the expression, tempo, and pitch at which a student reads (Vaughn et al., 2022). One way to do this is to use a strategy called phrase-cued reading. In phrase-cured reading the teacher marks the passage to show where to pause or stop, breaking the text into chunks. For example, a sentence might look like “After the

went to dinner,/ the family hopped into the van.//" with one slash indicating a short pause, and two denoting a longer pause. After marking the text, the teacher models appropriate phrasing for the students. The students then practice reading the same text. After some practice, students practice marking their own texts (Hudson et al., 2022).

To address the needs of adolescent readers, educators must have the pedagogical knowledge to address fluency needs in the classroom, the basics of which include modeling fluent reading and having students repeatedly read a text with a focus on their own fluency.

The Impact of Teacher Knowledge on Student Outcomes

Research is inconclusive about the impact of teacher knowledge on student outcomes. Logically, it makes sense that teacher gains in knowledge in both content and pedagogy would positively impact student learning. McCutchen and colleagues (2002) found this relation in their study regarding the impact of ongoing professional development to kindergarten and Grade 1 teachers. Teachers who participated in the two-week professional development deepened their understanding of explicit instruction. This acquired knowledge led to "observable and sustainable changes in their practice" (p. 81), leading to improved student outcomes. This finding was replicated with Grade 3 and Grade 5 teachers (McCutchen et al., 2009). Lane and colleagues (2008) examined the effect of teacher knowledge about fluency on student outcomes in first-, second-, and third-grade students' oral reading fluency growth. They found that teacher knowledge is a significant predictor of growth in Grade 1 and Grade 2. Teacher knowledge explained 59% of the growth in decoding fluency and 86% in reading fluency in second grade.

However, there is also research that shows little or no relation between teacher knowledge and student growth. Carlisle and colleagues (2009) were interested in the extent to which teacher knowledge accounted for student improvement in word reading and reading

comprehension. After surveying the teachers and Grades 1 through 3 on early reading content knowledge, they found no significant interaction between teacher knowledge and student outcomes at any grade level. Additionally, Metzler and Woessmann (2012) examined the effect of teacher subject knowledge on student achievement utilizing a Grade 6 Peruvian dataset. Importantly, this dataset allowed the researchers to observe that impact of teacher knowledge across subjects for the same student. Results indicated that teacher knowledge in math has a significant effect on student outcomes but not in reading. However, this is not universally true. For example, this effect is not apparent when high-performing students are taught by low-knowledge teachers, or when female students are taught by male teachers. Overall, it is unclear what effect teacher knowledge has on student achievement or what threshold of knowledge teachers need to positively impact student learning.

Teacher Knowledge in Middle School

While there are studies that examine the impact of teacher knowledge on middle school student achievement in science (e.g., Guess-Newsome et al., 2019; Sadler et al., 2013) and math (e.g., Shechtman et al., 2010), no such studies could be found pertaining to English at the middle school level. This is noteworthy, as middle school ELA teachers may not have knowledge of the component skills of reading (e.g., fluency, vocabulary, background knowledge) or knowledge of research-based pedagogical practices for teaching reading. Secondary ELA teacher preparation programs rarely, if ever, focus on reading content knowledge. In a study of secondary ELA teacher preparation programs, Pasternak et al. (2017) found that most courses required for a degree in teaching secondary English were housed in English departments (50%). For comparison, only 37% of courses were housed in an education department. All respondents to the study's survey indicated that their program included an ELA content-specific methods

course, covering literature, composition, and language. It is unclear if any courses address foundational reading skills.

Moreover, the National Council of Teaching English changed their standards for pre-service English teachers to be less explicit regarding the reading process (2012; 2021). In the 2012 standards, Element 4 included "select appropriate reading assessments that inform instruction by providing data about student interests, reading proficiencies, and reading processes" (p. 1). In contrast, the 2021 standards do not mention reading proficiencies or the reading process. Rather, they state that ELA instruction and assessment should "support and engage all learners in meeting learning goals" (p. 3). This potential shift away from suggesting the English teaching candidates understand how reading assessment informs instruction regarding reading proficiencies and the reading process coupled with the finding that most pre-service programs do not include instruction on foundational reading skills, or the component skills of reading, points to the limited consensus of what middle school ELA teachers *should* know, rather less what they *do* know.

While extant research does not consistently demonstrate a relation between teacher knowledge and student achievement, it does stand to reason that one cannot teach what is unknown. Therefore, determining the knowledge base of middle school ELA teachers is important when thinking through what professional development may be needed to address both content and pedagogical knowledge.

Existing Teacher Knowledge Measures

While validated surveys exist for measuring teacher literacy knowledge in elementary school (e.g., Binks-Cantrell et al., 2012; Bos et al., 2001; Davis et al., 2021; Hall et al., 2023; Phelps & Schilling, 2004; Wijekumar et al., 2019), there is no such instrument for middle school.

No known studies have measured middle school English teachers' knowledge of both content and pedagogy as it pertains to reading. Measures that have been developed for middle school were not English specific and therefore too broad (Meyer, 2013) or are focused on one component and too narrow (Duguay et al., 2016). Meyer (2013) sought to understand what content-area teachers in middle and high school know about foundational knowledge of adolescent literacy, including English teachers. Foundational knowledge is conceptualized broadly and includes digital literacy, motivation, and literacy experiences. All 51 items on the survey are multiple choice. The survey focused on middle/high school teachers broadly and lacked a focus on ELA. In addition, the scope of knowledge surveyed was broad, limiting the available items to focus on the content and pedagogical knowledge necessary for high-quality English instruction. For example, questions such as "An instructional strategy that works in most content-area classes is a/an -" and "Content area literacy places different cognitive demands on students because each content area has different-" are content area specific, while questions such as "A blog is-" and "A Uniform Resource Locator (URL) is the same as a/an-" may be outdated. While this survey does include some necessary content and pedagogical knowledge, they are not the focus of the survey.

Duguay and colleagues (2016) developed an instrument to measure teachers' knowledge of vocabulary development and instruction with a focus on pedagogical knowledge as it relates to English learners. While the survey has been validated with middle school teachers, it is narrow in its focus.

With no measure of teacher knowledge specific to middle school ELA, there are no opportunities to determine the content or pedagogical needs for individual teachers, schools, or districts or begin to examine how teacher knowledge at this level may impact student learning.

This study aims to address this gap by reporting on the development and pilot study of an instrument that assesses English teachers' reading content and pedagogical knowledge at the middle school level.

Criterion – and Norm - Referenced Measures

When developing a new measure or scale, it is important to consider what it will be used for. There are two types of assessments, norm- and criterion-referenced, that are widely used. A criterion-referenced measure is a test of mastery. It compares an individual's overall score to some pre-established criteria of knowledge based on the content of the assessment. This type of assessment is common in schools and credentialing programs, where test takers are given a score which corresponds with a "pass" or "fail". Another example that is common in schools is equating a 90-100% correct as "A" work. There is no limit on the number of people who can pass, and there is no way to determine how an individual's score compares to others who took the same assessment. This type of measure is preferred when there is a certain threshold of knowledge that is needed to be considered proficient (Assessment Learning Network, n.d.).

Alternatively, norm-referenced measures are designed to provide information as to where an individual's score ranks compared to the scores of a reference group, known as the *norm group*. Scores are reported as percentile ranks and *not* as percentile correct. These scores help to answer questions such as "How did this person do compared to other people who took the same assessment?" and are used for purposes such as selection purposes or when it is important to know where someone stands in relation to the norm group, like the height and weight of a baby (Bandalos, 2018).

These scores can be used in a complimentary manner, and many widely used education achievement tests, such as the SAT and ACT, report both types of scores (Bandalos, 2018).

However, the purpose of teacher knowledge surveys is to begin to understand not only the level of knowledge that educators have about certain constructs, but to also explore the relation between levels of knowledge, instructional practices, and student outcomes. Therefore, these measures should be constructed to be norm-referenced with the sample population for the validation study serving as the norm group.

CHAPTER THREE

METHODS

Item Development

Boateng and colleagues (2018) state that the first steps in developing a reliable scale are: (1) defining the purpose of the construct, (2) confirming that there are no existing measures that serve the same purpose, and (3) determining the domains and dimensions of interest. The purpose in creating this measure is to assess middle school English language arts (ELA) teachers' content and pedagogical knowledge regarding general literacy concepts and evidence-based practices to inform both professional development activities at different levels (individual, school, division) and pre-service teacher education programs at large. Additionally, the measure can be utilized in research to begin to investigate the relation between ELA teacher knowledge, classroom practices, and student outcomes.

Domain Identification

To determine what domains and dimensions should be included on this instrument, three electronic databases (ERIC, Google Scholar, PsychINFO) were searched using various combinations of the following search terms: *survey, adolescent, secondary, literacy, reading, review, meta, evidence-based practices* to identify (1) existing surveys pertaining to adolescent literacy and (2) meta-analyses and reviews that have been conducted to suggest what knowledge and practices teachers might need to know to best serve adolescent readers. What Works Clearinghouse (WWC) practice guides on adolescent literacy (e.g., Kamil, 2008; Vaughn et al., 2022), teacher education standards published by international and national literacy and teaching organizations (e.g., IDA, 2018; ILA, 2017; NBPTS, 2014; NCTE 2021), and relevant theoretically models (e.g., DIER and DIME) were also analyzed to determine critical knowledge and pedagogy for middle school ELA teachers. Using the found studies, snowball and citation

searches were conducted to locate any other studies that may have been missed in the original search.

Once the search was complete, the literature was analyzed to determine what content and pedagogical domains are important for middle school ELA teachers to know and understand. The most recent practice guide was used as a foundational document (Vaughn et al., 2022). For each additional text, information about what domains were deemed beneficial to overall adolescent reading was collected. Then, these pieces of data were joined together to see what themes in content and pedagogy emerge across the literature. The data represent the domains for the survey.

Four overarching constructs emerged: (1) word knowledge: content knowledge (WKCK), (2) word knowledge: pedagogical knowledge (WKPK), (3) reading comprehension: content knowledge (RCCK), and (4) reading comprehension: pedagogical knowledge (RCPK), all aligning with the Simple View of Reading (Gough & Tunmer, 1986) and Shulman's theory of teacher knowledge (1986). Seven instructional domains are situated with these two constructs (see Table 1). Appendix A contains the relevant evidence and justification for these domains. It should be noted that fluency does not easily fit within either of these constructs, as fluency is a reciprocal process between decoding and comprehension processing (Paige, 2011b). Therefore, while fluency is not a separate construct it is not situated under word knowledge or reading comprehension for the purposes of item development. Fluency items were tested with each construct during factor analyses.

Table 1

Domains of knowledge within the word knowledge and reading comprehension constructs

Word Knowledge	Reading Comprehension
Multisyllabic Decoding	Building knowledge
Vocabulary	Generating inferences
	Finding the main idea and summarizing
	Monitoring comprehension
Fluency	

Decoding Multisyllabic Words. Decoding multisyllabic words was present in almost all sources (Kamil et al., 2008; Pearson et al., 2020; Sacrammacca et al., 2007l; Strategic Education Research Partnership, 2025; Torgesesn et al., 2007; Vaughn et al., 2022; Virginia Department of Education, 2024) and is divided into three categories: general, syllabication, and morphology. Across studies, decoding multisyllabic words was associated with gains in reading comprehension (Pearson et al., 2007; Scammacca et al., 2007) and that teaching should be explicit and routine focused, with an emphasis on identifying affixes and root words and being able to flexible use syllabication to figure out which syllables to stress in a word.

Vocabulary. Similarly, vocabulary instruction emerged as beneficial to overall reading comprehension (Kamil et al., 2008; Pearson et al., 2020; Scammacca et al., 2007; Torgesen et al., 2007; Vaughn et al., 2022; Virginia Department of Education, 2024) and can be broken down into three categories. First, general instruction includes explicitly teaching specific words critical for understanding the text and providing practice opportunities. Second, morphological instruction consists of explicitly teaching word analysis, including identifying affixes, root and bases. Third, context instruction models how to use the surrounding context to infer the meaning of an unknown word, which may be done using a routine.

Fluency. Torgesen et al. (2007) considers fluency to be one of six essential areas for literacy, and other sources agree (Pearson et al., 2020; Scammacca et al., 2007; Strategic Education Research Partnership, 2025 Torgesen et al., 2007; Vaughn et al., 2022; Virginia Department of Education, 2024). Evidence suggests that teachers should understand the three tenants of fluency, accuracy, rate, and prosody, and have knowledge of routines and practices, such as repeated reading and phrase-cued reading, that have been shown to increase fluency in adolescent readers.

Activate and Build Knowledge. Logically, "(s)tudents may need a minimum amount of topic knowledge to comprehend texts on that topic" (Pearson et al., 2020, p.47). This sentiment is echoed throughout the literature (Pearson et al., 2020; Torgesen et al., 2007; Vaughn et al., 2022; Vaughn & Schumm, 1998; Virginia Department of Education, 2024). To ensure that students are equipped to understand texts and build knowledge, teachers are encouraged to create texts sets and develop world knowledge through other mediums such as video clips, podcasts, and illustrations.

Generating Inferences. Generating inferences emerged as making substantial contributions to overall reading comprehension (Pearson et al., 2020; Strategic Education Research Partnership, 2025; Torgesen et al., 2007; Vaughn et al., 2022; Virginia Department of Education, 2024. To effectively teach students how to generate inferences, teachers need to provide explicit instruction that includes modeling making multiple types of inferences, including connecting information across a text to draw conclusions as well as understanding information within the same sentences, such as who or what a pronoun is referring to.

Finding the Main Idea and Summarizing. Developing a routine for finding the main ideas and generating a summary is beneficial for overall reading comprehension (Strategic

Education Research Partnership, 2025; Vaughn et al., 2022; Vaughn & Schumm, 1998; Virginia Department of Education, 2024). Explicitly teaching students how to determine the most important information, paraphrase that information, and writing it in a concise summary is encouraged and expected.

Monitoring Comprehension. Finally, monitoring comprehension emerged as an important aspect of adolescent reading comprehension (Pearson et al., 2020; Scammacca et al., 2007; Torgesen et al., 2007; Vaughn et al., 2022; Vaughn & Schumm, 1998; STARI). Students need to be able to identify when they are not understanding a text, and have strategies in place, such as rereading or asking themselves questions, to help their own comprehension. For this to take place, teachers need to have the knowledge of what strategies are helpful for students, and how to help students develop this type of metacognition.

Construct Maps

Once the four constructs, WKCK, WKPK, RCCK, and RCPK were established, a construct map was created for each, provided in Appendix B. Construct maps center around one domain, or characteristic, and establish a visual representation of research-based ordering of different levels of performance within that domain (Wilson, 2009). A construct map contains two important features: (1) a clear definition of the content of the construct and (2) the idea that an underlying continuum along which the items can be ordered exists (Wilson, 2005).

To create a construct map, it is necessary to focus on one construct at a time, allowing the focus to be on the essential features of what is to be measured (Wilson, 2005). Engaging in "variable clarification" (Wilson, 2005, p. 38) lets each construct be clearly defined and delineated from the others.

Theoretical concept maps were created (Wyse, 2013), where theory is used to hypothesize what pattern of performance might been observed by respondents. Each level of the construct map includes not only what would be expected knowledge at that particular level (e.g., the word *recreated* has three morphemes), but also the common errors that may be made in that level (e.g., being unable to separate less common roots from affixes). These levels, which might be described as "novice" to "expert" will then be used as a basis for item creation to ensure that varying levels within the continuum are measured.

Initial Item Creation

With four identified constructs and identified domains within each construct, initial item creation began. Additionally, as fluency items might either be subsumed into the word knowledge or reading comprehension constructs, care was taken to write fluency specific items that then could be analyzed to determine which construct they best represented.

The initial pool of items should be at least twice as long as the desired final scale (Boateng et al., 2018). The target for the final scale was 10 questions per construct, for a total of 40 items. Therefore, the goal for writing the initial pool of items was at least 25 items per construct, with a total item count of 100.

To begin creating items, the constructs and domains were cross referenced with validated surveys from students in younger grades (e.g., Hall et al., 2023; Wijekumar et al., 2019). These served as a starting point for the developing specific survey items for the word knowledge domains. Sentence stems and example questions were mapped onto the construct maps to ensure that each perceived level of the construct would be measured. An example of this is shown in Table 2.

Table 2

Mapping questions stems onto the construct map: Word knowledge content knowledge

Level	Description	Sample question stems
Developing *Knows and understands*	Knows that each syllable has a vowel sounds	Which vocabulary words would be the best choice to explicitly teach in a 7th grade English class?
	Uses multiple types of context clues to determine word meaning	How many morphemes does this word have? OR Determine the number of morphemes in this word.
	Defines *morpheme*	In the words proactive, progress, and projecting, pro is a(n) (prefix/suffix/affix) and means _____.
	Determines the number of morphemes in words that have common morphemes (*replayed*)	Select all the words in which *in-* is used as a prefix meaning "not".
	Defines rate, accuracy, and prosody	Adding the prefix *anti-* to a root word means what?
	Determines which vocab words to teach explicitly and implicitly	Why is reading fluency important for overall comprehension?
	Uses synonyms and antonyms to determine meanings of new words	
	Can articulate how fluency is related to reading comprehension	

Additionally, assessments that are commonly used in the field to assess reading comprehension pedagogical and content knowledge, such as the Praxis exams for Middle School English Language Arts (ETS, 2023b) and English Language Arts: Content Knowledge (ETS, 2023a), the Advanced Placement Literature exam (College Board, 2012), and the Virginia

Standards of Learning (SOL) assessment (Virginia Department of Education, 2022) were consulted for question content and construction.

Given the need to assess reading comprehension content knowledge, two passages, one fiction and one nonfiction, were used as the basis for creating questions. The fiction passage was an excerpt from the novel *The Age of Innocence* by Edith Wharton (1920), sourced from Project Gutenberg. This passage is referenced on Advanced Placement Literature exams (College Board, 2024). The nonfiction passage was about overfishing and was generated by ChatGPT (OpenAI, 2024) to contain academic and content specific vocabulary that is expected in a high school text, mirroring the text level of the Advanced Placement Literature exam.

Items were organized by construct domains to ensure that each domain was represented during item generation. Table 3 shows examples of an item from each construct and domain. Appendix C shows the overall item count by domain, with a total of 117 items being generated across all domains.

Table 3

Word knowledge: Decoding item examples

Domain	Item Example
Morphology: Content knowledge	Consider the word *beneficial*. How is this word divided into morphemes?
Morphology: Pedagogical knowledge	Mr. Cooke is teaching his 7th grade class how to decode multisyllabic words. What might be his first step?
Syllabication: Content knowledge	What is a syllable?
Syllabication: Pedagogical knowledge	What is the first step in syllable division?

During item development the guidelines outlined by Bandalos (2018) were adhered to. This includes making alternatives for multiple choice questions the same length, making sure the alternatives are grammatically consistent with the stem, and making sure one item does not give away the answer to another.

Item Revision

Expert Review

After items are developed, they were reviewed by three expert reviewers (Boateng et al., 2018), two of whom are professors of literacy and one of whom is a former middle school teacher and current literacy researcher. Before the review started, each engaged in a recorded asynchronous training that reviewed the overarching research questions, theoretical framework, constructs, and domains. Additionally, the video highlighted the systematic nature of the review, explaining the protocol that was developed based on the procedures used by Duguay and colleagues (2015) and Piasta et al. (2022). For each item, the expert reviewers were asked (1) is this something that all middle school English teachers should know? (2) does this item belong in the identified construct? (3) is the item accurate? and (4) does the item work as a test item? Reviewers rated each question using a scale of 0 (*no*), 1 (*maybe*), and 2 (*definitely*) and provided additional feedback pertaining to the wording of questions or specific content.

Each reviewed was assigned a Google folder. In each folder were Google documents for items related to word knowledge, fluency, general reading comprehension, and passage dependent questions. Each document included links to the construct maps, the evidence document, the training video, and the training slide deck. An example of this document can be found in Appendix D.

The reviewers' numerical ratings guided revision to the item pool. Any item that was rated a 2 across reviewers and categories was retained. Any item that scored a 0 from any reviewer on *something all middle school English teachers should know* or *accuracy* was deleted (Piasta et al., 2022). All other items receiving a 0 or a 1 in other domains were looked at individually and revised or deleted.

Cognitive Interviews

Three cognitive interviews were conducted with current middle school teachers to evaluate face validity, or the degree to which the end users judge that the items appropriately measure the underlying construct (Boateng et al., 2018; Castillo-Diaz & Padilla, 2012; Peterson et al., 2017). In cognitive interviews, participants go through the measure one item at a time and provide a think aloud of how they process the item. This provides detailed feedback about perception, cognitive load, wording, item difficulty, and construct measurement. Before the interview a protocol was designed to elicit information about the potential for misunderstanding, judgement, response clarity, and adequacy of content through follow-up probes (Peterson et al., 2017). The combination of the think-aloud and probes allowed for a more complete picture of whether the item is operating as intended.

Participants were recruited using a convenience sample. All three participants were white females who currently teach in a public middle school setting. One currently teaches sixth grade, while two teach eighth grade. One teaches in Virginia, and two teach in Colorado. One interview was done in person, while the other two were done over Zoom. All were recorded and parts pertaining to their thinking were transcribed.

During the interview, the participants would read the question and answer choices aloud and talk through their process of choosing an answer. The researcher asked clarifying follow-up

questions (see Table 4) to examine whether the word choice in the question was clear, whether the participant thought the question was relevant to their teaching, or to better understand the participant's thinking behind an answer choice. Participants had copies of the measure during the interview, and the researcher wrote notes on a hard copy of the survey. These notes consisted of the final answer choice of the participant, any other answer choices that were considered, and what the participant had said relating to the clarity or importance of each item. The interviews took approximately an hour, and teachers were compensated with a $50 Amazon gift card for their time.

Table 4

Cognitive Interview Questions

Why did you choose that answer?
Is the wording clear in this question?
What do you think this question is asking?
Can you tell me more about that?
Why did you choose that answer instead of …?
Do you think this question is necessary? Why or why not?

After the interviews, the researcher compiled notes across interviews to determine which items were easy, which were difficult, and which might need revision before being added to the final measure.

Final Instrument

Based on the feedback from the expert reviewers and the information gained from the cognitive interviews, items were either (1) included as is, (2) revised and included, or (3) deleted.

If too many items within a construct were deemed acceptable by both experts and teachers, then the items were cross referenced with the construct maps to ensure that all levels of the construct maps had similar numbers of items.

The final instrument (see Appendix E) consisted of 49 multiple-choice items measuring teacher knowledge across construct domains (see Appendix F). The items were split between content knowledge (25 items) and pedagogical knowledge (24 items). Each question had four answer options.

The final instrument is entitled The Middle School ELA Teacher Knowledge of Reading (METoR) Survey. The METoR survey is written in English and was administered online using the Qualtrics XM survey design software (Qualtrics, 2020). All 49 closed-response items were grouped by concept following Piasta and colleagues' (2022) guidance. Each item was scored on a binary scale as correct or incorrect.

Pilot Study

A pilot study was conducted to further revise and refine the survey. This study provided further evidence on the reliability and validity of the overall survey and led to revision and reduction.

Recruitment and Participants

Prior to recruitment, an application was submitted to the University of Virginia Institutional Review Board (IRB) for approval to ensure the study complies with federally mandated research guidelines. To recruit participants, applications were submitted to 7 districts, and emails were sent to 154 districts asking for permission to conduct research in their district. Of the 161 districts contacts, 48 responded, and 29 agreed to distribute the survey to their qualifying teachers. If the request was met with approval, teachers who actively teach ELA at a

public school in the United States to at least one section of students in Grades 6-8 were invited to participate. Teachers were sent an email from either someone in the central office of their district or their principal detailing the study and providing the link to survey. Participants were also recruited over social media and by word of mouth.

Before completing the survey, all participants consented electronically. Participants were given the option of providing their email to be entered to win one of fifteen $50 Amazon gift cards. If emails were provided, they were separated from the other survey data to ensure anonymity of responses.

Analytic Plan

Psychometric and statistical analyses for this study were conducted using Stata 17 (StataCorp, 2021). Survey items were evaluated for item difficulty, adjusted item-total score correlation, item-domain score correlations, and alpha-if-deleted indicies following Classical Test Theory (CTT; Magnusson, 1967). The decision to use CTT instead of Item Response Theory (IRT) is intentional. One advantage of IRT is that scores can be equated on different scales. Here, only one scale is being constructed. IRT also requires a larger sample size, while CTT allows for smaller sample sizes, starting with a sample of 30 to 50 participants.

For research question one regarding the overall reliability of the survey, the distribution of the survey was examined, including skewness and kurtosis values for the overall scale and each hypothesized construct. Skewness measures the symmetry of a distribution. When skewness is 0 it indicates that the data is distributed in a symmetrical way. That is, the mean, median, and mode are all the same. A right-skewed, or positively skewed, distribution suggests that the mean is to the right of the distribution's peak, or the mode of the data. A left-skewed, or negatively skewed, distribution suggests the opposite. Kurtosis is a measure of how peaked the data is.

Vales of 0 show the data to have the same kurtosis as a normal distribution. Positive values are interpreted as bring more peaked, while negative values are flatter than the normal distribution (Blanca et al., 2013).

According to Lei and Lomax (2005), absolute values for both skewness and kurtosis less than 1.0 have a slight non-normality, values between 1.0 and 2.3 are considered to have a moderate non-normality, and values larger than 2.3 represent severe non-normality. However, Blanca and colleagues (2013) studied the distribution shape of 693 distributions with sample sizes ranging from 10 to 30 and found that skewness ranged between -2.49 and 2.33 while kurtosis values ranged from -1.92 to 7.41. This suggests that there is a wide range of variation, especially in kurtosis values, when small sample sizes are used.

After examining the skewness and kurtosis values, Cronbach's alpha and KR-20 were calculated as measures of internal consistency. Coefficient H and McDonald's omega were considered, but ultimately not included due to the poor model fit of the factor structure, as both indices rely on factor loadings to compute reliability.

Cronbach's alpha (Cronbach, 1951) is a widely used measure of reliability that has four assumptions (McNeish, 2018). First, it assumes tau equivalence, or that the standardized factor loadings for each item are nearly identical to all other items on the scale. Second, it assumes that the items are continuous with normal distributions. Third, it assumes that the errors are uncorrelated. Finally, alpha is sometimes considered to be a measure of unidimensionality. However, the factor structure must be examined to determine dimensionality. Given that at least one of these assumptions is not met by the METoR survey, as it is on a binary scale, other reliability measures were explored. KR-20 (Küder & Richardson, 1937) is an internal

consistency coefficient that is like Cronbach's alpha but is used for dichotomously scored items. Since questions on this survey were scored correct/incorrect, the KR-20 index was included.

To answer research question two about the factor structure of the survey, CFAs were performed. Research indicates that there is no specific number of observations needed to perform a CFA as there is variability in sample size requirements that depend on the model being run (Wolf et al., 2013).Westland (2010) conducted a meta-analysis that examined the sample sizes used versus the sample sizes needed to (1) "compensate for the ratio of number indicator variables to latent variables" (p. 482) and (2) "assure the existence or non-existence of a minimum effect (correlation) on each possible pair of latent variables in the SEM" (p. 482). He found that many studies underestimated the sample size needed to accurately perform these analyses. For example, in a study that estimated 6 latent variables using 43 indicator variables, the needed sample size, according to Westland (2010) would be 2694, while the study's original sample size was 31. The sample size of the current study, then, is considered small and underpowered.

When considering model fit, multiple statistics were used. First, the RMSEA of approximation was analyzed (Steiger & Lind, 1980). This is a badness-of-fit index, whose value declines with improving fit (Hoyle et al., 2023). An RMSEA of .10 is considered to be a bad fit, while <0.08 is good and <0.05 is excellent. Second, CFI were considered (Bentler, 1990). CFI is a goodness-of-fit index that has a theoretical maximum value of 1 and is unaffected by sample size (Hoyle et al., 2023). A CFI > 0.90 is considered an acceptable fit, while a value > 0.95 is considered good. Third, the TLI was taken into consideration (Bentler & Bonett,1980; Tucker & Lewis, 1973). The TLI is a goodness-of-fit statistic that generally falls between 0 and 1 and is unaffected by sample size (Hoyle et al., 2023). TLIs follow the same recommendations are CFIs

in terms of fit statistics; a TLI > 0.90 is considered an acceptable fit, while a value > 0.95 is considered good. Finally, the SRMR was examined (Bentler, 1995). The SRMR is a badness-of-fit index, with 0 indicating perfect fit (Hoyle et al., 2023). Models that have an SRMR <.1 are acceptable, while <.08 are considered good.

Finally, the relation between teacher knowledge and teacher characteristics was analyzed using ANOVAs.

CHAPTER FOUR

RESULTS

Teacher Characteristics

Overall, 70 participants began the Middle School English Language Arts Reading Knowledge (METoR) survey, while 42 provided complete data. Table 5 displays the demographic data for the survey sample. Most of the sample was female (88%) and white (79%), which differs slightly from national data which indicate that 64% of secondary teachers are female while 80% are white (National Center for Education Statistics, 2023). Participants taught in 10 states (with 50% in Virginia).

Table 5

Teacher Demographic Information

Participant Characteristics	*n*	*%*
Gender		
Male	2	5%
Female	37	88%
Non-binary/ third gender	2	5%
No response	1	2%
Race		
American Indian or Alaska Native	1	2%
Black or African American	5	12%
White	33	79%
Hispanic	3	7%
Education Level		

Bachelor's degree	14	33%
Master's degree	25	60%
Doctoral degree	3	7%

Additionally, 76% hold standard certifications and 67% have a master's degree or beyond, which also differs from national data which states that 89% of secondary teachers hold regular certifications, and 55% have a master's degree or above (National Center for Education Statistics, 2023). Table 6 displays the background information for the survey sample. Most participants were general education teachers (93%) and were equally spread out across grade levels.

Table 6

Teacher Background Information

Participant Characteristics	*n*	*%*
Years Teaching		
Less than 1 year	2	5%
1-3 years	5	12%
4-10 years	15	36%
11-15 years	6	14%
16+ years	14	33%
Position		
General education teacher	39	93%
Special education teacher	1	2%
Reading specialist	2	5%

Current Grade Level Position		
6	13	31%
7	12	29%
8	12	29%
More than one grade level	5	12%
Teaching Certificate		
Standard	32	76%
Alternative certification program	7	17%
Temporary or emergency	1	2%
Other	2	5%
*Areas of Certification**		
Secondary education: English	21	50%
Middle school: English	18	43%
Elementary education	15	36%
Reading specialist	9	21%
English as a second language	4	10%
Special education	7	17%
Other	5	12%

**Note:* Many participants are certified in more than one area, so these percentages will not add up to 100%

Item Characteristics

Initial item analyses examined the characteristics of individual items to identify any that did not contribute to the scale and should be removed. Complete analyses can be found in Appendix G. First, item difficulty was calculated as the proportion of correct responses on each

item (Magnussen, 1967). This helps identify items that may have floor or ceiling effects. Lower values indicate that fewer participants answered the question correctly, suggesting that there may be issues with the wording or the content, while higher values indicate that the items may be too easy and not discriminant. Items that are deemed "extremely difficult" (values between 0 and .3; see Thompson, 2020) and "very easy" (values between .9 and 1.0) will be reviewed for revision or deletion in future iterations of the measure. Item difficulty values ranged from .33 to 1, with a median of .88. The breakdown of difficulty level is found in Table 7 (Thompson, 2020). Three items with a proportion correct of 1.0 were deleted from further analysis.

Table 7

Item levels of difficulty

Level of difficulty	*n*	*%*
Extremely difficult (0-0.3)	0	0%
Very difficult (.3-.5)	5	10%
Moderately difficult (.5-.7)	11	23%
Moderately easy (.7-.9)	11	23%
Very easy (.9-1.0)	22	45%

Next, adjusted item-total score correlations were considered (Boateng et al., 2018). This analysis helps identify items that may have been misinterpreted by participants. Items with higher adjusted item-total correlations are more discriminant, helping to differentiate between respondents who have lower and higher overall scores. Items with negative adjusted item-total correlation were iteratively deleted, as it signifies that respondents with lower or higher overall scores are equally likely to answer the item correctly.

Adjusted item-total correlations ranged from -0.05 to 0.56, with a median correlation of .2. 67% of the items (31 of 46) had item-total score correlations greater then 0.10. Due to a smaller sample size, items with discrimination values less than <.1 were reviewed and iteratively removed, beginning with the lowest value. While items with discrimination values of less than .3 are generally removed from scales (Boateng et al., 2018), the small sample size here makes these estimates less than precise, so a more conservative approach was taken (Piasta et al., 2022). This analysis was iteratively completed until no adjusted item-total correlations fell below .1. Fourteen items were deleted. Overall, 17 items were deleted, leaving a revised scale of 32 items. The final number of questions per construct is presented in Table 8, while the final survey can be found in Appendix H. After deleting these items, the adjusted item-total correlations for the revised measure ranged from .12 to .6.

Table 8

Revised items per construct

	Content Knowledge	Pedagogical Knowledge
Word Knowledge	5	5
Fluency	2	2
Reading Comprehension	10	8

Reliability

To evaluate reliability, the skewness and kurtosis levels were examined. The skewness value for the METoR survey (-.44) is considered slightly non-normal, while the kurtosis value (2.17) is considered to have a moderate non-normality. However, given the small sample size and the inconclusive agreement about acceptable kurtosis values (see Bandalos, 2018, p. 343),

there is little evidence that these values impacted analysis. Hypothesized constructs and fluency items were also examined for skewness and kurtosis (see Table 9) to ensure that these values would not impact further reliability analyses.

Table 9

Skewness and kurtosis values for hypothesized constructs

	Skewness	Kurtosis
Total scale	-.44	2.17
Word Knowledge	-.69	2.71
Content Knowledge	-1.30	4.37
Pedagogical Knowledge	-.38	2.45
Reading Comprehension	-.26	1.98
Content Knowledge	-.14	1.89
Pedagogical Knowledge	-.55	2.85
Fluency	.03	1.97

Next, alpha-if-item-deleted indices were performed for all items. Thompson and Levitov (1985) suggest removing items from the measure that lower the overall alpha. After examining each item, no items were deleted as there would be no increase to the overall alpha by doing so.

Finally, the overall reliability for the revised METoRS survey was calculated using Cronbach's α and KR-20, as the KR-20 is generally used for dichotomous variables. Table 10 presents the reliability of the overall score and individual scales for the constructs. Due to the nature of the fluency items, analysis was done for each construct individually and then repeated to include the corresponding fluency items to see if reliability increased.

Table 10

Internal consistency reliability

	Number of items	Cronbach's alpha	KR-20
Full scale	32	.798	.789
Word Knowledge: CK + PK	10	.488	.538
Reading Comprehension: CK + PK	18	.686	.644
Fluency: CK +PK	4	.447	.433
Word Knowledge: CK	5	.475	.204
Word Knowledge: CK + Fluency: CK	7	.478	.400
Word Knowledge: PK	5	.307	.329
Word Knowledge: PK + Fluency: PK	7	.465	.384
Reading Comprehension: CK	10	.585	.422
Reading Comprehension: CK + Fluency: CK	8	.631	.512
Reading Comprehension: PK	8	.470	.354
Reading Comprehension: PK + Fluency: PK	10	.433	.421

CK = content knowledge; PK = pedagogical knowledge

Overall reliability was 0.789, indicating good reliability (Ponterotto & Ruckdeschel, 2007). Individual construct alphas ranged from .307 for word knowledge pedagogical knowledge to .631 for reading comprehension content knowledge and fluency combined. No construct showed satisfactory reliability. However, reliability for the overall reading comprehension scale was .686, which, according to Nunnally (1978) is approaching acceptability for scales in the initial phases of development.

The overall composite score had very large correlations (*r's* > 0.7) with all construct composite scores (see Table 11). It did not correlate highly with the fluency items (*r* = 0.58).

Additionally, all between-construct composites were considered large (r's > 0.5; Cohen, 1988) and were significant, with the exception of the fluency items.

Table 11

Between-construct correlations

	1	2	3	4	5	6	7
1. Full scale		.72**	.79**	.87**	.87**	.60**	.38*
2. Word Knowledge: CK	.72**		.52**	.56**	.64**	.33*	.05
3. Word Knowledge: PK	.79**	.52**		.61**	.62**	.34*	.16
4. Reading Comprehension: CK	.87**	.56**	.61**		.67**	.38*	.24
5. Reading Comprehension: PK	.87**	.64**	.62**	.67**		.56**	.20
6. Fluency: CK	.60**	.33*	.34*	.38*	.56**		.31*
7. Fluency: PK	.38*	.05	.16	.24	.20	.31*	

CK = content knowledge; PK = pedagogical knowledge; * p<0.05; **p<0.01

Factor Structure

Confirmatory factor analyses (CFAs) were performed using structural equation modeling (SEM) to understand the underlying constructs of the METoR survey. However, the sample size of 42 decreased precision across models.

It was hypothesized that the responses would be organized around four domains: (1) word knowledge: content knowledge, (2) word knowledge: pedagogical knowledge, (3) reading comprehension: content knowledge, and (4) reading comprehension: pedagogical knowledge. To determine the appropriateness of this model, multiple models were compared.

Five models were tested. The first was a one-factor model where all items loaded onto one factor. The second and third models examined whether (1) there were two clear constructs

and (2) if the fluency items were better situated with the word knowledge construct or the reading comprehension construct. The fourth model tested the hypothesized constructs, with fluency items being included with the reading comprehension constructs. This fourth model would not converge, even when variances were constrained. The fifth model was like the fourth, except the fluency items were included with the word knowledge items. This model would also not converge.

Of the models that ran, no model demonstrated good, or tolerable, fit (see Table 12). However, a model comparison test indicated that a two-factor model with fluency items included with reading comprehension items fit the data better than the one-factor model (chi-squared [27] = 64.53, $p<0.001$). Additionally, a two-factor model with fluency items included with word knowledge items also fit the data better than the two-factor model (chi-squared [27] = 58.68, $p<0.001$). These results should be interpreted with caution, as the models are underpowered.

Table 12

Model fit statistics

Factor Model	RMSEA	CFI	TLI	SRMR
One Factor: Unconstrained	0.162	0.189	0.133	0.176
Two-Factor: Constrained Word Knowledge Reading Comprehension + Fluency	0.163	0.128	0.119	0.188
Two-Factor: Constrained Word Knowledge + Fluency Reading Comprehension	0.162	0.137	0.128	0.188
Four-Factor: Constrained Word Knowledge + Fluency: CK Word Knowledge + Fluency: PK Reading Comprehension: CK Reading Comprehension: PK	Would not converge			

Four-Factor: Constrained Word Knowledge: CK Word Knowledge: PK Reading Comprehension + Fluency: CK Reading Comprehension + Fluency: PK	Would not converge

Levels of Teacher Knowledge

An overall METoR composite score was calculated as the proportion correct across all items in the scale. Across the sample, total scores ranged from 15 items correct (47%) to 31 (97%), with a median of 25 (78%). Additionally, composite scores were calculated for each construct, as well as for the fluency items (see Table 13). Teachers had the highest mean accuracy on word knowledge content knowledge item (89% correct), followed by items representing reading comprehension pedagogical knowledge (79.5%), and reading comprehension content knowledge (74.5%). Participants scored lowest on fluency pedagogical knowledge (63.1%), although it should be noted that there are only two questions in this domain.

Table 13

Proportion correct across constructs

	Mean % correct	SD
Full scale	76.5	13.79
Word Knowledge	81.0	15.74
Content Knowledge	89.0	14.78
Pedagogical Knowledge	72.8	21.10
Reading Comprehension	76.7	14.4
Content Knowledge	74.5	16.26
Pedagogical Knowledge	79.5	15.07

Fluency	64.3	24.8
Content Knowledge	65.5	25.9
Pedagogical Knowledge	63.1	35.03

Teacher Knowledge and Teacher Characteristics

The relation of the METoR overall score with six teacher characteristics was examined: education level (coded as bachelor's degree, master's degree, or doctoral degree), years of teaching experience (coded as less than one year, 1-3 years, 4-10 years, 11-15 years, or 16+ years), type of certification (coded as standard, alternative, temporary, or other), and certification in elementary education (coded as yes or no). ANOVAs were conducted to examine these relations. The results are summarized in Table 14. Results revealed that teacher knowledge was not significantly related to any of these variables (all *p* values >.05).

Table 14

Relations of METoR survey with teacher characteristics

	F [3, 38]	*p*
Teacher education level	0.96	0.42
Years of teaching experience	0.31	0.87
Type of certification	0.70	0.56
Certified: Elementary Education	1.23	0.27

CHAPTER FIVE

DISCUSSION

The goal of this study was to develop and pilot an instrument that measures middle school ELA teachers' content and pedagogical knowledge of reading. There is currently no known measure that does this. In addressing this gap in teacher knowledge literature, it was hypothesized that this tool might be used in research to examine the relations between teacher knowledge, classroom practices, and student outcomes and in school settings to determine what professional development teachers might benefit from, and the effectiveness of the professional development itself. The METoR survey was created following a rigorous and iterative development process, following the methods of other available teacher knowledge surveys that are intended for other purposes (see Binks-Cantrell et al., 2012; Duguay et al., 2015; Hall et al., 2023; Piasta et al., 2022). This process yielded a measure with initial reliability findings that indicate specific areas for revision.

Validity and Reliability

Originally, the METoR survey was 49 questions long. After deleting items that all participants got correct and those that did not have high item-total correlations, 32 items remained. Of the deleted items, 10 were in the word knowledge domain, 4 fluency, and 3 reading comprehension.

Validity

The development work of the initial items provide evidence that supports the initial content validity of the METoR survey. Several steps were taken to ensure that this measure would be as valid with respect to the hypothesized constructs of WKCK, WKPK, RCCK, and RCPK. These steps included developing the constructs based on a review of extant research,

creating construct maps to ensure all levels of each construct were measured on the final survey, and conducting expert reviews and cognitive interviews on preliminary items. This work aligns with methods of previous validated surveys (e.g., Duguay et al., 2016; Hall et al., 2023; Piasta et al., 2022) and served to ensure that the items on the measure were relevant and meaningful for teachers to know. Both experts and teachers agreed that the questions on the final survey met these criteria, providing content validity evidence (Boateng et al., 2018).

In contrast, the measure was not found to have construct validity. CFA was used to assess model fit for multiple models based on existing theories (e.g., Gough & Tunmer, 1986; Shulman, 1986) and evidence-based practices (e.g., Pearson et al., 2020; Vaughn et al., 2022), yet the factor analyses revealed inconclusive results, with no model obtaining good fit. This indicates that there is a lack of correlation between items in the specified constructs. Results reveal that there are items in each domain that negatively correlate with the other items, and that few items are statistically related to one another. This could be due to the small sample size, but it also points to the need for revision of items within the identified constructs to ensure that the items are more highly correlated. This includes confirming that all items are designed to be norm-referenced, which is discussed in more detail in an upcoming section.

Reliability

Overall, the measure of the revised METoR survey yielded a reliability of $\alpha = 0.789$. This alpha indicates that it is approaching "good" reliability (e.g., .80; Ponterotto & Ruckdeschel, 2007). The alpha values for individual constructs ranged from .307 for word knowledge pedagogical knowledge to .631 for reading comprehension content knowledge combined with fluency content knowledge. These findings are similar to other novel measures. Piasta and colleagues (2022) designed a measure to assess early childhood teacher's knowledge

of oral language. They report an initial internal consistency of $\alpha = .82$ with alphas for included dimensions ranging from .43 to .63. Due to these low alphas, they chose to analyze the survey holistically and not consider individual dimensions. This differs from the present analysis. While the hypothesized constructs were found to have unacceptable levels of reliability (Ponterotto & Ruckdeschel, 2007), it is important to parse out the reliability of each construct, as they are meant to be used as individual assessment domains. Bandalos states that "coefficient alpha should be calculated at the level at which test scores are to be interpreted" (2018, p. 181).

The METoR survey was designed so that it could be analyzed at a more granular level. Whether or not teachers have general content and pedagogical reading knowledge is not very useful for determining what *types* of knowledge, if any, impact instructional practices and student outcomes, or what *kinds* of professional development is needed for specific sets of teachers.

Word Knowledge and Reading Comprehension Items. One explanation for the low reliabilities for these constructs may be the number of questions in each domain. Both word knowledge domains had only five questions on the revised survey, while the reading comprehension domains had ten related to content knowledge and eight for pedagogical knowledge. An increase in items may result in an increase in the overall alpha. Alpha takes item covariances into consideration, and the more items there are, the more covariances there are (Bandalos, 2018). However, the interitem correlation must also be considered, as just adding items of any type will not automatically result in increased reliability.

Another explanation may be that questions were unclear or poorly worded. For example, one reading comprehension content knowledge question asked, "Which of the following would NOT belong in a summary of this article?" This seems like a straightforward question, as typical

adults can summarize. However, only 57% of respondents answered this questions correctly. Here, use of the word "not" could have been misleading, or it could be the answers choices were poorly written, leading to confusion. It should be noted that it is not a problem theoretically that only 57% of teachers got this question correct. It becomes problematic as this was designed as a low-knowledge question that was anticipated to have a higher percent correct, making it less discriminatory between high- and low-knowledge respondents.

Conversely, there are many items in these constructs that most teachers got correct, which adversely affects the alpha. For example, 93% of participants correctly identified the meaning of the nonsense word *unscribable* and 95% correctly answered how making inferences should be explicitly taught. Having less variance in in answers impacts the alpha through the restriction of range, meaning that certain values above or below a certain point are not included in the sample (Bandalos, 2018). These items require revision to provide differentiation between levels of knowledge in the sample. Ideally item difficulty for a norm-referenced type measure should be in the range of about 0.3 to 0.7 (Bandalos, 2018).

Fluency Items. Fluency domain items proved to be problematic. Originally, eight fluency items – four for content knowledge and four for pedagogical knowledge –were included. The goal was to include these items in the factor structure analysis for both word reading and reading comprehension to see which construct the fluency items fit with, given that the ability to read fluently requires both word knowledge and comprehension (see Kim, 2020a). However, in the initial analyses of the results, half of the fluency questions were iteratively deleted as they had item-total score correlations of <0.10. The final measure had four fluency items, two in each domain. Subsequent analysis revealed that composite fluency scores, especially those for fluency

pedagogical knowledge, did not significantly correlate with the composite scores from the other constructs.

There is a lack of consensus in teacher knowledge measurement research on how to treat fluency items. Some measures consolidate fluency with other domains and do not report individual statistics on the correlation of fluency items either within the construct or overall (e.g., Garet et al., 2008; Spear-Swerling & Cheesman, 2012), providing little empirical evidence for which, if any, construct fluency items belong in. Garet et al. (2008) note that theoretically fluency reflects both word reading and comprehension constructs yet included fluency items in the word-level subscale "because the study's PD and the fluency items in the test emphasize the more mechanical aspects of fluency development" (p. D-3). Conversely, Spear-Swerling and Cheesman (2012) combine fluency with items pertaining to vocabulary and comprehension and not those related to phonemic awareness and phonics. They do not explain this decision.

Some studies do report the psychometric properties of fluency items. While Davis and colleagues (2021) found that a single-factor model, combining all measured domains (i.e., decoding, fluency, morphology, syntax, text structure, vocabulary and phonological awareness), best depicted the structure of the measure they created, they provide a correlation matrix for the domains. The matrix reveals that fluency had the lowest correlation with other domains, ranging from .29 (syntax) to .40 (morphology). Hall and colleagues (2023) also found that fluency items were significantly correlated with composite scores relating to phonological awareness (.67), phonics, decoding, and encoding (.63), oral language (.54), and reading comprehension (.56), but at a higher level. The current survey does not include items pertaining to phonological awareness or early decoding, which are the domains that fluency is most highly correlated with (Davis et al., 2021; Hall et al., 2023).

Many of the fluency items on the METoRs survey were derived from existing teacher knowledge surveys meant to measure an elementary level of knowledge (e.g., Folsom et al., 2017; Garet et al., 2008; Hall et al., 2023). While expert reviewers and teachers agreed that the items that were included were both accurate and important for middle school ELA teachers to know, it is possible that the items do not measure necessary teacher knowledge. For example, one question asks teachers to identify the expected oral reading rate of a seventh-grade student. While fluency has been shown to be an important indicator of reading comprehension, it may not be necessary to know the specific words per minute rate. When revising these items, it will be important to consider that items must reflect the knowledge needed to teach students in Grades 6-8, which is different from the knowledge needed to teach early literacy skills.

Norm- and Criterion Referenced Items

Another possible explanation for why the measure has low internal consistency within the constructs is that both criterion- and norm-referenced type items were used. Criterion- and norm-referenced scores can be used in a complimentary manner. Producing scores in both domains is not an unusual practice in educational achievement testing (Bandalos, 2018). However, when it comes to answering research questions relating teacher knowledge to teacher practice, or teacher knowledge to student outcomes, a norm-referenced type measure is needed.

Results indicate that the METoR survey is a compilation of norm- and criterion-referenced items, making it difficult to examine the item-total correlations and the overall reliability of the measure. It would be expected that norm-referenced items create a normal distribution of scores, with the median proportion correct around 0.50, while it would be expected that criterion-referenced items would have a higher proportion correct, up to 1.0, depending on the content.

This survey has both items that display characteristics of both types of items. For example, 45% of the items on the METoRs survey were “very easy” in terms of item difficulty, with over 90% of respondents answering correctly. It might be expected that middle school ELA teachers can use context clues to infer the meaning of a word in a text, to identify prefixes and suffixes, and be able to define what an inference is. These items would then be criterion-referenced, as it is considered expected knowledge. However, other items on the measure, such as those on syllabication, vocabulary instruction, fluency instruction, and building knowledge, proved to be more norm-referenced with 40% to 64% of respondents answering correctly.

Given that this measure was developed using both types of measures as models (e.g. existing norm-referenced type teacher knowledge surveys and criterion-referenced content knowledge assessments and state standards), this is not unexpected. Future iterations of the METoR survey should be revised to be comprehensively norm-referenced so that it can be used in future research to relate teacher knowledge to instructional practices and student outcomes.

Participant Demographics and Implications

Teachers were invited to take this survey and self-selected into the study. When self-selection is engaged, probability sampling cannot be applied (Bethlehem, 2010). This suggests that the population of teachers who took the survey may not be representative of middle school ELA teachers nation-wide. The demographic data collected from participants supports this. For example, 7% of the study sample identified as having a doctoral degree and 60% stated that they hold a master’s degree. National wide data indicates that 2% of secondary teachers have obtained a doctorate, and 53% have completed a master’s degree (National Center for Educational Statistics, 2023). Teachers who self-selected into this survey have a higher level of education

than the general population. This could also help explain the large number of items that were easy.

Impact of Teacher Characteristics

This study examined the extent to which education level, certification type, teaching experience, and elementary certification are associated with knowledge levels. Findings revealed that there were no significant associations between any of the teacher characteristics examined and METoR survey scores. These null findings are not surprising as existing studies offer a mixed picture of what teacher characteristics contribute to higher levels of knowledge. For example, Hall and colleagues (2023) found a statistical association between education level and both the overall and literacy domain scores but found no such association for certification type or other examined characteristics. Notably, the sample for Hall et al.'s study (2023) was diverse in terms of education level. 11% reported having a high school diploma, GED, or associate's degree, 41% a bachelor's degree and 48% a master's or beyond. In the current study 33% reported having a bachelor's degree while 67% have a master's degree or beyond. The lack of variety in education level may explain the null findings in the current study. Furthermore, McMahan and colleagues (2019) found no observable difference in teacher knowledge between educators who held a bachelor's degree and those with a master's degree on a measure that included mostly code-based items. This highlights that the findings from Hall and colleagues (2023) may be a result from having a more varied sample.

A few studies have found a significant relation between teaching experience and educator knowledge (Bos et al., 2001; Pittman et al., 2020; Spear-Swerling-Chessman, 2012), while others have not (McMahan et al., 2019). However, these findings pertain predominantly to code-based aspects of language such as phonics and phonemic awareness. There is no known measure that

has found a significant association between teaching experience and domains that explore knowledge of reading comprehension. In the present study there was a wide variation of teacher experience, suggesting that there are other factors that were not explored that may better explain different levels of teacher knowledge.

All teacher knowledge measures that have found significant relations between teacher characteristics and teacher knowledge have been done at the elementary level. While grade level was not found to be significantly associated with any aspect of knowledge (Hall et al., 2023; Washburn & Mulcahy, 2018), the present study examined whether there is a difference in knowledge levels of teachers who hold certifications for different grade bands. Specifically, it analyzed whether teachers who hold a certification in elementary education had a different knowledge level than teachers who hold a certification in middle school or secondary English. The rationale is that elementary certification programs have different expectations then those for secondary education certification, as secondary program rarely, if ever, include courses regarding reading instruction (Pasternak et al., 2014). Furthermore, state requirements for these certifications vary.

Results revealed that there is no significant association between teachers having a certification in elementary education and their overall score on the METoR survey. Descriptively, a higher percentage of teachers with an elementary certification (60%; 6/15) scored below the overall mean score than teachers with a secondary certification (41%; 11/27). For the word knowledge construct, where elementary teachers might be expected to have more knowledge due to their preparation to teach students to read, results indicate equal percentages of teachers with and without elementary certifications (33%) scored below the mean. This finding may indicate that knowledge is being gained through professional development opportunities or

through other means such as collaborative meetings, district initiative, or informally through colleagues or individual inquiry.

Limitations

Limitations include the length and composition of the survey, the sample size, and the focus of the content. A concern of any survey is its length. While the survey is designed to take 20 minutes, it is not possible to tell how long the survey took this sample on average, as the total minutes spent ranged from 12 to 8264 with a median of 51. Because the survey was taken online and was untimed, respondents could keep the window open for an undetermined amount of time. However, cognitive interviews that consisted of more questions than the final survey and where each question was discussed took about one hour. Therefore, the median of 51 minutes may be an inaccurate time estimate. More information is needed about the length of the survey, as surveys that are too long may produce fatigue in the participants and not be an accurate portrayal of knowledge.

The survey itself consisted of stand-alone multiple-choice questions, a short fiction passage with questions, and a short non-fiction passage with questions. Overall, 51 teachers began the survey while only 42 finished all the questions. The largest drop off was found between the stand-alone questions and the first reading passage, when five teachers chose not to continue. As Krosnick (1991) states, "(s)urvey respondents are often asked to expend a great deal of cognitive effort for little or no apparent reward" (p. 214). Therefore, tasks that are deemed harder or seemingly require more effort may not be completed to the best of the participants ability (Krosnick, 1991) or not completed at all (Ganassali, 2008). In future iterations of the survey the sequence in which the sections are delivered should be considered, and randomized if possible. This may decrease overall fatigue as well as the rate of non-respondents.

Another limitation to this study is the sample size of teachers surveyed. The small sample size of 42 limited the analyses that could be completed. Bandalos (2018) summarizes the research on sample sizes for piloting surveys and states that while a minimum of 30 participants may be used for item analysis, a larger sample size of 50-80 is needed for the analyses that was completed in this study, such as item-total correlation and coefficient alpha. Moreover, interitem correlations should be considered, as lower correlations require larger sample sizes. As this measure was found to have low correlations between items both as a whole and within the hypothesized constructs, a larger sample size is needed for more precise estimates.

The small sample size also impacted the ability to determine the factor structure of the survey, as sample size has been known to affect some goodness-of-fit statistics (Marsh et al., 1988). Furthermore, the weak factor loadings require a larger sample size (Wolf et al., 2013), which may explain why some of the models would not converge.

Finally, while the METoR survey was developed to cover evidence-based practices in middle school ELA classrooms, the topics covered are not exhaustive. It does not consider overarching pedagogical moves, such as collaborative groups and facilitating discussion (Pearson et al., 2020), nor does it include questions relating to specific components of explicit instruction such as feedback or scaffolding (Archer & Hughes, 2010).

Future Directions and Implications

Plausible explanations exist for the low alphas for the hypothesized constructs and lack of good fit for the factor models tested, many of which inform the implications of this study. First, future research must include revising the METoR survey with a focus on developing norm-referenced type questions that will better discriminate the knowledge levels of teachers. This includes going back to validated surveys to ensure clarity in wording and conducting another

round of expert reviews and cognitive interviews to further refine the items. Additionally, it would be beneficial to consult with English professors regarding the RCCK. These professors may be knowledgeable about varying levels of reading comprehension in adults. Currently, the RCCK items were adapted from the Advanced Placement Literature assessment (College Board, 2012), which is designed for high school students.

After the measure is revised it should be given to a larger, more representative, sample of middle school ELA teachers. This would provide a more comprehensive picture of how the items on the survey are working and allow for more detailed analysis, such as examining the factor structure at more discrete levels. The current sample size limited the possible analyses.

Assuming the revision yields a validated measure with a representative sample, there are several research questions that can be explored. First, middle school ELA teacher knowledge could be more widely studied to gain a more holistic view of the state of teacher knowledge. Second, teacher knowledge could be linked to classroom practices using observational methods. This type of study could examine if there is a relation between teacher knowledge and instructional practices. Third, the impact of teacher knowledge on student outcomes could be investigated. The current literature on this is mixed and mainly includes studies done at the elementary level. Given the dearth of teacher knowledge research at the secondary level, the validation of the METoR survey could provide opportunities for research that do not yet exist.

Finally, a validated survey would be useful for districts as they consider what professional development opportunities are needed for teachers. This survey can be used both to inform professional development planning as well as service as pre- and post- assessment to determine the effectiveness of the professional development on increasing teacher knowledge.

While adolescent literacy research has increased over the past decades, there is still much that is unknown about the interplay between teacher knowledge, instructional practices, and student outcomes. As many middle school readers are not yet proficient readers (U.S. Department of Education, 2024), it is important to match instruction to the academic needs of students. One way to do that may be to increase teacher knowledge in the reading domains. An instrument such as the METoR survey is key to measuring this and beginning to parse out what aspects of knowledge, both content and pedagogical, may positively impact student outcomes.

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Appendix A

Evidence for Sub-Constructs Example

Reading Comprehension

Sub-Construct	Source	Justification	What teachers should DO	What teachers need to KNOW
Develop and activate world/ background knowledge	IES Practice Guide: 4-9 Interventions (Vaughn et al., 2022)		• "Students need enough knowledge about a topic to read and understand a text on that topic…Provide a brief 3-5 minute introduction on the topic before reading to help students develop knowledge that might help them understand what they are reading" (p. 22) - can be done by reading an easier text, using video clips, podcasts, informational lecture w/ illustrations • "Another way to develop world knowledge before reading is to ask students questions about the topic" (p. 23)	• Appropriate ways to develop world knowledge
	Reaping the Rewards of the Reading for Understanding Initiative (Pearson et al., 2020)	• "Word and world knowledge support comprehension, at least in part, by aiding readers' inference and monitoring" (p. 43) • DIME model - vocabulary knowledge and background knowledge have the strongest impact on comprehension (p. 47) • After grade 6 background knowledge increases in its contribution to reading comprehension (p. 47) • "Students may need a minimum amount of topic knowledge to comprehend texts on that topic" (p. 47) • "Background knowledge and vocabulary knowledge are associated with ease or speed of processing inferential relationships in text and comprehension monitoring" (p. 55) • "Studies bolster substantial prior research demonstrating the significance of word and world knowledge for comprehension, particularly as students move into adolescents" (p. 61)		
	Academic literacy instruction for adolescents: Torgesen et al. (2007)	• Considered one of six essential areas for literacy (p. 6)		
	Collaborate Strategic Reading (Vaughn & Schumm, 1998)		• Preview - think about what you know and make predictions about the passage	
	VA SOLs (Virginia Department of Education, 2024)	• 6.RI.3B "Compare and contrast one author's presentation of ideas or events with another's identifying where text agree or disagree"	• Create text sets	• What are text sets • What to consider when creating one • How to use text sets in the classroom
Generating inferences	IES Practice Guide: 4-9 Interventions (Vaughn et al., 2022)		• Teach "Author and Me" questions - also referred to as an inferential question (p. 38) • 'Show students how to integrate the information from the text with their knowledge to formulate	• Modeling • Question stems for inferring questions

Appendix B
Construct Map: Word Knowledge Content Knowledge
(**decoding** (morphology & syllables), **vocabulary** (non-generative, morphology & context clues), **fluency**)

Level	Description
Advanced *Knows, understands, and can explain*	• Defines multiple morpheme words using affixes and roots • Flexibly uses vowel sounds in multisyllabic words • Explains how derivational suffixes work • Understands the difference between morphology, syntax, and semantics • Explains how rate, accuracy, and prosody work together • Identifies the types of context clues and is able to explain when each type is being used • Applies knowledge of morphology, synonyms, and antonyms to determine meanings of complex words • Understands the components of prosody • Knows general wpm that students should be reading
Developing *Knows and understands*	• Knows that each syllable has a vowel sounds • Uses multiple types of context clues to determine word meaning • Defines *morpheme* • Determines the number of morphemes in words that have common morphemes (*replayed*) • Defines rate, accuracy, and prosody • Determines which vocab words to teach explicitly and implicitly • Uses synonyms and antonyms to determine meanings of new words • Can articulate how fluency is related to reading comprehension
Beginning *Knows*	• Divides a word into syllables • Identifies common affixes • Identifies common roots • Chooses vocab words that are important to text • Can identify fluent vs. dysfluent reading • Uses context clues to determine meaning of unknown words and multiple-meaning words • Monitors own reading to confirm/ self-correct word recognition • Can identify synonyms and antonyms

Construct Map: Word Knowledge Pedagogical Knowledge
(**decoding** (morphology & syllables), **vocabulary** (non-generative, morphology & context clues), **fluency**)

Level	Description
Advanced *Knows, understands, and can explain*	• Uses morphology and syllabication to explicitly teach multisyllabic word reading • Has a clear routine for decoding multisyllabic words • Uses gradual release as a practice for word reading • Is able to choose appropriate vocabulary based on text and Tier; considers other content areas as well • Understands generative and individual word vocab instruction • Explains research-based strategies for teaching vocabulary • Understands research-based fluency instruction • Engages in vocabulary instruction that includes opportunities for discussion, speaking, and writing opportunities • Understands the connection between reading and writing fluency
Developing *Knows and understands*	• Engages in some instruction in word parts • Explicit teaches vocabulary at times • May use word maps to break words down • Provides more than one opportunity for students to practice newly taught words • Modules fluent reading in the classroom through read alouds
Beginning *Knows*	• Prompts students to sound out unknown words • May teach how to use context clues • Prompts students to use dictionaries to find the meaning of unknown words • Gives a brief definition of an unknown words in a commonly read text while reading • Has students circle prefixes and suffixes • Identifies round robin reading as not being evidence-based • Models fluent reading in the classroom through read alouds, but practice is not linked to fluency

Construct Map: Reading Comprehension Content Knowledge
(main idea, inference generation, building knowledge, monitoring)

Level	Description
Advanced *Knows, understands, and can explain*	• Understands that there are different types of inferences (local/global) • Analyzes how the text structure impacts the meaning of a text • Analyzes the development of main ideas over a text • Considers how word choice contributes to the author's overall intended meaning • Writes an organized summary that is concise and synthesizes the key ideas and details from across the text • Chooses texts that build in difficulty to build student knowledge
Developing *Knows and understands*	• Explains the difference between main idea and details, and the purpose of each • Summarizes main ideas using specific details from the text • Knows transitional words for different text organizational patterns • Can infer the meaning of figurative language • Identifies ways to build knowledge before and during units • Understands that one way to monitor comprehension is to divide texts into chunks
Beginning *Knows*	Identifies: • Text organizational patterns • The main idea • Simple inferences based on one part of a passage • Can summarize main ideas • Activates background knowledge before reading

Construct Map: Reading Comprehension Pedagogical Knowledge
(main idea, inference generation, building knowledge, monitoring)

Level	Description

Advanced *Knows, understands, and can explain*	• Matches the strategy to the text and not vice versa. Thinks holistically. • Provides timely feedback to students • Uses gradual release as an iterative process • Teaches both global and local inference making • Models how text structure can aid in determining the main idea of a text • Allows students to discuss multiple interpretations of a text, including what inferences were made • Models and expects students to be able to support their claims using evidence from the text • Models how to ask questions while reading to monitor comprehension and provides time for student practice and feedback
Developing *Knows and understands*	• Breaks down comprehension skills into steps and models their thinking • Understands gradual release • Identifies research-based strategies for most of the skills, including generating inferences, finding the main idea, and activating background knowledge • Models how to determine important information for main ideas and summaries (headings, word repetition • Differentiates between topics and main ideas • Understands that inferences need to be supported by examples from the text • Teaches that inferences are made by connecting the text to our background knowledge
Beginning *Knows*	• Uses multiple choice questions to gauge comprehension • Can differentiate between reading strategies • Teaches strategies in isolation • Main idea instruction includes worksheets that ask “What’s the main idea?” or teaches a formula for main idea construction • Asks literal questions to determine comprehension

Appendix C

Initial Item Generation

Overall Item Count: 117

Word Knowledge			
Sub-construct	**CK**	**PK**	**Total**
Decoding (morphology)	5	6	11
Decoding (syllables)	4	3	7
Vocab (general)	5 (1 passage)	6	11
Vocab (context clues)	7 (2 passage)	4	11
Vocab (morphology)	9	7	16
Fluency	9	8	17
TOTALS	39	34	73

Reading Comprehension			
Sub-construct	**CK**	**PK**	**Total**
Generating Inferences	3 (general) 7 (fiction passage) 2 (nonfiction passage) Total: 11	4 (general)	15
Background/ World Knowledge	2 (general) 2 (fiction passage) 1 (nonfiction passage) Total: 5	3 (general) 1 (fictional passage) 1 (nonfiction passage) Total: 5	10
Main idea/ summarizing	2 (general) 3 (fiction passage) 2 (nonfiction passage) Total: 7	5 (general) 2 (non-fiction) Total: 7	14
Monitoring comprehension	1 (fiction passage) 1 (general) Total: 2	3 (general)	5
TOTALS	25	19	44

Word Knowledge: Content Knowledge

Construct Maps Evidence Training Slide Deck

Subconstruct: Vocabulary Content Knowledge (general)			
	Scale: **0** (no) **1** (maybe) **2** (definitely)		
Question	**Does this item belong in the identified subconstruct?**	**Is the item accurate?**	**Does this item tap knowledge that teachers should know?**
Which vocabulary word would be the best choice to explicitly teach in a general 7th grade English class? a. negligible b. evaluate* c. grumble d. eupeptic			
When choosing vocabulary words to explicitly teach, which category is most important to focus on? a. Tier 1 words: basic, everyday words b. Tier 2 words: academic words used across disciplines* c. Tier 3 words: content-specific words d. Rare words to build students' interest in word study			
What types of words should be prioritized for vocabulary instruction? a. words that are often used in academic texts* b. words that can be inferred by their roots and affixes c. words that can be determined using context clues d. words that are phonetically irregular			

Appendix E

Initial METoR Survey Questions

15. Consider this word: *unscirbable*. Based on its morphemes, what is this word's definition?
16. Which of the following words has a prefix and a suffix?
17. What is a syllable?
18. Which of the following best describes the purpose of teaching context clues?
19. When choosing vocabulary words to explicitly teach, which categories of words is most important to focus on?
20. In which word does the suffix change the way the base word is pronounced?
21. The syllable *-ment* is a _____ that turns a _____ into a _____.
22. How many syllables are in the word *conceptualize*?
23. Which would **NOT** be a good example for the prefix *dis-*
24. Which graphic organizer is best use for vocabulary instruction?
25. Mr. Cookie is teaching his 7th grade class how to decode multisyllabic words. What might be his first step?
26. A student encounters this sentence while they're reading: "The painting was so *vivid* that it seemed to come to life with bold, bright colors." The student does not understand what the word *vivid* means. Which teaching strategy would best help the student understand the meaning of *vivid*?
27. When teaching students to use context clues, which question should come first?
28. What is the first step of syllable division?
29. Which of the following strategies is most effective for promoting lasting learning of vocabulary word meanings?
30. A student encounters the unfamiliar word *unbelievable* while reading. Which of the following strategies demonstrates using morphological analysis to help the student understand the word's meaning?
31. Which of the following is the best definition of fluency?
32. Fluency serves as a bridge between what two processes?
33. What is the expected oral reading rate (in words per minute) for an average seventh grader?

34. Why is fluent reading important for reading comprehension?
35. Which of the following is an evidence-based approach to improving a student's reading fluency?
36. Which of the following is **NOT** an appropriate way to assess fluency?
37. You administer an oral reading passage, and your sixth-grade student has a mean oral reading rate of 78 words per minute (which is considered slow). What would you do next after collecting this data?
38. You are planning a repeated reading activity with a small group of students to work on their fluency. Which of the following reading materials would be the best fit for this type of instruction?
39. An inference should be –
40. All of the following are true about summaries **EXCEPT –**
41. Which of the following accurately reflects research findings about monitoring comprehension?
42. A student is reading a text. They stop and ask themselves, "What is happening in this section?" What strategy are they using?
43. A teacher wants their class to make inferences about why a character acted in a particular way. What would be the most effective strategy for doing this?
44. A teacher wants their students to analyze how the main character's actions affect another character. What is the most effective question to scaffold this thinking?
45. You are working with a group of students who include too much information in their summaries. What strategy would you model for them?
46. A student reads a section of text but is having trouble summarizing what they just read. Assuming they can read all of the words, what instructional strategy would be a good next step?
47. Which of the following is **NOT** an effective way to build knowledge about a topic?
48. You are starting a unit on identity. Which of the following is an evidence-based way to build students' background knowledge?
49. How should making inferences be explicitly taught?
50. Overall, the author's attitude towards the patrons of the Academy of Music may be described as –

51. Which information from the selection would be most important to include in a summary?
52. In order to make an inference about what "above the Forties" means, what background knowledge would be most helpful?
53. Who or what is this sentence mostly about?
54. If you taught this novel, which of the following strategies would be most effective for building necessary knowledge?
55. A teacher reads lines 1-9 aloud to their class. After they finish, they say, "There's a lot of description here! I want to make sure I understand what's happening. I'm going to ask myself 'What is this section all about?' to make sure I'm understanding." What strategy Is this teacher modeling?
56. You've chosen the word *immense* as one of the words that you will explicitly teach for this section of text. Which of the following should you include in your explicit vocabulary lesson?
57. In the passage, which words would be important to explicitly teach?
58. Which of the following would **NOT** belong in a summary of this article?
59. What can you infer about the role of governments in combating overfishing?
60. In context, the word *quotas* (line 11) most nearly means –
61. What background knowledge would be helpful for a person to know in order to better understand the second paragraph?
62. A student is having some trouble writing a summary of this text. You provide a graphic organizer that focuses on text structure. What graphic organizer would you give to this student?
63. A student is having trouble figuring out what the word *crucial* means (line 5). They have reread the sentence and still cannot figure it out. What would you prompt them to do next?

Appendix F

Final Item Distribution

Word Knowledge

		Content	Pedagogy
Decoding	Syllables/ vowel sounds	2	1
	Morphology	4	3
Vocabulary	General	2	3
	Context Clues	2	3
Total		10	10

Fluency

	Content	Pedagogical
Fluency	4	4

Reading Comprehension

	Content	Pedagogical
Building Knowledge	2	3
Summarizing	3	2
Monitoring	2	2
Inferring	4	3
Total	11	10

Appendix G

Initial item level analysis

Item	Construct	Item difficulty	Item-total correlation	Alpha if removed (total)	Item-domain correlation	Alpha if removed (construct)
15	WKCK	0.93	0.15	0.74	0.34	0.30
16	WKCK	0.98	0.12	0.74	0.01	0.40
17	WKCK	0.74	0.34	0.73	0.34	0.25
18	WKCK	0.95	0.20	0.74	0.02	0.40
19	WKCK	0.64	-0.05	0.75	0.05	0.44
20	WKCK	1.0	NA	NA	NA	NA
21	WKCK	.90	0.26	0.73	0.39	0.27
22	WKCK	0.76	-0.03	0.75	0.04	0.42
23	WKPK	0.97	0.01	0.74	0.23	0.27
24	WKPK	0.86	0.33	0.73	0.28	0.31
25	WKPK	0.64	0.01	0.75	0.25	0.31
26	WKPK	1.0	NA	NA	NA	NA
27	WKPK	0.93	0.17	0.74	0.06	0.40

28	WKPK	0.40	0.50	0.72	0.18	0.36
29	WKPK	0.98	0.03	0.74	0.10	0.39
30	WKPK	1.0	NA	NA	NA	NA
31	FCK	0.71	0.05	0.74	0.08	0.33
32	FCK	0.86	0.07	0.74	0.25	0.09
33	FCK	0.33	0.43	0.72	0.19	0.16
34	FCK	0.98	0.24	0.74	0.09	0.29
35	FPK	0.79	0.20	0.73	0.19	0.03
36	FPK	0.88	0.04	0.74	0.06	0.19
37	FPK	0.48	0.01	0.75	0.07	0.19
38	FPK	0.48	0.14	0.74	0.07	0.19
39	RCCK	0.93	0.41	0.73	0.27	0.48
40	RCCK	0.91	0.17	0.74	0.15	0.50
41	RCCK	0.67	-0.01	0.75	-0.13	0.58
42	RCCK	0.93	0.41	0.73	0.32	0.47
43	RCPK	0.88	0.43	0.73	0.26	0.42

44	RCPK	0.95	0.13	0.74	0.40	0.41
45	RCPK	0.93	0.02	0.74	0.05	0.48
46	RCPK	0.93	0.25	0.73	0.26	0.43
47	RCPK	0.55	0.45	0.72	0.11	0.49
48	RCPK	0.43	0.37	0.73	0.01	0.49
49	RCPK	0.95	0.08	0.74	0.01	0.41
50	RCCK	0.64	0.26	0.73	0.24	0.47
51	RCCK	0.52	0.44	0.72	0.42	0.40
52	RCCK	0.69	0.56	0.71	0.51	0.38
53	RCCK	0.64	0.44	0.72	0.27	0.46
54	RCPK	0.96	0.25	0.73	0.01	0.43
55	RCPK	0.71	0.10	0.74	0.01	0.46
56	WKPK	0.67	0.37	0.72	0.09	0.42
57	WKCK	0.93	0.39	0.73	0.28	0.32
58	RCCK	0.57	0.04	0.74	0.17	0.50
59	RCCK	0.98	0.27	0.73	0.08	0.51

60	WKCK	0.88	0.09	0.74	0.05	0.40
61	RCCK	0.64	0.21	0.73	0.08	0.52
62	RCPK	0.90	0.12	0.73	0.01	0.45
63	WKPK	0.79	0.29	0.73	0.24	0.33

Appendix H

Revised METoR Survey

1. Consider this word: *unscirbable*. Based on its morphemes, what is this word's definition?
    a. not able to be written*
    b. not able to be described
    c. able to be written
    d. able to be described
2. What is a syllable?
    a. A group of letters that contain a vowel sound and make a complete word
    b. The smallest unit of sound that can be pronounced
    c. The smallest unit of language that has meaning
    d. A unit of pronunciation that has one vowel sound*
3. Which of the following best describes the purpose of teaching context clues?
    a. To promote using the dictionary to learn new words
    b. To help students recognize when they don't know a word
    c. To help students monitor their understanding of a text
    d. To enable students to infer the meaning of unknown words*
4. The syllable *-ment* is a _____ that turns a _____ into a _____.
    a. affix, noun, verb
    b. prefix, verb, noun
    c. suffix, noun, verb
    d. suffix, verb, noun*
5. Which graphic organizer is best use for vocabulary instruction?
    a. semantic map*
    b. Venn diagram
    c. flow chart
    d. mind map
6. When teaching students to use context clues, which step should come first?
    a. Infer the meaning of the unfamiliar word using prefixes, suffixes, and root words
    b. Have students brainstorm a list of synonyms for the unfamiliar word

c. Look for surrounding words or phrases that help infer the meaning of the unfamiliar word*
d. Sound out the unfamiliar word to determine its meaning

7. What is the first step of syllable division?
    a. read the whole word
    b. identify the vowel sounds*
    c. identify the prefix and suffix
    d. clap out the syllables

8. What is the expected oral reading rate (in words per minute) for an average seventh grader?
    a. 80
    b. 100
    c. 120
    d. 140*
9. Why is fluent reading important for reading comprehension?
    a. Fluent readers focus on each word, giving them time to understand the text
    b. Fluent reading frees up cognitive resources, allowing readers to focus on understanding the text*
    c. Fluency is only about reading speed and does not impact comprehension
    d. Fluent readers do not need to rely as much on their background knowledge to understand the text
10. Which of the following is an evidence-based approach to improving a student's reading fluency?
    a. Providing frequent opportunities to engage in independent, silent reading
    b. Guiding students to engage in round robin reading (i.e., taking turns to read a text)
    c. Telling students to skip a difficult word and come back to it so they can focus on the words they know
    d. Guiding students to engage in repeated reading with feedback*

11. You are planning a repeated reading activity with a small group of students to work on their fluency. Which of the following reading materials would be the best fit for this type of instruction?
    a. A passage from the state assessment
    b. A chapter from the book that you're currently reading as a class or group
    c. An article that is based on their reading ability
    d. A few paragraphs from a grade-level text*
12. An inference should be –
    a. a personal opinion about the text
    b. supported with evidence from the text*
    c. based on personal experiences
    d. a summary of the information in the text
13. All of the following are true about summaries **EXCEPT –**
    a. They should focus on the main ideas and key details in a text
    b. Thet should be concise, accurate, and objective
    c. They should be written in the reader's own words
    d. They should include interpretations of the text*
14. A student is reading a text. They stop and ask themselves, "What is happening in this section?" What strategy are they using?
    a. monitoring comprehension*
    b. making inferences
    c. using text structure to summarize
    d. using background knowledge
15. A teacher wants their class to make inferences about why a character acted in a particular way. What would be the most effective strategy for doing this?
    a. Guiding students to examine the character's previous actions and thoughts*
    b. Having the students summarize the text up until this point
    c. Asking students to go through the text and highlight adjectives that describe the character
    d. Making a prediction and reading on to see if they are correct

16. A teacher wants their students to analyze how the main character's actions affect another character. What is the most effective question to scaffold this thinking?
    a. What just happened in the text?
    b. How would you feel if someone did this to you?*
    c. What do you think will happen next in the text?
    d. What is the setting of the text?
17. A student reads a section of text but is having trouble summarizing what they just read. Assuming they can read all of the words, what instructional strategy would be a good next step?
    a. Have them keep reading the text to see if the information begins to make sense
    b. Provide them with a text that has the same content, but does not have complex sentence structure
    c. Prompt them to write down information from the text so they don't forget it
    d. Divide the text into sections and have the student identify the important information in each section*
18. Which of the following is **NOT** an effective way to build knowledge about a topic?
    a. Provide context for a text before reading through the use of multimedia resources
    b. Explicitly teach vocabulary words before and during reading that are related to the topic
    c. Incorporate multiple texts on the same topic that increase in difficulty so students can build understanding
    d. Have students read a text before discussing it so they can build their own understanding*
19. You are starting a unit on identity. Which of the following is an evidence-based way to build students' background knowledge?
    a. Begin reading a novel in which a person goes on a journey to discover their own identity
    b. Have students choose a novel that they are interested in reading for book clubs based on their own formed identities
    c. Share some short YouTube slips about people explaining words that they use to describe themselves and why*

d. Ask students to write down everything they think of when you say “identity”

20. How should making inferences be explicitly taught?
    a. By reading aloud a text and having students make inferences and discuss them with a partner
    b. By engaging students in creating a character profile of a main character in their book
    c. By modeling how to make an inference and providing feedback while students practice*
    d. By giving students a graphic organizer to help them think through their inferences

Please read this excerpt from *The Age of Innocence* by Edith Wharton and answer the following questions.

Excerpt from *The Age of Innocence* by Edith Wharton (sourced from Project Gutenberg)

(1) On a January evening of the early seventies, Christine Nilsson was singing in Faust at the Academy of
(2) Music in New York.

(3) Though there was already talk of the erection, in a remote metropolitan distances "above the Forties,"
(4) of a new Opera House which should compete in costliness and splendour with those of the great European
(5) capitals, the word of fashion was still content to reassemble every winter in the shabby red and gold boxes
(6) of the sociable old Academy. Conservatives cherished it for being small and inconvenient, and this keeping
(7) out the "new people" whom New York was beginning to dread and yet be drawn to; and the sentimental
(8) clung to it for its historic associations, and the musical for its excellent acoustics, always so problematic a
(9) quality in halls built for the hearing of music.

(10) It was Madame Nilsson's first appearance that winter, and what the daily press had already learned to
(11) describe as "an exceptionally brilliant audience" had gathered to hear her, transported through the slippery,
(12) snowy streets in private broughams, in the spacious family landau, or in the humbler but more convenient
(13) "Brown coupe." To come to the Opera in a Brown coupe was almost as honourable a way of arriving in
(14) one's own carriage; and departure by the same means had the immense advantage of enabling one (with
(15) a playful allusion to democratic principles) to scramble into the first Brown conveyance in the line, instead
(16) of waiting till the cold-and-gin congested nose of one's own coachman gleamed under the portico of the
(17) Academy. It was one of the great livery-stableman's most masterly intuitions to have discovered that
(18) Americans want to get away from amusement even more quickly than they want to get to it.

21. Overall, the author's attitude towards the patrons of the Academy of Music may be described as –
    a. indifferent and detached
    b. understanding and admiring
    c. wry and slightly critical*
    d. sentimental and comical
22. Which information from the selection would be most important to include in a summary?
    a. Christine Nilsson was singing Faust
    b. The patrons arrived using different types of transportation
    c. A new opera house is being built "above the Forties"
    d. The fashionable elites enjoy gathering at the Academy*
23. In order to make an inference about what "above the Forties" means, what background knowledge would be most helpful?
    a. How the streets in New York City are organized*

b. What music and fashion were like in the 1940s
c. Remote areas around New York City
d. What an opera house in Europe looks like

24. Who or what is this sentence mostly about? It was Madame Nilsson's first appearance that winter, and what the daily press had already learned to describe as "an exceptionally brilliant audience" had gathered to hear her, transported through the slippery, snowy streets in private broughams, in the spacious family landau, or in the humbler but more convenient "Brown coupe."
    a. Madame Nilsson
    b. the daily press
    c. the audience*
    d. types of transportation
25. If you taught this novel, which of the following strategies would be most effective for building necessary knowledge?
    a. Have students identify unknown words and discuss what they mean in context
    b. Provide a brief overview of the time period and cultural context*
    c. Have students read the assigned text and then discuss questions they have
    d. Ask students to write a brief reaction to the beginning of the text
26. A teacher reads lines 1-9 aloud to their class. After they finish, they say, "There's a lot of description here! I want to make sure I understand what's happening. I'm going to ask myself 'What is this section all about?' to make sure I'm understanding." What strategy Is this teacher modeling?
    a. monitoring comprehension*
    b. generating inferences
    c. metacognition
    d. making predictions
27. You've chosen the word *immense* as one of the words that you will explicitly teach for this section of text. Which of the following should you include in your explicit vocabulary lesson?
    a. A movement to help students remember the meaning
    b. The dictionary definition and entry

c. A student friendly definition*

d. A semantic map

Please read this text about overfishing and answer the following questions.

Overfishing

(1) Overfishing in the world's oceans is a significant environmental issue that threatens marine ecosystems and
(2) the livelihoods of millions of people. Overfishing occurs when fish are caught at a faster rate than they can
(3) reproduce, leading to a drastic decline in fish populations. Many popular fish species, like tuna and cod,
(4) have seen their numbers plummet due to excessive fishing practices. This decline disrupts the balance of
(5) marine life, as many fish play crucial roles in their ecosystems. As fish populations decrease, other marine
(6) animals that rely on them for food also suffer, leading to a cascade of negative effects throughout the ocean
(7) environment.

(8) To combat overfishing, several solutions can be implemented to ensure sustainable fishing practices. One
(9) effective approach is the establishment of marine protected areas (MPAs) where fishing is restricted or
(10) prohibited. These areas allow fish populations to recover and thrive, ultimately benefiting the entire
(11) ecosystem. Additionally, governments can enforce stricter fishing regulations, such as quotas that limit the
(12) number of fish caught, ensuring that fish populations can replenish. Promoting sustainable fishing

(13) practices among fishermen and consumers, such as choosing seafood from certified sustainable sources,
(14) can also help reduce overfishing. By working together to protect our oceans, we can preserve marine life
(15) for future generations while still enjoying the benefits of fishing.

28. In the passage, which words would be important to explicitly teach?
    a. fish, caught, food
    b. generations, popular, occur
    c. significant, ocean, protect
    d. decline, excessive, sustainable*
29. Which of the following would **NOT** belong in a summary of this article?
    a. Choosing seafood from sustainable sources can help reduce overfishing*
    b. Fish populations are declining due to excessive fishing practices
    c. When fish populations decline, other marine animals are also at risk
    d. Marine protected areas can help fish populations recover and thrive
30. What can you infer about the role of governments in combating overfishing?
    a. Governments have little control over overfishing practices
    b. Governments can help solve the issue by enforcing stricter fishing regulations*
    c. Governments should only get involved if other marine animals begin to suffer
    d. Governments have already worked and solved the problem of overfishing
31. What background knowledge would be helpful for a person to know in order to better understand the second paragraph?

a. What it means for something to be sustainable*
b. What a marine protected area is
c. What governments are doing to combat overfishing
d. What types of excessive fishing practices exist

32. A student is having trouble figuring out what the word *crucial* means (line 5). They have reread the sentence and still cannot figure it out. What would you prompt them to do next?
    a. Read the previous sentence
    b. Read the next sentence*
    c. Read the rest of the passage
    d. Read a different article at a lower Lexile level