Inference Making Skills in Young Learners and Educator Knowledge: Connecting Research to Practice

By

Barbara L. Adams

A Dissertation Submitted in Partial Fulfillment for the Degree of Doctor of Philosophy in Literacy Studies

Department of Education, Middle Tennessee State University

May 2022

Dissertation Committee:

Dr. Eric Oslund, Chair

Dr. Amy Elleman

Dr. Natalie Griffin

If you want to be a good writer, . . . You have to sit down and write, which can be very frustrating, and yet without that you would not get that good result.

- Desmond Tutu, *The Book of Joy*

To Walt, for instilling in me the desire to question and write.

ACKNOWLEDGEMENTS

I am humbled to have experienced a village of support throughout this journey. From family, to colleagues, to friends, to those I never met who completed my survey, your love and assistance has made a world of difference. I thank God for all of you.

Scott, Colin, and Lea, you are my strength. You sat with me many nights and weekends, wiped my tears of frustration, and encouraged me to just keep going. I am beyond grateful. Dr. Oslund, it has been an eventful six years. Thank you for the wisdom and for keeping it real. I knew I could do it; you showed me how. To Dr. Elleman, a true pillar of knowledge and support. I cannot thank you enough for the many conversations and words of hope. It has been an honor. To Dr. Griffin, for jumping in without question. You have so willingly shared your views; I am thankful for your insight. To Dr. Woods and Robynne, thank you for giving me my start. Speech and Hearing Associates will forever hold a place in my heart. To Laura, Krista, Clarissa, and Kelly, for believing in me from the beginning and suggesting others do the same. To Robin and Mattie, for keeping me level-headed. Your guidance and soundness in judgement has been phenomenal. To Nicole and Tammy, for confirming that a career-driven mom can complete a doctorate. I am glad we were in this together. To Caryl, Amy, and Diane. Your friendship has been endless, even though I have been a really bad friend these past few years. You inspire me to do better and be better. Finally, to my parents. Dad, it is because of you I have a true belief that there is a season for everything; thank you for reminding me that each day is a blessing. Mom, you are an amazing listener; I am proud to be your daughter and to call you friend. Thank you for the foundation and just for being you.

ABSTRACT

Adding to the current body of research on inference making skills and young learners, this study examined the knowledge base of classroom teachers, speech-language pathologists, and other literacy specialists. Specifically, educator knowledge was considered in relation to the extant literature on the inference making abilities of young children. Using a survey design, educator knowledge to accurately identify an inference, knowledge of young learners' capabilities for constructing inferences, and knowledge of instructional strategies for teaching inference making was explored. Descriptive statistics, correlational analysis, and analysis of variance were used to explore the close-ended question responses of general education teachers, special education teachers, reading interventionists, and speech-language pathologists working with preschool through third grade students. Additionally, open-ended questions were considered through qualitative inductive and deductive coding of responses. Statistical analyses of survey results revealed no statistically significant relationships among educator experience, role, or trainings, and educator knowledge to accurately identify an inference (EK), knowledge of young learners' inference making abilities (EKYL), or knowledge of inference making instructional strategies (EKIS). However, descriptive analyses aligned with previous educator knowledge studies and indicated educators may lack evidence based knowledge regarding inference making, young learner ability, and instructional strategies. Mean differences among groupings demonstrated classroom educators (general education teachers and special education teachers) scored higher on EK items than itinerant educators (reading specialists and speech-language pathologists), but itinerant educators scored higher on EKYL and EKIS. Whereas 28% of educators answered all eight questions comprising the variable EK correctly, 43% of respondents

were unable to provide an accurate response on five or more EK items. Likewise, only 26.5% of respondents strongly agreed that young learners who are good at forming inferences from a picture will likely be good at inferencing from other sources such as read alouds. Finally, although 78% of respondents recognized small group instruction as a way to teach inference strategies, only 12% reported actually using small group instruction. Study limitations discussed included sample size and limited response. Future directions were noted as further survey development, professional development applications, and the addition of a student component to the study.

Keywords: Inference making, inference skill, young learner, educator knowledge, inference strategy

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER ONE: INTRODUCTION

Several decades of research regarding the influence of inference making abilities on reading comprehension has substantiated the relationship between the ability to establish coherency and understand text (Cain & Oakhill, 1999; Cain et al., 2001; Castles et al., 2018; Elleman & Oslund, 2019; Filiatrault-Veilleux et al., 2015; Kintsch, 1988; Stahl, 2014). Primary school-aged children who are able to make inferences based on narrative text demonstrate strong reading comprehension abilities in later grades (Castles et al., 2018; National Early Literacy Panel [NELP], 2008). In fact, a large body of evidence demonstrating the importance of inference making ability for later reading comprehension has led the Institute of Education Sciences (IES; National Center for Educational Evaluation and Regional Assistance [NCEE], 2016) to now recommend early instruction in inference making for all children beginning in kindergarten.

Empirical evidence suggest that inference skills develop in the preschool years, long before a child formally learns to read (Filiatrault-Veilleux et al., 2015; Florit et al., 2011; Kendeou et al., 2008; Language and Reading Research Consortium [LARRC] et al., 2019; Lepola et al., 2012). In fact, studies have identified children as young as 3 years of age are able to make inferences (Filiatrault-Veilleux et al., 2015; Kendeou et al., 2008). Furthermore, activities involving inference making during storybook narrations support a preschooler's development of later reading comprehension (van Kleeck, 2008).

In the classroom setting, educators have been charged with the task of explicitly teaching inference making skills to preschool and primary school-aged children (NCEE, 2016). Current curriculum standards demand evidence-based practices for the implementation of all reading and literacy instruction (National Governors Association

[NGA], 2010). Additionally, research has supported the effectiveness of direct and methodical teaching of inferencing skills (Elleman, 2017; Hall, 2016). Therefore, educators need a solid understanding of inference making and how to instruct this skill.

Inference Making Defined

Although the importance of inference making abilities on comprehension is supported in the research regarding young learners (Cain & Oakhill, 1999; Cain et al. 2001; Compton et al., 2014), the way inference making has been defined and studied varies across the extant research literature, making it difficult to generalize and apply findings to educational practice. At the surface level, an inference is made when an individual connects information known with information presented to form a coherent, or whole meaning, of the content. However, the complexities of inference making are evident when considering studies regarding young learners.

For example, some researchers have divided inferences into two categories, such as implicit and explicit (Florit et al., 2011; Paris & Paris, 2003). Implicit is utilizing one's background knowledge to improve overall understanding of the text. Explicit is using information found within the text to bridge gaps from one part of the story to another. Using these definitions, findings support the ability of neurotypical young learners to generate both implicit and explicit inferences.

Notably, Florit et al. (2011) studied over 200 preschoolers in northern Italy using the Test for Listening Comprehension and a researcher created story comprehension task. Children ages 4-6 years demonstrated implicit and explicit inference making abilities following an oral presentation of a story. Participants were read a researcher created paragraph and asked a question requiring either an implicit or explicit inference to be

made. Responses were scored on a 2-point scale with a score of 1 being awarded if the experimenter needed to ask for more information. In addition, several standardized measures were administered, including a listening comprehension test that elicited implicit and explicit inferences following a paragraph and giving multiple choice options through picture presentations. After controlling for age, Florit and colleagues demonstrated a shared variance of 36% (r = .60) for implicit and explicit inference making ability on story comprehension.

Likewise, Paris and Paris (2003) found significant correlations for implicit and explicit inference making and story comprehension during a researcher created prompted comprehension task with young learners (r = .62). Presenting young learners with shortened versions of commercially available storybooks across three distinct tasks, researchers elicited picture walks, story retells, and answers to implicit and explicit inference questions. In both studies, when considered separately, overall performance was better on explicit versus implicit inference making (Florit et al., 2011; Paris & Paris, 2003). Explicit inferences were not only easier for the 4-6 year old study participants to understand, but also more consistently generated for this age group.

Studying elementary age children and focusing on skilled and less skilled comprehenders, using different, but complimentary, definitions of inference making, Cain & Oakhill (1999) found that all participants ages 6 to 8 years experienced more difficulty generating gap-filling inferences, or those aimed at utilizing one's background knowledge to improve overall understanding of the text. Text-connecting inferences, or those requiring the use of information found within the text to bridge gaps from one part of the story to another, appeared easier to generate.

Similarly, using the categories of elaborative versus coherence inferences, Cain and colleagues (2001) studied the inferencing abilities of skilled and less skilled 7 and 8 year-old comprehenders. Coherence inferences were defined as informative links within the story, whereas elaborative inferences were defined as those that add to, or enhance, the text. For example, being able to resolve a pronoun from one part of the text to another would be considered a coherence inference and necessary for comprehension. On the other hand, the creation of an elaborative inference, such as noting the color of a character's fur coat based on information received earlier about a particular animal, would only add more vibrancy for the listener. Analysis following the presentation of an experimenter created story requiring all participants to acquire background knowledge about an imaginary planet revealed literal memory for text did not account for group differences in inference making. Furthermore, although coherence inferences were easier for groups to generate, less skilled comprehenders experienced difficulty with both inference types.

Other researchers have adhered to different labels of inferencing ability, namely global and local coherency (Currie & Cain, 2015; Freed & Cain, 2017; LARRC & Muijselaar, 2018; LARRC et al., 2019). Whereas global coherence is defined as the ability to infer themes, settings, and character changes through the integration of background knowledge, local coherence is the ability to access and manipulate text-based information. In this definition, literature has supported that global coherence is stronger than local coherence in younger children (Currie & Cain, 2015; Freed & Cain, 2017).

For example, Currie and Cain (2015) found novice readers (age 6 years) performed better on global coherence questions following the presentation of four stories

read aloud. Researchers noted that local coherence may present as more challenging for novice readers due to the reliance on grammatical markers such as pronouns. In addition, Currie and Cain found that vocabulary significantly predicted performance on both local and global coherence questions for this age group (R^2 = .36 and .37, respectively). Furthermore, when considering both working memory and vocabulary, vocabulary mediated the effect of working memory on local and global inference generation.

However, in a recent validation study, LARRC and Muijselaar (2018) were unable to reliably separate local and global coherence during an inference task assessment with preschool through third grade participants. Presenting participants with two oral stories followed by local and global inference questions and using confirmatory factor model analysis, researchers noted low factor reliability (.00 - .34) for separating local and global constructs. They suggested, based on these findings, and at least with young children, that inference generation may be best considered a singular construct.

Further magnifying the complexity of inference generation, still others have separated inference skills to specifically address character state, emotion, action, goal, and causal sequences (Filiatrault-Veilleux et al., 2015; Ford & Milosky, 2008; Kendeou et al., 2008; Lepola et al., 2012; Silva & Cain, 2015; Tompkins et al., 2013). For example, Tompkins et al. (2013) studied ten inference types using a preschool story comprehension task with children aged 4-5 years. Researchers found significant correlations between story comprehension and goal (character motivation for completing an action), action (what the character is likely to do), and state (the character's feeling while the action is being completed) inference types. Likewise, in an analysis of 16 previous research studies Filiatrault-Veilleux and colleagues (2015) noted goal and

solution inference types were not only similar across studies but also easier for preschool children to understand.

In other research, instead of separately addressing these skills, three broad categories of inference making have been defined (van Kleeck, 2008). Causal inferences combine initiating events, character emotion, goal, action, and solution. Informational inferences combine setting, background knowledge, and text connections. Evaluative inferences judge the character's choices. Considering these categories, van Kleeck noted causal inferences to be more important than informational and evaluative types for preschool children's comprehension during shared storybook reading events.

Finally, the labels of anaphoric, background knowledge, predictive, and retrospective inferences have been identified (Maguet et al., 2021). Anaphoric inferences consider pronoun replacements and synonyms within a text, such as replacing a character's name with a corresponding pronoun in the next sentence. Background knowledge inferences consider the reader's experiences, while predictive inferences require the reader to understand foreshadow. Perhaps the most difficult inference making skill according to this labeling are retrospective inferences, made when a reader connects current information from a story to information or an event that has already occurred in the story. Maguet and colleagues noted that, although children responded well to the explicit teaching of these four inference types in a recent qualitative study, more research is needed.

Influential Comprehension Frameworks

Whether considered in a singular form, that of inferencing, or as multiple constructs, inference making is regarded a critical skill for comprehension. Therefore,

numerous frameworks exist in an attempt to explain the formation and role of inference making. Several examples include the situation model (Kintsch & van Dijk, 1978; Kintsch, 1986), construction-integration model (Kintsch, 1988), direct and inferential mediation model (DIME; Cromley & Azevedo, 2007) and, more recently, the inferential language comprehension framework (iLC; Kendeou et al., 2019). These models support the idea of inferencing as foundational and continuous for comprehension.

One of the first frameworks developed to address the importance of inferencing for cohesion, Kintsch and van Dijk (1978) recognized the need to consider text-based and gap-filling information in their situation model of comprehension (Kintsch, 1986). Both as a foundational skill to achieve coherence at the text level, and as a means to connect experiences to the text allowing for deeper meanings, the situation model differentiates inference classifications. Text based inferences are those necessary for understanding the text itself, whereas the reader's situation, or mental, model fills in the information with knowledge to construct deeper meaning (Kintsch & van Dijk, 1978; Kintsch, 1986).

Likewise, the construction-integration model of comprehension proposes the formation of bottom-up mental representations acting in harmony with top-down knowledge integration simultaneously leading to successful understanding of text (Kintsch, 1988). Text, linguistic input, and background knowledge support construction, while coherency is built in integrating new and existing information, suppression of unnecessary representations, and constant on-line activations (Gernsbacher et al., 1990; Kintsch, 1988, 1998; McNamara & Magliano, 2009). Construction and integration are not hierarchical; both can and do occur concurrently as general inference ability shapes connections (Kendeou et al., 2008; Kintsch, 1998). Furthermore, Kintsch (1988) asserts

that association building is an online process with constant, and automatic, working and reworking of coherent representations.

Expanding upon the idea of skill integration, the direct and inferential mediation model (DIME) proposed by Cromley and Azevedo (2007) explores the interaction of background knowledge, inferencing, strategy use, vocabulary, and word decoding to explain the influence of skills at any given point in time. Considering each separately and then integrated, the model proposes background knowledge and vocabulary as having the largest direct effects on comprehension, while also having effects mediated by inferencing and word reading (Ahmed et al., 2022; Oslund et al., 2018). In addition, word reading and inferencing demonstrated direct effects on comprehension with inferencing also mediating effects for the predictors of vocabulary, strategy use, and background knowledge.

Finally, the inferential language comprehension framework (iLC; Kendeou et al., 2019) encompasses concepts from traditional theories such as the construction-integration model (Kintsch, 1988) within modern, technologically driven constructs. Accounting for a variety of circumstances, the framework attempts to move inference generation to the forefront of sound comprehension ability, regardless of text type, visual, or symbolic input. Core assertions of the iLC framework directly align with the construction-integration model's active process of developing connections through inference generation to bridge concepts given bottom-up and top-down interactions (Kendeou et al., 2019).

Using these theoretical models of comprehension to drive inferencing classifications has implications for classroom instruction. Instead of incidentally

addressing inferencing to support learning in the classroom, educators can purposefully instruct inference skill to support comprehension growth. In fact, inference making instruction and intervention has been supported in the extant literature as a viable means to improving comprehension abilities for young learners (van den Broek et al., 2011; Zucker et al., 2010).

Inference Making Instruction

Considering the ability of young learners to make inferences and the importance of inference making for comprehension (van den Broek et al., 2011), several studies addressing inference instruction for this age group have emerged. Although there may be some difficulty in the generalization of findings across inferencing intervention research, overall when educators ask inferential questions and use inference-based instruction with young learners positive effects have been noted (Elleman, 2017).

For example, van den Broek and colleagues (2011) implemented a question and answer intervention during a story listening task with children aged 2-3 years and 8-9 years. All children in the study were asked questions both during and after story presentations. Following intervention, researchers showed comprehension gains in both preschool and elementary-aged groups with effect sizes of .34 and .60 respectively. Furthermore, they concluded that questions asked during reading to access online processing of information appeared more beneficial for both groups.

Likewise, studying 25 preschool teachers during a mixed narrative-informational reading of a text, Zucker et al. (2010) noted 57.2% of teacher's questions were inferential in nature. Considering both teacher utterances and children's responses, the researchers developed a coding system for measurement and analysis. Following classroom

observations of teacher-child interactions, descriptive statistics and sequential analysis were used to determine the influence of inferential teacher questions on the complexity of children's responses. Results indicated children produced statistically significantly more complex responses, with more abstraction and deeper meaning, when teachers asked inferential questions.

Elleman (2017) reviewed research focused on instructional approaches for inference making. Analyzing studies available from 1950 through 2014 with school-aged participants, 25 met criteria for inclusion. Elleman coded inference making instruction across studies to include a category of inference type, or those that specifically addressed inference making classifications (i.e., local versus global, implicit versus explicit, character state versus action, etc.), noting the lack of agreement in definition across studies. Findings revealed the benefits of small group instruction, instruction for both skilled and less-skilled readers, and instruction focused on executive function skills, but noted the difficulty in generalizing the evidence to practice.

Teacher Knowledge and Inference Making

Regardless of definition or instructional method, overall research supports the importance of inference making abilities for comprehension and the ability of young learners to infer (Elleman, 2017; Florit et al., 2011; Kendeou et al., 2008). Educators, therefore, are charged with needing to possess the knowledge to instruct students in this area. Although multiple past studies have addressed teacher knowledge in relation to phonological and orthographical skills, to date, no known studies of teacher knowledge specific to inferencing skills exist.

For example, Moats and Foorman (2003) distributed knowledge surveys to educators in the Houston and Washington, D.C. areas. The survey focused on content such as phoneme counting and identification, grapheme correspondence, grammar constructs, and reading fluency. Results indicated difficulties across multiple areas of phoneme and phonological awareness and spelling. Additionally, researchers noted educators involved regularly with professional development learning opportunities achieved higher survey scores.

Other studies focusing on literature, phonological awareness and phonics have had similar results. Cunningham and colleagues (2004) addressed teacher content knowledge of children's books, awareness of phonemes, morphemes, and letter-sound correspondence, as well as self-perception of skill. They included teachers of kindergarten through third grade students. Results indicated low overall knowledge of children's literature, phonological awareness, and phonics.

Though not specific to inference skill knowledge or instruction, recently, several studies have considered teacher knowledge of comprehension (Jakobson et al., 2022; Loveall et al., 2022). Jakobson and colleagues interviewed Estonian general education and special education teachers and coded results quantitatively to address teacher knowledge of comprehension, and comprehension strategies and instruction. Results demonstrated teachers conceptualized comprehension as cognitive awareness of syntax, vocabulary, grammar, and fluency. Whereas special education teachers were more likely to discuss a wide variety of comprehension strategies, fluency and reading accuracy tasks were mentioned the most.

The Current Study

In order to implement evidence-based inference skill instruction in the preschool and early elementary classroom, educators must have a sound knowledge of inference making skill. Evidence-based instruction requires educator knowledge not only of inference making but the importance of inference development for comprehension. In other words, to effectively teach a skill, it is important for an educator to know exactly what that skill is and how it is operationalized. In addition, educators must be able to bridge research-to-practice in order to understand the why behind what they are teaching.

Although the importance of educator knowledge in supporting comprehension instruction in the classroom is agreed upon to date, educator knowledge studies have focused on foundational skills for reading, such as phonological awareness and phonics (Cunningham et. al., 2004; Macken-Horarik et. al, 2018; Moats & Forman, 2003). Currently, few studies exist on educator knowledge specifically in relationship to inference making skills. However, it is without question that comprehension is a pillar of reading and inference skill is necessary for comprehension (NELP, 2008; NCEE, 2016). Therefore, this study seeks to begin to understand the importance of educator knowledge of inference making skill as it supports classroom instruction in the preschool and early elementary grades.

Specifically, when considering inference making skills, this study aims to explore whether educators: (a) possess the knowledge to accurately identify an inference, (b) have adequate knowledge regarding the inference making capabilities of young learners as identified through previous research, and (c) are familiar with evidence-based inference making instructional methods for young learners.

CHAPTER TWO: REVIEW OF THE LITERATURE

Inferencing is the ability to make connections within and surrounding acquired information in order to establish coherency for comprehension (van den Broek et al., 2015). Accordingly, inferencing has been the topic of much comprehension research over the past several decades (e.g., Cain & Oakhill, 1999; Elleman, 2017; Hogan et al., 2011; Perfetti & Stafura, 2015). Whereas there is lack of consensus on classifications of inferencing across studies, this research has demonstrated agreement that inferencing is a critical skill for establishing coherency and should be a part of focused comprehension instruction for young learners.

Inference Classification

Perfetti and Stafura (2015) noted that poorly operationalized inferencing "taxonomies" are the result of multiple definitions of inferencing skill. This is problematic because it lends to difficulty when attempting to generalize findings across inferencing research (Elleman, 2017). Additionally, translating research to classroom practice is not clear-cut when unique labels of inferencing skill exist from study to study. A review of the extant literature has revealed the use of both multiple category types of inferencing and the classification of inferencing into two categories (i.e., text-connecting and gap-filling). However, if carefully considered, these classifications appear to overlap and can be grouped to think about inferencing skill as connecting information within the media presented and bridging information acquired from the presented media with general knowledge (Cook & O'Brien, 2015), where media refers to information presented orally, visually, or in text.

Researchers who classify inferencing using multiple categories have looked at specific events or character's response. Considering a variety of labels, with some studies including close to 10 or more (Kendeou et al., 2008; Tompkins et al., 2013) most have broadly identified the importance of character goal, action, and state within these multiple categories. Goals are what drives the character to do what they are doing (motivation), actions are causal and connect from one point of the presented material to another, and states involve consideration of a character's emotions (Kendeou et al., 2008; Tompkins et al., 2013).

Studies eliciting multiple classifications of inferencing mostly focus on what Perfetti and Stafura (2015) refer to as the highest level of a three-part pyramid, where literal meaning constructs the base, connections made within the media comprise the middle, and knowledge bridging inferences form the point. All inferences within these defined categories are not necessary to understand the general meaning (such as information one would gain from a pronoun referent), or the middle of Perfetti and Stafura's pyramid. Rather, they assist a comprehender in weaving together what is presented to elicit deeper meaning.

For example, Kendeou and colleagues (2008) included 6 inference types in their study of children 4-6 and 6-8 years old. Goal, action, causal antecedents, causal consequences, character emotion, and state inferences were considered to explore connections a learner could make during presentations of varying media. Causal antecedents referred to inferences that involved an action proceeding or leading to another action. Causal consequences were labels used for inferences that were the result of a character's action. Emotions and state inferences were considered separately to refer

to character descriptors of desire and attributes. Following stories narrated, read, and watched (videos), researchers presented participants with open-ended questions. Inference skill corelated across presentations with goal, causal antecedents, consequences, and actions accounting for most of the measured variance in participant's comprehension regardless of age.

On the other hand, some researchers have classified inferencing skill into two categories, inferences that connect information within the presented media and those that require background knowledge activation to fully understand the media (Hall, 2016). Labels for inferences that require connecting media-based information include explicit, text-connecting, local, and anaphoric or coherence. Labels for inferences that fill in gaps in the media using an individual's background knowledge include implicit, gap-filling, global, and elaborative.

Whereas varying classifications of inferencing clearly exist in the literature, it is feasible to consider these broad categories of media-connecting versus gap-filling inferences and sort all other labels in this way. As previously demonstrated, research classifying inferencing into multiple categories addresses the establishment of gap-filling coherency or only the highest point of Perfetti and Stafura's (2015) pyramid. However, research classifying inferencing into two categories addresses the establishment of gapfilling and presentation-based coherency, or the point and the middle of Perfetti and Stafura's pyramid.

In order to ease the discussion of findings in the extant literature regarding inferencing when considered as a two-category classification, this review will refer to inference types as local versus global. This terminology was selected as it is inclusive of

young learner's ability to form inferences from varying presentations beyond just text and it was also easily understood during a cognitive interview with a literacy expert (to be discussed in depth in Chapter 3). Whereas local inferences are often considered necessary for comprehension, inferences that are global are not (Cook & O'Brien, 2015). Instead, global inferences are thought to enhance connections with what a learner knows in order to better relate with the presented media (van Kleeck, 2008).

Although some have supported a stronger ability for young learners to formulate global inferences (Currie & Cain, 2015; Freed & Cain, 2017), most researchers have demonstrated local inferences are easier to formulate for young comprehenders (Cain & Oakhill, 1999; Cain et al., 2001; Florit et al., 2011; Gough Kenyon et al., 2018; Paris & Paris, 2003). For example, Cain and colleagues (2001) studied the inferencing abilities of both skilled and less skilled 7-8 year old comprehenders. Using a researcher-created story read-aloud about an imaginary place, participants were assessed on their ability to make local and global inferences. Results demonstrated that for both skilled and less skilled comprehenders, local inferences were easier to formulate than global inferences.

Inference Skill Instruction

Research has supported the direct and systematic instruction of inferencing for making gains in comprehension skill (Elleman, 2017; Elleman & Oslund, 2019). This instruction can begin before children are able to read independently and continue throughout their educational career (Kendeou et al., 2008). In addition, the continuous development of inference skills as a learner interacts with media (Kelly & Moses, 2018) can be strengthened through instruction (Elleman, 2017).

In a synthesis of research, Hall (2016) conducted an analysis of nine inference instruction studies. Whereas four of the studies specifically addressed teaching strategies to elicit local inferences, three focused on global inference strategies to draw upon background knowledge. The additional studies instructed a mixture of both local and global inferences. Hall's review noted that all studies achieved statistical significance using a pre-posttest design with either standardized or researcher created measures, or a combination of both.

For example, as part of a large format comprehension study in France, Bianco and colleagues (2010) instructed 88 teachers to implement a shared reading intervention with more than 80 preschool and kindergarten students. A focus on strategies to develop local inferences, as well as reasoning and problem solving, was noted. Researchers reported that students who received training for inference making strategies demonstrated significant growth in overall comprehension. Additionally, this growth was maintained for 9 months following intervention.

Likewise, van Kleeck and colleagues (2006) studied the effect of an interactive reading intervention on the ability of preschoolers diagnosed with impaired language. Specifically utilizing a control-treatment group design with random assignment, the researchers implemented an 8-week intervention with a focus on literal and inferential questioning. Whereas some gains were observed in both the control and intervention groups, results revealed statistically significant growth in the inferential skills of children assigned to the intervention group. Of note, the researchers did not classify the type of inference question instead treating inference making as a singular construct.

Additionally, extending the benefits of this instruction to school-age, McMaster and colleagues (2012) designed a 9 week inferencing instruction study for elementary students grouped according to reading skills. Students were paired with a peer, matching a skilled reader with a struggling reader. Students were grouped into three intervention conditions: general (global) inference questioning, causal (local) inference questioning, and literal questioning. Students were then trained by a classroom teacher to work as a peer model in reading, questioning, and giving feedback. During each intervention session, students sat with their designated peer and were provided with a narrative text. The teacher read the text stopping at predetermined points and asking questions. Students worked together to answer the question, with the peer model giving a specific prompt dependent upon condition. Using a repeated measures analysis of variances, the researchers found that all three intervention groups made reading gains during the study. However, struggling readers who elaborated and tended to inaccurately infer during reading on the outset demonstrated the greatest benefit from the local inference questioning intervention. On the other hand, struggling readers who restated the presented text on the outset demonstrated the greatest benefit from the global questioning intervention.

Finally, Loveall and colleagues (2022) studied speech-language pathologists' approach to reading instruction and their confidence in focusing on reading specific skills during intervention through the use of a widely distributed survey. Although the study did not specifically address inference skill knowledge or instruction, results indicated that speech-language pathologists did not feel well prepared to work on reading comprehension with their students. In addition, respondents noted that they were not

confident about their knowledge of reading development or disabilities and, although they often worked with students with reading impairments, comprehension strategies were not a focus of their sessions.

Inference Skill Strategies

The available research on inference instruction for young learners has evidenced several themes. Both using questions for eliciting inferences during shared media presentations and directly teaching the use of strategies for making inferences were noted as effective (Hogan et al., 2011; Kelly & Moses, 2018; van Kleeck, 2008). Additionally, small group work appeared to support the benefits of inference skill instruction (Elleman, 2017; Hall, 2016).

Questioning during read aloud or shared storybook interventions was an effective method for inference skill instruction (Elleman, 2017; McMahon-Morin et al., 2021; van Kleeck, 2008). This strategy involved utilizing inference questions while an educator encouraged learners to actively listen to a story being orally read. For young learners, local and global inference questions embedded systematically during shared story tasks were more effective than questions presented after the story (Freed & Cain, 2017; van den Broek et al., 2011; van Kleeck, 2008). Likewise, educators posing inferential questions during shared literacy moments among students supported greater inference making skills in young learners (Filiatrault-Veilleux et al., 2015; Kelly & Moses, 2018).

Direct teaching of strategies for inference making was also noted throughout inference skill instruction research (Hall, 2016; Hogan et al., 2011; Maguet et al., 2021; van Kleeck, 2008). For young learners, direct teaching of background knowledge using think-aloud strategies was common. For example, educators who participated in an

instructional study conducted by Maguet and colleagues (2021) reviewed with students the concept of background knowledge and, as learners, the importance of connecting a past experience, or something already known, to the presented media. Educators then demonstrated how students could think-aloud to determine their background knowledge about a specific word or concept.

Finally, small group instruction was noted throughout inference instruction methodology research. Whereas some studies utilized a whole classroom approach (McMahon-Morin et al., 2021; Zucker et al., 2010), the majority found benefits instructing inference making skills in small group settings (Elleman, 2017; Hall, 2016). Guided and small group instruction allowed for increased inferential questioning through teacher modeling and student interactions (Morrow et al., 1999; Stahl, 2014; van Kleeck, 2008).

Teacher Knowledge to Support Inference Instruction

Although more research is certainly warranted to continue considering the effects of systematic inferencing instruction on the literacy growth of preschool and early elementary students, the importance of inferencing skills for comprehension development and the ability of young learners to form inferences is clearly supported (Cain & Oakhill, 1999; Filiatrault-Veilleux et al., 2015; van den Broek et al., 2011). Therefore, educators in pre- and early elementary classrooms should not only be charged with fostering foundational skills, such as phonological and phonemic awareness, but also with enhancing inference making abilities (Elleman & Oslund, 2019). However, the question remains as to whether educators possess the knowledge base to meaningfully engage their students in generating inferences to support comprehension abilities.

Morrow and colleagues (1999) observed several experienced first grade teachers in the northeastern United States during their English language arts teaching block. All educators planned collectively and held a similar philosophy of contextual skill instruction with reinforcement throughout the day in natural environments. Inferencing instruction was provided through the teaching of strategies for referring to the text and predicting. The observed teachers were ranked highly by administration because their students consistently showed growth and performed well on monitoring measures.

Likewise, Pressley and colleagues (2001) studied teacher knowledge of, and behavior during, literacy instruction in 30 classrooms across five states. The researchers observed and interviewed first grade teachers who administrators identified as being either typical or exemplary in their teaching of literacy. Focus was placed on the teachers' instruction of foundational skills such as phonological awareness, as well as comprehension and writing skills. The observations also considered behaviors such as management of the classroom and positivity. All collected data was analyzed qualitatively. Results supported the integration of foundational skill teaching and comprehension strategies by exemplary teachers. Furthermore, all teachers identified as being exemplary implemented specific comprehension skill instruction including inferencing strategies.

One recent study specifically questioned educators' knowledge of comprehension. Jakobson et al. (2022) interviewed 65 general education and special education teachers in Estonia regarding their knowledge of reading comprehension and instructional strategies. Researchers collected responses to questions of what encompasses text comprehension, strategy use and understanding, and teaching struggling comprehenders. Responses were

coded to allow for quantitative analysis. Results indicated a majority of educators noting fluency and reading accuracy in relation to comprehension knowledge and instructional strategies (77%). Also, linguistic skills and a student's attention to reading and motivation were identified by educators as necessary skills for good comprehension. However, close to one third of participants were unable to give an example of a reading comprehension strategy. In addition, educators seldom discussed inference making skills or strategies as important to comprehension. Background knowledge as a necessary component for cohesion was only noted by one fifth of the participants. Overall, researchers found both general educators' and special educators' responses to lack specific knowledge of reading comprehension and comprehension strategy instruction.

Previous Educator Knowledge Study Designs

Previous educator knowledge studies have implemented similar study designs to explore the relationship between skill instruction and educator knowledge. Some have gathered information through observation or interview (Carlisle et al., 2011; Jakobson et al., 2022; Morrow et al., 1999; Pressley et al., 2001). Other researchers have explored educator knowledge in relation to foundational literacy skills utilizing the survey design to gather information (Bos et al., 2001; Cunningham et al., 2004; Macken-Horarik et al., 2018; Moats & Foorman, 2003; Sangster et al., 2013).

For instance, Moats and Foorman (2003) longitudinally implemented three phases of a survey to assess kindergarten through fourth grade educators' knowledge of foundational literacy skills, including phonological and phonemic awareness. Phase one of the study elicited responses through open ended questions designed to explore the ability of classroom teachers to match sound and print concepts. Phase two required

educators to complete close ended knowledge questions containing prefixes and suffixes, identify phonemes, and identify spelling patterns. The final phase of the survey study used information gathered in the first two phases and included more components such as analysis of a student writing and oral reading sample. Frequency of response results were reported. Results indicated 43% of teachers surveyed demonstrated partial knowledge, or errors on 4-6 of 19 items, on the concepts questioned.

Likewise, Cunningham and colleagues (2004) assessed educator knowledge of phonics, phonological awareness, and children's literature using similar or previously developed survey tasks and sampling over seven hundred kindergarten through third grade educators during a professional development conference. Following survey distribution, the researchers reported Cronbach's alpha (.40-.86 across constructs) and completed correlational analysis using unpaired *t*-tests with effect sizes (Cohen's *d*). Significant differences were noted between teachers' perceived and actual knowledge in phonological awareness. However, no significant differences were observed between teachers' perceived and actual knowledge of implicit or explicit phonics. In addition, comparisons of educator knowledge and years of experience noted educators with little to no experience scored better than those with fifteen or more years of experience for phonological awareness and explicit phonics, though differences in implicit phonics and children's literature were not indicated.

Macken-Horarik and colleagues (2018) surveyed over three hundred kindergarten through twelfth grade Australian educators regarding their knowledge of language and grammar, as well as their confidence in teaching the subject area. Results were analyzed through quantitative response frequencies and Cronbach's alpha for reliability (.72-.89

for all constructs). In addition, cross tabulation analysis and chi-squared tests were utilized to examine relationships between variables and several open-ended responses were coded inductively. Researchers noted statistically significant relationships among Australian educators' knowledge of grammar and confidence, and teaching experience. Results also demonstrated educators' desire for professional development opportunities.

Other researchers considered survey data through the use of analysis of variance or exploratory factor analysis (Al Otaiba et al., 2019; Binks-Cantrell et al., 2012; Sangster et al., 2013). For example, Sangster and colleagues (2013) conducted a survey consisting of scaled questions assessing knowledge of literary terminology and parts of speech, along with questions regarding an educators' perceived knowledge of these constructs. In addition, a task requiring participants to analyze three literary passages was administered. Tasks were carried out with 383 pre service teachers in Scotland pursuing undergraduate and postgraduate level degrees. Researchers employed factor analysis for scaled items and identified grammar terminology and knowledge of literature as accounting for 73% of the measure's variance. Perceived knowledge, or educator confidence, was considered using analysis of variance and statistically significant mean group differences were identified, with primary pre service teachers performing worse on the measure than secondary pre service teachers. Whereas postgraduate educators outperformed those in undergraduate programs on skill based tasks, collectively, disconnects were noted among the perceived and actual knowledge of the educators studied.

Purpose of This Study

Beyond observation, little research exists regarding educator knowledge of inference skill and instruction. Whereas Moats and others (Bos et al., 2001; Cunningham et al., 2004; Foorman & Moats, 2004; McCutchen et al., 2002; Moats, 2009; Sangster et al., 2013) have viewed educator knowledge in relation to phonological awareness, phonics, grammar, and orthographic conventions, there are limited studies of educator knowledge on inferencing, no less comprehension strategies in general (Jakobson et al., 2022; Loveall et al., 2022). As Elleman (2017) noted in her extensive analysis of inference instruction research, "It is unclear if teachers are aware of evidence-based strategies for teaching inference generation and whether skilled and less skilled readers have equal opportunities to practice these skills in the classroom" (p. 772).

The lack of current research on educator knowledge of inferencing skills serves as a timely indicator of the present study's purpose. Clearly, the extant literature has addressed theoretical frameworks, inferencing taxonomies, inference making skill development, and intervention. However, it falls short in its connection to practice and what educators must know in order to implement evidenced inference skill instruction for comprehension. Therefore, this study will address the following questions:

1. What is the construct validity and reliability of the survey measure developed?

2. Do educators possess the knowledge to accurately identify an inference?

    2a. What is the relationship between educator knowledge to accurately identify an inference and educators' years of experience?

2b. Is there a difference in educator knowledge to accurately identify an inference based on role?

2c. Is there a difference in educator knowledge to accurately identify an inference based on training?

3. Do educators have adequate knowledge regarding the inference making capabilities of young learners as identified through previous research?

3a. What is the relationship between educator knowledge regarding the inference making capabilities of young learners and educators' years of experience?

3b. Is there a difference in educator knowledge regarding the inference making capabilities of young learners based on role?

3c. Is there a difference in educator knowledge regarding the inference making capabilities of young learners based on training?

4. Are educators familiar with evidence based inference making instructional strategies?

4a. What is the relationship between educator knowledge regarding inference making strategies and educators' years of experience?

4b. Is there a difference in educator knowledge regarding inference making strategies based on role?

4c. Is there a difference in educator knowledge regarding inference making strategies based on training?

CHAPTER THREE: METHODOLOGY

Design

Considering the extant literature on young learners inference making skills and previous educator knowledge studies, the development of this study followed a sequential-exploratory design. This design was appropriate because it allowed for purposeful collection of qualitative data in order to strengthen the collection of quantitative data (Terrell, 2016). First, a preliminary survey consisting of 33 questions (see Appendix A) was developed by the researcher. Next, utilizing the preliminary survey, cognitive interviews were conducted separately with a reading coach and speech-language pathologist to strengthen the face validity of the measure, considering an educator's knowledge of inferencing making abilities of young learners, terminology within theoretical frameworks, and instructional methods. Finally, using the information gained from the interviews along with expert review feedback and existing literature, the researcher made alterations to the preliminary survey resulting in the final educator knowledge survey that was disseminated (see Appendix B).

Measure Development

Cognitive interviewing involves allowing a participant to explicitly describe their thought process as they read and respond to individual survey questions (Desimone & Le Floch, 2004). In this process, the researcher meets with the participant and allows time to talk through each item, having the individual describe what they were thinking and how they derived an answer. The use of cognitive interviews as a preliminary measure to guide survey development was chosen for this study to assist in assuring questions were asking what they intended to and participants understood what was being asked.

During the development phase of the survey, two cognitive interviews were conducted individually with a reading interventionist and speech-language pathologist to explore their interpretation of and response to individual questions. Changes were made to the survey including using the terms local versus global inferencing instead of text-based versus gap-filling inferencing, widening of text-based to media-based, altering the middle value on the sliding scale questions from "unsure" to "neutral," and adding a question to explore why educators thought teaching inferencing was useful.

As an additional preliminary measure during survey development, an expert review of the survey was elicited. Following review, a need for more precise professional development questions as well as purposeful ordering of items was identified. Likewise, the need for clearer instruction for each question type was noted, as well as altering professional development questions to have drop down options (versus a sliding scale). In addition, and similarly to feedback collected during the interviews, a recommendation for more questions regarding educator knowledge of the importance of inference making for comprehension was made.

The final survey consisted of 40 knowledge questions, plus four questions eliciting demographic information, including role as an educator, years in role, and highest degree earned. Questions 5 and 6 asked for amount of formal and additional training. Question 7 was an open-ended question asking a respondent to define inference. Questions 8-11 regarded level of confidence working on inferencing with students. Questions 12-24 and 37-44 were inference knowledge based. Questions 25-36 explored how the respondent instructs inferencing, with questions 35 and 36 requiring an

open-ended response. To answer research question number one, both construct validity and reliability of the measure were examined (see Chapter 4).

Participants and Procedure

Non-probability, purposeful sampling was used to electronically distribute the survey to professionals working with young learners, that of preschool and early elementary classroom teachers, special education teachers, reading coaches (interventionists, specialists), and speech-language pathologists. Recruitment occurred through direct email contact using platforms such as the American Speech-Language and Hearing Association's online community bulletin board (ASHA, 2022), the National Association of the Education of Young Children's list of accredited centers (NAEYC, 2022), and statewide principal listservs. Additionally, educators from several school districts located in two mid-southern states were directly recruited for participation through contact with school human resource departments, instructional supervisors, headmasters, and principals. University teacher educator program deans were also contacted for survey dissemination to Masters level educators in a dozen universities across the same states.

Sampling procedures aligned with methods utilized in previous survey study research. For example, Macken-Horarik et al. (2018) recruited participants for a grammar knowledge survey using national professional platforms in Australia. Others disseminated their research through local area school districts with direct contact to building-level principals (Al Otaiba et al., 2019; Moats & Foorman, 2003; Cunningham et al., 2004). Finally, Bos et al. (2001) and Sangster and colleagues (2013) chose to recruit survey participants directly from university teacher education programs.

For this study, personally identifying information was not collected on respondents. The demographics of educational role, years of experience, and highest degree earned were noted. Although a question regarding what age group of students an educator worked with was elicited, it was decided not to use this information as part of the analysis due to a potential flaw. The question asked educators to choose the grade level with which they most closely associated. However, during development, an option of choosing multiple items, or all that applied, was added. Although this was a necessary addition, the wording of "most closely" should have been altered at that time. Therefore the question could not be used in descriptive analysis. However, qualitative review of responses noted all respondents checked at least one item, indicating that the sampled population did work directly with young learners, as intended.

It was the intention to collect survey responses from roughly 200 individuals. Past educator knowledge research elicited the participation of anywhere from 200 to over 700 individuals through direct paper-to-pencil or online dissemination (Bos et al., 2001; Cunningham et al., 2004; Sangster et al., 2013). Whereas it has been suggested that roughly 100 participants in survey research are needed at minimum to complete viable data analysis, other guidance for suggested sample size varies (Memon et al., 2020). For example, in order to complete a multiple regression analysis of data, Green (1991) proposed the following equation, where N equals the number of participants and m equals the number of predictors: $N >/= 50+8m$. Using Green's suggested method, and considering the predictors of educator role, amount of training, and years of experience, 74 participants would be necessary to complete correlational analysis. Following online survey dissemination, the number of respondents was 82. Not including dissemination to

ASHA's online community bulletin board which reports roughly 4,000 subscribers, it was estimated that the survey reached 800 professionals. This demonstrated a response rate of roughly 10%. This response rate is low even for online survey research (Wu et al., 2022) and will be discussed further as a limitation in Chapter 5.

Data Analysis

Whereas some of the previous educator knowledge research did not include in-depth or statistical analysis of results, discussing most findings qualitatively, others discussed results using descriptive statistics (Cunningham et al., 2004; Foorman & Moats, 2004) or correlational and regression analysis (Bos et al., 2001; Macken-Horarik et al., 2018). Macken-Horarik et al. (2018) examined frequencies to demographic questions and analyzed educator responses to Likert-scale questions using Pearson's correlations. Likewise, Bos and colleagues (2001) utilized an analysis of variance (ANOVA) to consider differences among pre- and in-service teachers' knowledge of foundational reading skills. In order to consider relationships among variables, and due to a small sample size, descriptive analysis and statistical analyses, including correlations, t-tests, and ANOVA, were chosen for the current study (Green, 1999; Memon et al., 2020).

Under IRB regulations, a researcher cannot mandate a response to any given question on a survey. Therefore, with the exception of the informed consent, all survey item responses were optional. For informed consent questions, a respondent had to choose "yes" or "no." If "no" was selected, the survey automatically ended. Responses of "yes" demonstrated consent was received and the respondent was able to move forward with the survey.

The total number of survey respondents equaled 82. However, 6 respondents did not complete, or answered "no," to questions gaining consent and were eliminated from the study. Therefore, for the purpose of analysis, the total number of respondents (*N*) equaled 76. For items where all 76 respondents did not answer, pairwise deletion was utilized. This method of accounting for missing data was chosen in order to maximize the use of available data and consider all viable responses (Field, 2013).

For the current study, four independent variables were chosen based on the research questions selected. The independent variables of educator role, years of experience, formal training, and additional training were used to explore the outcomes of educator knowledge to accurately identify an inference (EK), educator knowledge of the inference making capabilities of young learners (EKYL), and educator knowledge of inference making instructional strategies (EKIS), thus considering the sub parts of research questions 2- 4.

Response distributions for the independent variables of educator role, experience, formal training, and additional training can be found in Table 1. Of the total number of respondents, 52% were classroom educators (general education or special education teachers) while 48% were itinerant service providers (reading specialists or speech-language pathologists). Overall, 11% noted having less than a year of experience in their role while 26% of respondents reported having 15 or more years of experience. Most respondents had earned a Masters level degree in their field (63%) with 20% having earned a Masters degree plus certification or endorsement (i.e., Certificate of Clinical Competence).

Table 1

Distribution of Responses of Independent Variables

Variable	Number of Respondents	Percentage of Respondents
Educator Role	75	
General or Special Education Teachers	39	52
Reading Specialists or Speech-Language Pathologists	36	48
Years of Experience	74	
Less than 1 year	8	11
1-4 Years	14	19
5-9 Years	18	24
10-14 Years	15	20
15 or More Years	19	26
Formal Training	71	
None	19	27
Low	45	63
High	7	10
Additional Training	68	
None	31	46
Instructor-Led PD	20	29
Manual or Materials	11	16
Combination	6	9

Note. Number of respondents reflects responses received per variable. Total $N = 76$.

In order to analyze the amount of formal training received in reading comprehension and inferencing skills, responses to the question asking how much formal training have you had were condensed to none, low, and high levels of training. Low level of formal training was defined as having one course on foundational reading, reading comprehension, or language skills at the university level. High level of training was defined as having two or more courses at the university level. The majority of respondents noted low levels of formal training (63%) with 10% reporting high levels of formal training, and 27% no formal training.

Likewise, the amount of additional training received in inference making skills (responses to the question asking how much additional training have you had) was condensed to none, instructor-led professional development (PD), use of a manual or other materials, and a combination of instructor-led and other materials. Of the respondents, 46% reported no additional training, with 30% noting attendance at an instructor-led PD. Whereas 16% reported use of a manual or other materials, only 9% of respondents noted utilizing multiple sources (instructor-led development, manuals, and materials) to increase their knowledge of inference making skills. However, 70% of all respondents reported they would be "extremely willing" to attend a PD session specifically designed to address inference instruction with young learners.

Three dependent variables were also considered based on the selected research questions. In order to answer the second research question, do educators possess the knowledge to accurately identify an inference, the dependent variable EK consisted of survey questions 37-44, requiring an educator to answer yes and no questions following three short passages. Questions were coded as "0" for incorrect and "1" for correct

response. Three questions elicited identification of a local inference and two questions elicited identification of a global inference. The remaining three questions were literal and, therefore, incorrect if an inference was identified. Reverse coding was utilized for analysis, when necessary, by assigning a "0" if a "1" was indicated and vice versa.

In addition, as part of the variable EK, an open-ended question asking educators to define inferencing (question 7) was considered. This question was inductively coded. Inductive coding allows for exploration of the collected responses and is based solely on themes that emerge in the data (Rouder et al., 2021). Coding revealed five response themes across 57 responses. Individuals defined inference as drawing of a conclusion or predicting an outcome, finding a deeper meaning, understanding what is not explicitly stated, using context clues, and using background knowledge to comprehend.

In order to answer the third and fourth research questions, do educators have adequate knowledge regarding the inference making capabilities of young learners as identified through previous research, and are educators familiar with evidence based inference making instructional strategies, 13 continuously scaled items were initially considered for the dependent variables EKYL and EKIS. The variable of EKYL was derived from responses to five continuously scaled questions (survey questions numbered 14, 16-19). The variable of EKIS was originally derived from eight continuously scaled questions (survey questions 12-13, 15, 20-24). However, reliability analysis led to the deletion of question 24 from the final analysis (see Chapter 4). Responses to all questions were based on a scale of 1-100, with 1 indicating strong disagreement, 50 indicating neutrality, and 100 indicating strong agreement. Reverse

coding was necessary for 5 items (survey questions 13-15, 21 and 24) using the formula (max x) + 1 – (x).

Open-ended questions 35 and 36 were also considered for the variable EKIS through deductive and inductive coding. Deductive coding was completed for the open-ended question asking respondents to describe what inference instruction looked like in their classroom or therapy session (question 35). Deductive coding utilizes themes gathered from previous research to explore current responses (Rouder et al., 2021). Considering the extant literature which revealed instructional themes of questioning utilizing various media, direct teaching of inference making, and small group instruction (van Kleeck, 2008, Hall, 2016, Elleman, 2017, Hogan et al., 2011, Kelly & Moses, 2018), three response types across 43 responses were coded. Additionally, as part of the analysis of the variable EKIS, inductive coding of the open-ended question asking respondents what resources they utilized to teach inference making (question 36) was completed. Overall, across 44 responses, the four response types of manufactured or boxed programs, worksheets and graphic organizers, teacher created tools, and the use of applications or websites were coded.

CHAPTER FOUR: RESULTS

What is the Construct Validity and Reliability of the Survey Measure Developed?

Construct validity refers to the consideration of a measure's alignment with the research questions posed. In other words, is a given measure assessing what it intends to assess. For this study, and in order to answer research question one, construct validity was considered through Smith's (2005) five step model. In addition, the measure's reliability was considered through the use of Cronbach's alpha as a measure of internal consistency (Cronbach, 1951).

Progressing through Smith's (2005) method of construct validation, the constructs chosen for this study, namely educator knowledge to accurately identify and inference, educator knowledge of young learners' inference making capabilities, and educator knowledge of inferencing making instructional strategies were based upon previously existing research on educator knowledge of foundational reading skills (Moats & Foorman, 2003; Cunningham et al., 2004; Macken-Horarik et al., 2018). Second, these constructs were further developed through discussions with professionals and experts in the field of education and reading comprehension. Face validity was established through cognitive interviewing and expert review prior to the measure being piloted. Third, the research design was carefully considered and, based upon the research questions and extant literature, a survey was deemed the most appropriate method of data collection. Fourth, consideration of how well the survey answered the research questions was completed through analysis of reliability. Fifth, and as part of the continuous progression of research, consideration of survey revision will be discussed in Chapter 5 as part of future directions.

Reliability was initially considered both following piloting of the measure. Using standards highlighted by Cortina (1993), an acceptable Kuder-Richardson coefficient of .66 was achieved on dichotomous items asking educators to accurately identify an inference. A low Cronbach's alpha of $a = .40$ was achieved for all scaled questions. It was noted that removal of the question asking educators to rate if a child understands inferences in a visual presentation, it is likely she would be good at inferences in oral discourse and story read aloud (question 15) would raise alpha to within an acceptable range. However, because the survey was piloted on a limited number of individuals, and during cognitive interviews and expert review there was no indication of it posing a threat to face validity, it was decided to leave this question in the final survey and revisit when analyzing results and answering the first research question regarding the validity and reliability of the measure.

Following final dissemination, reliability was again considered for the variables EK, EKYL, and EKIS. On a whole, and utilizing Cortina's (1993) guidelines, the survey's scaled items achieved an acceptable reliability, $a = .59$. When considered separately, the variable EK achieved an acceptable Kuder-Richardson coefficient of .59. The variable EKYL achieved an alpha of $a = .51$. However, EKIS achieved a low reliability, $a = .27$. Deletion of the item of the item asking educators to rate if inference instruction can improve both literal and inferential comprehension for typical learners led to a sizeable improvement, $a = .52$. Therefore, for the final analysis of EKIS questions numbered 12, 13, 15, and 20-23 were utilized.

Do Educators Possess the Knowledge to Accurately Identify an Inference?

Analysis of responses revealed 28% of educators answered all eight questions comprising the variable EK correctly. However, 43% of respondents were unable to provide an accurate response on five or more knowledge questions. Considering local inferences, global inferences, and literal questions separately, 76% of respondents were able to accurately identify a local inference, and 71% of respondents were able to accurately identify a global inference. Surprisingly, only 48% of respondents were able to provide an accurate response to literal questions demonstrating an over-identification of inferences.

Table 2

Measures of Central Tendency and Descriptives for the Variables of EK, EKYL, and EKIS

Variable	*n*	Mean	Median	Mode	*SD*	*SE*
EK	54	6.11	6.0	8	1.57	0.21
EKYL	65	59.39	58.75	50.00	14.95	1.85
EKIS	65	72.85	74.71	72.00	16.71	2.01

Note. Total $N = 76$.

Table 3

Inductive Coding for the Question Asking Educators to Define Inference (Question 7)

Theme	Examples	% Response
Drawing a conclusion or predicting an outcome	The ability to draw a conclusion from the given information; The ability to make predictions from exposure to a text	35
Finding a deeper meaning	Understanding written or spoken content on a deeper level	7
Understanding what is not explicitly stated	The skill to understand what is not directly stated	21
Using context clues	The ability to take clues and use the clues to figure out what the answer is to the question being asked	35
Using background knowledge to comprehend	To take previous/background knowledge and apply it to new knowledge from a story or text to produce an educated thought or idea on the topic	28

Note. *Number of responses received = 57.*

In addition, the open-ended question asking for the definition of an inference was examined based on the prior mentioned coding. Many responses contained several of the coded themes, thus accounting for the collective total of greater than 100%. Of the respondents, 35% mentioned drawing a conclusion or predicting an outcome in their definition. Likewise, 35% included utilizing context clues, while 28% noted prior or background knowledge is needed to form an inference. Whereas 7% of respondents defined inference as forming a deeper meaning or connection, 21% mentioned using

known information to decipher information not explicitly stated. Overall, only 14% of respondents defined inferencing as connecting information known (background knowledge) or presented (context clues) to form a coherent, or whole meaning (deeper meaning, prediction, conclusion) of the content (not explicitly stated). See Table 3 for inductive coding themes and examples.

What is the Relationship Between Educator Knowledge to Accurately Identify an Inference and Educators' Years of Experience?

Before conducting statistical analyses for this outcome, tests of skew and kurtosis were conducted to consider normality of the distribution. The dependent variable of EK (N = 54, M = 6.11, SD = 1.57) had relatively aligned measures of central tendency (see Table 2). A small negative skew of -0.16 was noted with a negative kurtosis value of 1.43. A Shapiro-Wilk test was completed to further assess normality of distribution. The knowledge variable varied significantly from the normal distribution, $W(54) = 0.871$, $p < .001$. Examination of a histogram confirmed a platykurtic shape with heavy tails. Therefore, this variable was judged to be non-normally distributed.

In order to account for the non-normal distribution of EK, a nonparametric Spearman's correlation was run to consider the relationship between EK and educator experience. Results were not significant, $r_s(54) = 0.07$, $p = .642$. This indicated that the null hypothesis could not be rejected. Therefore, no statistically significant relationship between knowledge and experience was found in this study (see Table 4).

Is There a Difference in Educator Knowledge to Accurately Identify an Inference Based on Role?

In order to account for the non-normal distribution of EK, a nonparametric independent samples Mann-Whitney U test was conducted to compare the distribution of ranks in scores for EK among classroom educators and itinerant educators. Although itinerant educators had a lower mean rank score (25.65) than classroom educators (29.35), EK did not differ significantly among the two groups, $U = 314.50$, $z = -0.89$, $p = .375$ (see Table 5). Converting the z score into an effect estimate noted a small effect, $r = .12$. This indicates that classroom educators are no more knowledgeable in identifying an accurate inference than itinerant educators.

Table 4

Correlation Between EK and Educator Experience

Variable	*n*	*M*	*SD*	1	2
1. EK	54	6.11	1.57	-	0.07
2. experience	74	3.31	1.33	0.07	-

Is There a Difference in Educator Knowledge to Accurately Identify an Inference Based on Training?

In order to account for the non-normal distribution of EK, a nonparametric Kruskal-Wallis test was completed to explore ranked group differences among EK scores

(dependent variable) and levels of formal training (independent variable), considering the groups of no formal training (*Mdn* = 7.0), a low level of formal training (*Mdn* = 5.5), and a high level of formal training (*Mdn* = 6.0). Although those with a low level of formal training had higher ranked scores than those with no or high levels of formal training, EK scores were not significantly affected by formal training, $H(2) = 2.30$, $p = .316$ (see Table 6). Converting the *z* score into an effect estimate noted a small effect, $r = .01$. This indicated that, overall, significant differences on EK scores among no, low, and high levels of formal training were not found in this study.

Table 5

Independent Samples Mann-Whitney U Test of Classroom Educators' and Itinerant Educators' Scores for the Variable EK

	Classroom Educators	Itinerant Educators			
Variable	Mean Rank	Mean Rank	*U*	*z*	*p*
EK	29.35	25.65	314.50	-0.89	.375

Likewise, a nonparametric Kruskal-Wallis test was completed to explore ranked group differences among EK scores (dependent variable) and levels of additional training (independent variable), considering the groups of no additional training (*Mdn* = 7.0), instructor-led PD (*Mdn* = 5.0), use of a manual or other materials (*Mdn* = 6.0), and a combination of instructor-led PD and use of a manual or other materials (*Mdn* = 6.0).

Although those reporting no additional training outperformed those utilizing instructor-led PD, other manuals or materials, or a combination of the two, EK scores were not significantly affected by additional training, $H(3) = 0.18$, $p = .981$ (see Table 6). Converting the *z* score into an effect estimate noted a small effect, $r = .13$. This indicated that, overall, significant difference on EK scores and additional training were not found in this study.

Table 6

Kruskal-Wallis Results for the Dependent Variable EK with the Predictors of Formal Training and Additional Training

Variable	*N*	*df*	*H*	*p*
Formal Training	54	2	2.30	.316
Additional Training	51	3	0.18	.981

Do Educators Have Adequate Knowledge Regarding the Inference Making Capabilities of Young Learners as Identified Through Previous Research?

Analysis of individual responses to questions comprising the variable EKYL revealed only 18% of educators strongly agreed (providing a score of 80 or higher) that a learner's ability to construct a global inference is usually not necessary but can deepen a story's meaning. Whereas 67% of educators strongly agreed that learners do not need to be able to decode text before being able to develop inference making skills, only 26.5% recognized that young learners who understand an inference in a visual presentation will likely be good at inference making given oral discourse and story read

alouds. Finally, only 40% of educators strongly agreed that it is important for a learner to make a local inference when a pronoun is used to refer to a previously introduced character.

What is the Relationship Between Educator Knowledge Regarding the Inference Making Capabilities of Young Learners and Educators' Years of Experience?

Before conducting statistical analyses for this outcome, tests of skew and kurtosis were conducted to consider normality of the distribution. EKYL (N = 65, M = 59.39, SD = 14.95) demonstrated aligned measures of central tendency (see Table 2). Positive skew (0.79) and kurtosis (1.05) values were noted. A Shapiro-Wilk test demonstrated that the variable's distribution varied significantly from normal, $W(64)$ = 0.95, p = .007. However, upon examination of the histogram, only a slight positive skew to the left and slight leptokurtic shape was confirmed with a relatively normal distribution curve noted. Therefore, this variable was judged to be normally distributed.

A Pearson's correlation was run to consider the relationship between EKYL and experience. Results were not significant, r = -0.11, p = .376 (see Table 7). This indicated that the null hypothesis could not be rejected. Therefore, no relationship between EKYL and experience was found in this study.

Is There a Difference in Educator Knowledge Regarding the Inference Making Capabilities of Young Learners Based on Role?

An independent samples test was conducted to compare classroom educators (M = 57.56, SD = 11.49) and itinerant educators' (M = 61.16, SD = 17.68) mean scores for the variable EKYL (M = 59.39, SD = 14.95). Levene's test was significant and, therefore, equal variance could not be assumed. Overall statistical significance was not

achieved with $t_{(\$\$)} = -0.97$, $p = .334$, $d = .24$. The ability score for classroom educators was lower than itinerant providers with a mean difference of 3.59 (see Table 8).

Table 7

Correlation Between EKYL and Educator Experience

Variable	*n*	*M*	*SD*	1	2
1. EKYL	65	59.39	14.95	-	-0.11
2. experience	74	3.31	1.33	-.011	-

Table 8

Independent Samples T-Tests of Classroom Educators' and Itinerant Educators' Scores for the Variables of EKYL and EKIS

	Classroom Educators	Itinerant Educators			
Variable	*M(SD)*	*M(SD)*	Mean Difference	*t*	*p*
EKYL	57.56(11.49)	61.16(17.68)	-3.59	-0.97	.334
EKIS	71.13(14.15)	74.52(17.98)	-3.40	-0.84	.402

Is There a Difference in Educator Knowledge Regarding the Inference Making Capabilities of Young Learners Based on Training?

A one-way ANOVA was completed to explore group mean differences among

EKYL scores (dependent variable) and levels of formal training (independent variable), considering the groups of no formal training (M = 59.93, SD = 13.74), a low level of formal training (M = 59.02, SD = 15.15), and a high level of formal training (M = 54.61, SD = 8.47). Equal variance was assumed. The omnibus test revealed no statistically significant differences among EKYL and formal training, $F_{(!,'()} = 0.35$, p = .705 (see Table 9). Further descriptive analysis revealed those with no formal training scored slightly higher than those with low levels of formal training with a mean difference of 0.91, d = 0.06. Those with no formal training also scored higher than those with high levels of formal training with a mean difference of 5.32, d = 0.47.

Table 9

Analysis of Variance Results for the Dependent Variables of EKYL and EKIS with the Predictor of Formal Training

Variable	Sum of Squares	*df*	Mean Square	*F*	*p*
EKYL					
Between Groups	143.76	2	71.88	0.35	.705
Within Groups	12488.50	61	204.73		
EKIS					
Between Groups	980.24	2	490.12	1.20	.145
Within Groups	14977.81	61	245.54		

Additionally, a one-way ANOVA was conducted to explore group mean differences among EKYL scores (dependent variable) and additional educator training (independent variable), considering the groups of no additional training (M = 58.17, SD = 14.44), instructor-led PD (M = 60.51, SD = 19.51), use of manuals or other materials (M = 60.00, SD = 10.84), and a combination of instructor-led PD and use of a manual or other materials (M = 62.88, SD = 11.35). Homogeneity of variance was assumed. The omnibus test revealed no statistically significant differences among EKYL and additional training, $F_{(),\$*)}$ = 0.20, p = .898 (see Table 13). Further descriptive analysis revealed those who reported utilizing a combination of both instructor-led PD and use of a manual or other materials scored higher than those reporting no additional training with a mean difference of 4.71, d = 0.36. Those who utilized only instructor-led PD or used a manual or other materials also scored higher than those reporting no additional training, with a mean difference of 2.34 (d = 0.14) and 1.83 (d = 0.14), respectively. Overall, those utilizing a combination of additional trainings scored higher than those only utilizing instructor-led PD with a mean difference of 2.37, d = 0.15, and those utilizing only a manual or other materials with a mean difference of 2.88, d = 0.26.

Are Educators Familiar with Evidence Based Inference Making Instructional Strategies?

Analysis of responses comprising the variable EKIS revealed 33% of educators strongly agreed that it is appropriate to begin formal inference instruction in preschool. However, 58% strongly agreed that inference instruction should begin at age 7 or older, with only 15% strongly disagreeing. Likewise, 56% of educators strongly disagreed that typical readers benefit more from literal instruction than struggling readers. Overall,

83% of educators strongly agreed that learners can improve comprehension skills through inference strategy instruction. In addition, 64% of educators strongly agreed that background knowledge can be taught to learners using a think-aloud strategy, and 78% of educators strongly agreed that inference strategies can be taught during small group instruction.

Table 10

Deductive Coding for the Question Asking Educators to Describe Inference Instructional Methods Used (Question 35)

Theme	Example	% Response
Questioning utilizing various media	I ask students questions while I read that have to do with how the character might feel, why they are doing something, and what they are doing if it doesn't say in the text. I also ask a lot of why questions.	86
Direct teaching	daily instruction with read alouds, written expression, and independent reading	30
Small Group Instruction	Small group intervention with 4 students. Explicitly taught to use context and pictures clues to make a smart guess	12

Note. *Number of responses received = 43.*

The open-ended question asking for educators to describe their inference instructional methods was examined based on the prior mentioned deductive coding (see Table 10). Responses were not mutually exclusive and, therefore, a collective total of

greater than 100% exists. A majority of respondents described their instruction as involving questioning and prediction through the use of various media (86%). Additionally, direct teaching of inference making was noted by 30% of respondents. However, only 12% of respondents indicated utilizing small group instruction to address inference making.

Table 11

Inductive Coding for Open Ended Question Asking Educators What Resources They Utilized to Teach Inferencing (Question 36)

Theme	Example	% Response
Manufactured programs	Expanding Expressions Tool (EET), Think-Aloud reading strategies, Dialogic Reading Approach (CROWD)	34
Worksheets or graphic organizers	Picture scenes, graphic organizers (what it is in the text + what you know=inference), targeted questioning and using picture to define unknown vocabulary	9
Teacher created tools	I really just make my own inference lessons from age appropriate books or passages	34
Applications or websites	Flocabulary, BrainPOP videos, Nearpod, Freckle, google slides we make	23

Note. *Number of responses received = 44. CROWD = completion prompts, recall prompts, wh prompts, distancing prompts.*

The open ended question asking respondents what resources they utilized to teach inferencing was examined through inductive coding as described previously (see Table 11). Responses were mutually exclusive. The use of manufactured programs was noted by 34% of respondents. Teacher created materials were also indicated by 34% of respondents, with an additional 9% noting the use of worksheets or graphic organizers. Finally, 23% reported utilizing applications or websites as resources for teaching inference making.

What Is the Relationship Between Educator Knowledge Regarding Inference Making Strategies and Educators' Years of Experience?

Before conducting statistical analyses for this outcome, tests of skew and kurtosis were conducted to consider normality of the distribution. The variable EKIS (N = 65, M = 72.85, SD = 16.17) demonstrated aligned measures of central tendency (see Table 2). A small negative skew value (-0.64) and positive kurtosis (0.76) were noted. A Shapiro-Wilk test demonstrated that the variable's distribution varied significantly from normal, $W(65) = 0.96$, $p = .046$. However, examination of the histogram confirmed a relatively normal distribution curve. Therefore, this variable was judged to be normally distributed.

To consider the relationship between EKIS and experience, a Pearson's correlation was run. Similar to correlation results of EK and experience, and EKYL and experience, the relationship between EKIS and experience was not statistically significant, $r = 0.09$, $p = .459$ (see Table 12). This indicated that the null hypothesis could not be rejected. Therefore, no relationship between EKIS and experience was found in this study.

Is There a Difference in Educator Knowledge Regarding Inference Making Strategies Based on Role?

An independent samples test was conducted to compare classroom educators (*M* = 71.13, *SD* = 14,15) and itinerant educators' (*M* = 74.52, *SD* = 17.98) mean scores for the variable of EKIS (*M* = 72.85, *SD* = 16.17). Levene's test was not significant and, therefore, equal variance was assumed. Overall statistical significance was not achieved with $t_{(')}$ = -0.84, *p* = .402, *d* = .21. The EKIS score for classroom educators was lower than itinerant providers with a mean difference of 3.39 (see Table 8).

Table 12

Correlation Between EKIS and Educator Experience

Variable	*n*	*M*	*SD*	1	2
1. EKIS	65	72.85	16.17	-	0.09
2. experience	74	3.31	1.33	0.09	-

Is There a Difference in Educator Knowledge Regarding Inference Making Strategies Based on Training?

A one-way ANOVA was completed to explore group mean differences among EKIS scores (dependent variable) and formal educator training (independent variable), considering the groups of no formal training (*M* = 76.94, *SD* = 12.48), a low level of formal training (*M* = 69.63, *SD* = 16.69), and a high level of formal training (*M* = 79.46, *SD* = 15.10). Homogeneity of variance was assumed. The omnibus test revealed no

statistical significance, $F_{(!,'()} = 2.00$, $p = .145$ (see Table 9). Descriptive analysis revealed those with high levels of formal training scored higher on EKIS than both those reporting low levels of formal training or no formal training with a mean difference of 9.83 ($d = 0.62$) and 2.52 ($d = 0.18$), respectively.

Table 13

Analysis of Variance Results for the Dependent Variables of EKYL and EKIS with the Predictor of Additional Training

Variable	Sum of Squares	*df*	Mean Square	*F*	*p*
EKYL					
Between Groups	137.75	3	45.90	0.20	.898
Within Groups	13537.93	58	233.41		
EKIS					
Between Groups	1127.60	3	375.87	1.53	.216
Within Groups	14222.00	58	245.21		

Additionally, a one-way ANOVA was conducted to explore group mean differences among EKIS scores (dependent variable) and additional educator training (independent variable), considering the groups of no additional training ($M = 72.48$, $SD = 15.65$), instructor-led PD ($M = 65.91$, $SD = 17.78$), use of a manual or other materials ($M = 74.95$, $SD = 14.04$), and a combination of instructor-led PD and use of a manual or other materials ($M = 80.12$, $SD = 10.78$). Homogeneity of variance was assumed. The omnibus test revealed no statistical significance, $F_{(),\$*)} = 1.53$, $p = .216$ (see Table 13).

Further analysis of descriptives revealed those who utilized a combination of instructor-led PD and manuals or other materials scored higher on EKIS than those reporting use of only instructor-led PD or use of a manual and other materials with a mean difference of 14.22 (d = 0.97) and 5.17 (d = 0.41), respectively. Those reporting no additional training scored higher than those reporting use of instructor-led PD alone, with a mean difference of 6.58 (d = 0.39).

CHAPTER FIVE: DISCUSSION

The intent of this survey study was to explore educator knowledge regarding inference making skills and instruction, and the abilities of young learners. Specifically, in an effort to gain a deeper understanding of the connection from evidence to practice, the following were examined: (a) educators' knowledge to accurately identify an inference, (b) educators' knowledge regarding the inference making capabilities of young learners, and (c) educators' knowledge of evidence-based inference making instructional methods for young learners. In addition, due to the preliminary nature of this research study, the construct of the measure was examined to assess validity and reliability in hopes of guiding future development.

Construct Validity and Reliability of the Survey Measure

Consideration of the measure's validity was an important component of this study. Because no known educator knowledge studies specific to inference making and young learners existed, the survey used for this study had to be created by the researcher. Utilizing a model outlined by Smith (2005) construct validity, or noting whether the measure addressed what it intended to, was established. First, the extant literature regarding educator knowledge was examined to derive questions of educator knowledge to accurately identify and inference, educator knowledge of the inference making capabilities of young learners, and educator knowledge of inference making instructional strategies. Next, confirmation of face validity was determined prior to this study through feedback provided during cognitive interviews and expert review. Again, the existing literature on educator knowledge was examined to decide on an appropriate research design, that of a survey. Reliability was then assessed at both the pilot phase and

following final dissemination. For a small scale preliminary study, reliability levels were noted using Kuder-Richardson coefficients and Cronbach's alpha, with one question deleted from analysis based on results. Finally, future directions for further survey development were considered and will be discussed later in this chapter.

Educator Knowledge to Accurately Identify an Inference

Considering the dependent variable of EK, interpretation of nonparametric correlational analysis, t-tests, and ANOVAs revealed no statistically significant findings. Whereas classroom educators scored slightly higher than itinerant educators, there was little difference noted in the groups' performance. In addition, for this study, no relationship existed between experience level and educator knowledge to accurately identify an inference.

Interestingly, in this study, those who reported high levels of formal training actually performed worse on EK than those reporting no formal training. Formal training was based on the number of foundational reading, reading comprehension, or language skill classes the respondent completed at the university level. This discrepancy in educational training versus knowledge may be due, in part, to the nature of university coursework, much of which is rooted in theory and not necessarily translatable to actual practice. Elementary classroom educators complete coursework to learn how to communicate information to young learners (Bureau of Labor Statistics, U.S. Department of Labor, 2022). In addition, special educators are trained in learning disabilities and how to teach concepts at a level students with exceptionalities will understand. This is also the case for reading specialists and speech-language pathologists, who must meet additional educational requirements focusing on reading and communication disorders.

However, many university programs, as Sangster et al. (2013) noted, tend to focus on the pedagogy of teaching practices, not the actual knowledge base of teachers.

Regarding additional training, those reporting utilization of a combination of instructor-led PD and a manual or other materials scored the highest on EK. This is in alignment with previous research suggesting that a combination of development opportunities translates best to teaching practices (Gore & Rosser, 2022; McCutchen & Berninger, 1999). In this study, classroom and itinerant educators who accessed both instructor-led PD and manuals or materials consistently scored higher across all three independent variables, that of EK, EKYL, and EKIS.

Overall, only 28% of survey respondents answered all of the EK questions correctly, demonstrating the ability to identify a local and global inference, as well as identify a literal meaning. On the contrary, 43% of respondents answered at least half of the EK questions wrong. Many errors indicated an over-identification of inferences with difficulty separating literal from inferential connections. Whereas descriptive analysis indicated classroom educators performed slightly better at accurately identifying an inference than itinerant providers, overall and regardless of levels of experience or training, only 48% of respondents were able to provide an accurate response to literal questions. Additionally, when asked to define an inference, most educators were able to provide a partial answer versus a complete definition. Only 14% of educators mentioned forming a coherent meaning utilizing both local and global constructs.

Past studies of educator knowledge of phonology and grammar have had similar findings. Deficits in classroom educators' ability to identify phonemes, spelling patterns, phonics, and children's literature have been identified (Moats & Foorman, 2003;

Cunningham et al., 2004). Likewise, although itinerant educators are charged with having the knowledge to intervene when it comes to comprehension deficits in young learners (Powell, 2018), speech-language pathologists have noted that they do not feel well equipped to assess reading and provide interventions (Loveall et al., 2022).

Although the current study found similar results to previous educator knowledge research, it is still surprising that identifying a literal meaning (or being able to note when something was not an inference) was difficult for 52% of classroom and itinerant educators surveyed. Perhaps the difficulty separating literal from inferential meaning, or being able to fully conceptualize what an inference is, has a direct link to the lack of agreement in inference classifications across the extant literature. As previously reviewed, multiple ways to consider inference skills exist and many of those, as noted by Perfetti and Stafura (2015), focus on the highest pyramidal level, that of knowledge bridging. However, automaticity helps a reader integrate media with meaning often blurring the lines of top-down and bottom-up processing (Gernsbacher et al., 1990; Kendeou et al., 2008). It is, possible, therefore, that when educators are asked to identify whether an accurate inference is made following a passage, their tendency for coherency outweighs attention to what is explicitly and syntactically conveyed in the text. Unfortunately, even if this explanation justifies the errors in response to accurate identification of inference questions deriving the knowledge variable in this study, it still leaves in question the competency of classroom and itinerant educators in providing sound comprehension instruction to young learners.

Educator Knowledge Regarding the Inference Making Capabilities of Young Learners

Correlational analysis demonstrated no relationship existed between an educators' experience and their knowledge of young learners' inference making ability. In addition, although there were no statistically significant results observed following *t*-tests and ANOVAs among the dependent variable of EKYL and the predictors of educator role or training, there were notable findings. Considering role, itinerant educators demonstrated greater knowledge of young learners' inference making abilities than classroom educators. Again, those reporting no formal training actually did better than those reporting low or high levels of formal training. In addition, those who reported utilizing a combination of instructor-led PD and a manual or other materials scored higher than those who reported no additional training, or those utilizing one or the other.

The descriptive anaylsis revealed, on average and collectively, respondents neither strongly agreed or disagreed with many of the young learner ability items. This could be indicative of an uncertainty of response. For example, in response to if a child easily understands an inference in a visual presentation, she will likely be good at forming inferences from oral presentations and read-alouds, only 26.5% of respondents indicated they strongly agreed with the statement. Likewise, in response to the importance of making a local inference when a pronoun referent is used, only 40% of respondents indicated they strongly agreed with the statement. For both questions, the response mode was 50, or neutral. Of the questions coded for the EKYL variable, only one received a majority of responses to be in strong agreement. Approximately 67% of

respondents strongly disagreed with the statement that a young learner must be able to decode text before being able to form an accurate inference.

Previous research by Kendeou et al. (2008) has demonstrated both a young learner's ability to form inferences across varying media and to form an inference long before being able to read words on a page. However, results from this study indicate that educators perhaps see the inference making abilities of young learners to be limited. Although educators do not believe a young learner needs to be able to first read before they can infer, there is not an understanding of the connections among visual and oral presentations and that inferencing ability is similar regardless of media. This is troublesome because the youngest preschool learners who are often instructed through large amounts of multimedia presentations may not be getting necessary exposure to inference making instruction if, in fact, educators do not recognize the learners' abilities.

Again, dissent in the extant literature regarding inference classifications may be contributing to the uncertainty in an educator's response knowledge to the inference making capabilities of young learners. As Elleman (2017) and others (Perfetti & Stafura, 2015) have noted, lack of agreement in inference skill research may make the generalization of results difficult and, therefore, evidence-based practice is muddled, at best. Even if the benefit of the doubt is granted, and it is assumed that educators have sought current research to improve their knowledge of the inference making capabilities of young learners, it is possible they find the information confusing and therefore, not of practical use.

Educator Knowledge Regarding Evidence Based Inference Making Instructional Strategies

Considering the dependent variable of EKIS, interpretation of correlational analysis, t-tests, and ANOVAs revealed no statistically significant findings. As with the variables of EK and EKYL, no relationship existed between educator experience and EKIS. Likewise, as with EK, itinerant educators scored higher than classroom educators on their understanding of inferencing making instructional methods. However, unlike comparisons noted on the variables of EK and EKYL and the predictor of formal training, scores on EKIS were highest for those who reported high levels of formal training. This may be that instructional practices are rooted in pedagogy and may be addressed better in university courses than educator's conceptual knowledge. Finally, and in agreement with EK and EKYL results, those who reported utilizing a combination of additional trainings outperformed those who reported no additional training or those utilizing just instructor-led PD or a manual or other materials.

A majority of educators strongly agreed with the utilization of inference strategy instruction for young learners. In line with previous research (Freed & Cain, 2017; van den Broek et al., 2011; Filiatrault-Veilleux et al., 2015), respondents reported using questioning (86%) as an inference making instructional strategy. Likewise, responses indicated that educators were knowledgeable regarding the most effective questioning presentations for young learners occur during, versus after, media presentations.

Although sparse, the extant literature shows consensus for strengthening comprehension skills through inference strategy instruction (Elleman, 2017).

Previous research has identified direct teaching methods of instructional strategies for inference making as successful (Maguet et al., 2021; Hall, 2016), along with small group instruction (Morrow et al., 1999; Stahl, 2014; van Kleeck, 2008). Whereas direct methods to teach inference making, including the instruction of think-aloud strategies, were only reported to be used by 30% of respondents in this study, with a mere 12% reporting utilization of small group instruction to teach inference making skills, the majority of respondents strongly agreed with the use of direct teaching methods such as think-aloud strategies (64%) and small group instruction (78%) to inform inference making skills.

As with findings for educator knowledge to accurately identify an inference, and educator knowledge of the inference making capabilities of young learners, educator knowledge of inference making strategy instruction responses demonstrated uncertainty. Only 33% of respondents strongly agreed that inference making instruction should begin in preschool with only 15% strongly disagreeing with waiting until a child is age 7 or older to initiate the teaching of inference making instructional strategies. Considering literal versus inferential instruction, only 44% of educators strongly agreed that struggling readers benefit more from literal instruction than typical learners. In addition, no respondents strongly disagreed when asked if both literal and inferential skills should be expected to improve following inference strategy instruction for typical learners.

Unlike educator knowledge to accurately identify an inference, and educator knowledge of the inference making capabilities of young learners, uncertainty in response cannot be presumed the consequence of dissent in the research. Viable inference skill strategies and methods of instruction are generally agreed upon in the

extant literature. Therefore, is it possible that this uncertainty is the result of deficiencies in preparedness?

In alignment with the extant literature, the current study noted benefits associated with the use of professional development resources. For example, Moats and Foorman (2003) demonstrated that first through third grade educators who took advantage of professional development opportunities scored higher on phonemic awareness content knowledge than those who did not. For the present study, educators who reported additional training through the utilization of both professional development and materials demonstrated higher scores on their knowledge of inference making instructional strategies. However, overall, the majority of general educators, special educators, reading specialists, and speech-language pathologists reported no formal university training (27%) or low levels of training (63%) regarding inference making and the importance of inference making skills for comprehension. Furthermore, roughly half of the respondents (46%) reported having no additional training while on the job, either through professional development sessions or access to materials. Regardless, an overwhelming majority of educators indicated an extreme willingness to participate in training specific to inference strategy instruction.

Limitations

The current study serves as a preliminary exploration of educator knowledge of inference making skills and young learners' abilities. Whereas this study aligns with past educator knowledge study findings, particularly when considering a lack of educator knowledge in foundational reading concepts, it is not without restrictions. Namely, a

small sample size with limited responses collected for many items should lead to the interpretation of results with caution.

Although the collected sample met the appropriate size utilizing Green's (1991) method to determine a suggested number of participants for quantitative analysis, a larger number of participants would have provided a better representative sampling of the population, namely educators of young learners (Gall et al., 2003). In addition, a larger sample size would reduce the chance of Type I error, and potentially allow for improved normality in distribution of the variables examined (Field, 2013).

Several possibilities were considered regarding the approximated 10% rate of response following dissemination. First, no incentive was offered to complete the survey. Second, the survey was released at the beginning of the school year (mid-August through beginning October). This may have reduced the number of respondents due to the high demands placed on many educators in regards to front loaded paperwork and classroom set-up. Third, other competing surveys may have taken precedent during this time. For example, in at least one district, a Gallup survey focused on culture used by the school board to guide budgeting conversations was opened during the time this study was live. Finally, and particularly for unfunded research, it has been noted that broad dissemination does not increase participation (Wu et al., 2022). Instead, surveys sent to smaller focused groups of participants with personalized follow-up has shown a higher rate of response. In hindsight, disseminating this study to only a few school districts with energy spent on direct contact with participants may have increased participation.

Memon and colleagues (2020) suggested a focus on the quality versus the quantity of a sample. In hindsight, for this study, instead of attempting to gather

participants from national organizations, working more closely with local school districts may have increased the number of responses received. For example, presenting at faculty meetings, visiting with administrators, and personally offering to follow-up with study results may have boosted participation rate.

Regarding the actual data collected, lack of full participation on many items was problematic. As per IRB requirements, all questions, aside from those gaining consent, must be made optional for response. Because of this, low degrees of freedom were observed when analyses were run due to respondents skipping questions. Further consideration of raw data did not indicate a pattern regarding survey responses. Whereas some skipped questions initially, others skipped questions throughout the survey. Still others quit before finishing. It has been suggested that the length of a survey can affect response rate (Gall et al., 2003) and it may be possible that the number of questions presented influenced full participation.

In addition, although this researcher wanted to compare the responses of distinct groups of educators, for a preliminary study it may have been best suited to begin with a focus on one group, that of general educators, special educators, reading interventionists, or speech-language pathologists. The limitations of sample size became further magnified when considering two distinct groups in the collected data for analysis. Although results did indicate several differences by role, these were not significant across the dependent variables of EK, EKYL, and EKIS. Therefore, all groups studied could have initially been considered as one because they are all charged with teaching young learners and considered to have expertise in early literacy.

Future Directions

Considering the limited research that exists regarding educator knowledge of inference making skills of young learners, the current study is not only timely but serves as a springboard for continued research in this area. Inasmuch as this is a preliminary study, several future directions are appropriate. These include, but are not limited to, further development of the educator knowledge of inference survey measure, review of professional development applications, and consideration of a student component.

The researcher created educator knowledge of inference survey used in this study was developed through the utilization of extant literature, cognitive interviews, expert review, and brief piloting. However, after broad dissemination, and consideration of continuous validation (Smith, 2005), further development is suggested. For example, and in accordance with previous studies (Moats & Foorman, 2003) a second, and possibly third, phase of this study is warranted. For additional phases, a redesigned version of the survey would be recommended. First, it is suggested that questions that were not vital to data analysis be eliminated. Next, adding questions to all three survey constructs, that of EK, EKYL, and EKIS would be recommended to improve the properties of the survey. Likewise, separating the survey into three distinct sections, that of educator knowledge of inference, educator knowledge of young learner ability, and educator knowledge of instructional strategies for inference making, would help streamline the questions for respondents. In doing so, improvements in both reliability and survey completion would be expected.

Overall, results of this study demonstrated a combination of additional trainings, such as instructor-led professional development and use of on-the-job materials,

improved educator knowledge of instructional strategies. Whereas an overwhelming number of respondents (70%) noted they would attend a professional development geared specifically for instructional strategies to teach inferencing to young learners, close to half of all respondents reported having no additional training. It is evident that a lack of training opportunities to extend an educator's knowledge of inference making skill and instruction as it relates to young learners exists. Therefore, a further extension of this study would involve the creation and implementation of an inference focused professional development.

In previous research, educator knowledge has been shown to improve following development opportunities (Gore & Rosser, 2022; Moats & Foorman, 2003; McCutchen et al., 2002). Effective PD in foundational reading generally included direct instruction components, interdisciplinary collaboration, and ongoing coaching opportunities. Furthermore, in the current study, educators who utilized a combination of instructor-led PD and a manual or other materials consistently scored higher in all areas. Therefore, it would be appropriate as an extension of this study to add a PD component involving the training and collaboration of general educators, special educators, reading specialists, and speech-language pathologists.

Professional development training could occur in conjunction with the addition of a student component to this study. Assessing student knowledge of inference making would allow for further connections to be made regarding the knowledge base of educators and the assumed resulting gains in student performance. For example, using a pre-posttest design, both educators and students would be administered knowledge items on the survey requiring accurate identification of an inference. Following administration,

educators would participate in instructor-led professional development and be provided additional resources and materials regarding inference making instruction and strategies. Then a posttest would be administered to both educators and students in order to provide comparison and offer direction regarding the meaningfulness of professional development activities.

Conclusion

Inferencing is important for comprehension and young learners are capable of forming inferences (NELP, 2008), connecting presented media and relational background knowledge to derive a coherent message (Kendeou et al., 2019). Likewise, research supports inference making skills can be enhanced through instruction (Elleman, 2017). Therefore, it is critical that educators know how to accurately identify an inference, what young learners are able to achieve when it comes to inferencing, and how to best teach inference making strategies.

This study aimed to connect prior research to current practice, focusing on educator knowledge of inference making skills in relation to young learners. Whereas the need for continued study in this area is certain, it is clear from this survey work that there is sizeable room for improvement when it comes to educator knowledge and instruction. In the current educational environment, the expectation to train young learners on components of reading instruction is falling on those who may not have the prerequisite knowledge to do so. Educators are uncertain of literal versus inferential meanings in text, unfamiliar with young learners' abilities to make connections regardless of the media presentation, and unable to consistently identify research supported strategies for instruction. Therefore, in order to move forward in strengthening

inference making skills for young learners with an end goal of improving reading comprehension, a focus on educator knowledge and preparedness must occur. It is time for both classroom and itinerant educators to become experts in their field.

REFERENCES

Ahmed, Y., Miciak, J., Taylor, W., & Francis, D. (2022). Structure altering effects of a multicomponent reading intervention: An application of the direct and inferential mediation (DIME) model of reading comprehension in upper elementary grades. *Journal of Learning Disabilities*, *55*, 58–78. https://doi.org/10.1177/0022219421995904

Al Otaiba, S., Baker, K., Lan, P., Allor, J., Rivas, B., Yovanoff, P., & Kamata, A. (2019). Elementary teacher's knowledge of response to intervention implementation: A preliminary factor analysis. *Annals of Dyslexia, 69,* 34-53. https://doi.org/10.1007/s11881-018-00171-5

American Speech-Language and Hearing Association. (2022, May). Community bulletin board. https://community.asha.org/home

Bianco, M., Bressoux, P., Doyen, A., Lambert, E., Lima, L., Pellenq, C., & Zorman, M. (2010). Early training in oral comprehension and phonological skills: Results of a three-year longitudinal study. *Scientific Studies of Reading, 14,* 211-246. https://doi.org/10.1080/10888430903117518

Binks-Cantrell, E., Malatesha Joshi, R., & Washburn, E. (2012). Validation of an instrument for assessing teacher knowledge of basic language constructs of literacy. *Annals of Dyslexia, 62,* 153-171. https://doi.org/10.1007/s11881-012-0070-8

Bos, C., Mather, N., Dickson, S., Podhajski, B., & Chard, D. (2001). Perceptions and knowledge of preservice and inservice educators about early reading instruction. *Annals of Dyslexia, 51,* 98-120.

Bureau of Labor Statistics, U.S. Department of Labor (2022, January). Office of Occupational Statistics and Employment Projections. https://www.bls.gov/ooh/education-training-and-library/

Cain, K., & Oakhill, J. V. (1999). Inference making ability and its relation to comprehension failure in young children. *Reading and Writing, 11,* 489-503.

Cain, K., Oakhill, J. V., Barnes, M. A., & Bryant, P. E. (2001). Comprehension skill, inference-making ability, and their relation to knowledge. *Memory and Cognition, 29,* 850-859. https://doi.org/10.3758/BF03196414

Castles, A., Rastle, K., & Nation, K. (2018). Ending the reading wars: Reading acquisition from novice to expert. *Psychological Science in the Public Interest, 19,* 5-51. https://doi.org/10.1177/15291000618772271

Compton, D. L., Miller, A. C., Elleman, A. M., & Steacy, L. M. (2014). Have we forsaken reading theory in the name of "quick fix" interventions for children with reading disability? *Scientific Studies of Reading, 18,* 55-73. https://doi.org/10.1080/10888438.2013.836200

Cook, A. E., & O'Brien, E. J. (2015). Passive activation and instantiation of inferences during reading. In E. J. O'Brien, A. E. Cook, & R. F. Lorch (Eds.), *Inferences during reading* (pp. 19-41). Cambridge University Press.

Cromley, J. G., & Azevedo, R. (2007). Testing and refining the direct and inferential mediation model of reading comprehension. *Journal of Educational Psychology, 99,* 311-325. https://doi.org/ 10.1037/0022-0663.99.2.311

Cronbach, L. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16,* 297-334. https://doi.org/10.1007/BF02310555

Cunningham, A. E., Stanovich, K. E., & Stanovich, P. J. (2004). Disciplinary knowledge of K-3 teachers and their knowledge calibration in the domain of early literacy. *Annals of Dyslexia, 54,* 139-167.

Currie, N. K., & Cain, K. (2015). Children's inference generation: The role of vocabulary and working memory. *Journal of Experimental Child Psychology, 137,* 57-75. http://dx.doi.org/10.1016/j.jecp.2015.03.005

Desimone, L.M., & Le Floch, K.C. (2004). Are we asking the right questions? Using cognitive interviews to improve surveys in education research. *Educational Evaluation and Policy Analysis, 26,* 1-22.

Elleman, A. M. (2017). Examining the impact of inference instruction on the literal and inferential comprehension of skilled and less skilled readers: A meta-analytic review. *Journal of Educational Psychology, 109,* 761-781. http://dx.doi.org/10.1037/edu0000180

Elleman, A. M., & Oslund, E. L. (2019). Reading comprehension research: Implications for practice and policy. *Behavioral and Brain Sciences, 6,* 3-11. https://doi.org/10.1177/2372732218816339

Field, A. (2013). *Discovering statistics using IBM SPSS statistics.* Sage.

Filiatrault-Veilleux, P., Bouchard, C., Trudeau, N., Desmarais, C. (2015). Inferential comprehension of 3-6 year olds within the context of story grammar: A scoping review. *International Journal of Language and Communication Disorders, 50,* 737-749.

Florit, E., Roch, M., & Levorate, M. C. (2011). Listening text comprehension of explicit and implicit information in preschoolers: The role of verbal and inferential skills.

Discourse Processes, 48, 119-138. https://doi.org/10.1080/0163853X.2010.494244

Foorman, B. R., & Moats, L. C. (2004). Conditions for sustaining research-based practices in early reading instruction. *Remedial and Special Education, 25,* 51-60. https://doi.org/10.1177/07419325040250010601

Ford, J A., & Milosky, L. M. (2008). Inference generation during discourse and its relation to social competence: An online investigation of abilities of children with and without language impairment. *Journal of Speech, Language, and Hearing Research, 51,* 367-380. https://doi.org/10.1044/1092-4388(2008/027)

Freed, J., & Cain, K. (2017). Assessing school-aged children's inference-making: The effect of story test format in listening comprehension. *International Journal of Language and Communication Disorders, 52,* 95-105. https://doi.org/10.1111/1460-6984.12260

Gall, M., Gall, J., & Borg, W. (2003). *Educational research*. Pearson.

Gernsbacher, M. A., Varner, K. R., & Faust, M. E. (1990). Investigating differences in general comprehension skill. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 16,* 430-445. https://doi.org/10.1037/0278-7393.16.3.430

Gore, J., & Rosser, B. (2022). Beyond content - focused professional development: Powerful professional learning through genuine learning communities across grades and subjects. *Professional Development in Education, 48,* 218-232. https://doi.org/10.1080/19415257.2020.1725904

Gough Kenyon, S. M., Palikara, O., & Lucas, R. M. (2018). Explaining reading comprehension in children with developmental language disorder: The importance of elaborative inferencing. *Journal of Speech, Language, and Hearing Research, 61,* 2517-2531. https://doi.org/10.1044/2018_JSLHR-L-17-0416

Green, S.B. (1991). How many subjects does it take to do a regression analysis. *Multivariate Behavioral Research, 26,* 449-510. https://doi.org/10.1207/s15327906mbr2603_7

Hall, C. S. (2016). Inference instruction for struggling readers: A synthesis of intervention research. *Educational Psychology Review, 28,* 1-22. https://doi.org/10.1007/s10648-014-9295-x

Hogan, T. P., Bridges, M. S., Justice, L. M., & Cain, K. (2011). Increasing higher level language skills to improve reading comprehension. *Focus on Exceptional Children, 44,* 1-20. https://doi.org/10.17161/fec.v44i3.6688

Jakobson, K., Soodla, P. & Aro, M. (2022). General and special education teachers' knowledge about reading comprehension processes and instructional practices. *Reading and Writing, 35,* 2229-2256. https://doi.org/10.1007/s11145-022-10280-8

Kelly, L. B., & Moses, L. (2018). Children's literature that sparks inferential discussions. *The Reading Teacher, 72,* 21-29. https://doi.org/10.1002/trtr.1675

Kendeou, P., Bohn-Gettler, C., White, M. J., & van den Broek, P. (2008). Children's inference generation across different media. *Journal of Research in Reading, 31,* 259-272. https://doi.org/10.1111/j.1467-9817.2008.00370x

Kendeou, P., McMaster, K. L., Butterfuss, R., Kim, J., Bresina, B., & Wagner, K. (2019). The inferential language comprehension (iLC) framework: Supporting children's comprehension of visual narratives. *Topics in Cognitive Science,* 1-18. https://doi.org/10.1111/tops.12457

Kintsch, W. (1986). Learning from text. *Cognition and Instruction, 3,* 87-108.

Kintsch, W. (1988). The role of knowledge in discourse comprehension: A constructionintegration model. *Psychological Review, 95,* 163-182. https://doi.org/10.1037/0033-295X.95.2.163

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

Kintsch, W., & van Dijk, T. A. (1978). Towards a model of text comprehension and production. *Psychological Review, 85,* 363-394. https://doi.org/10.1037/0033-295X.85.5.363

Language and Reading Research Consortium (LARRC), Currie, N. K., & Muijselaar, M. L. (2019). Inference making in young children: The concurrent and longitudinal contributions of verbal working memory and vocabulary. *Journal of Educational Psychology, 111,* 1416-1431. https://doi.org/10.1037/edu0000342

Language and Reading Research Consortium (LARRC), & Muijselaar, M. L. (2018). The dimensionality of inference making: Are local and global inferences distinguishable? *Scientific Studies of Reading, 22,* 117-136. https://doi.org/10.1080/10888438.2017.1371179

Lepola, J., Lynch, J., Laakkonen, E., Silven, M., & Niemi, P. (2012). The role of inference making and other language skills in the development of narrative listening comprehension in 4-6 year old children. *Reading Research Quarterly, 47*, 259-282. https://doi.org/10.1002/RRQ.020

Loveall, S.J., Pitt, A.R., Rolfe, K.G., & Mann, J. (2022). Speech-language pathologist reading survey: Scope of practice, training, caseloads, and confidence. *Language, Speech, and Hearing Services in Schools, 53,* 837-859. https://doi.org/10.1044/2022_LSHSS-21-00135

Macken-Horarik, M., Love, K., & Horarik, S. (2018). Rethinking grammar in language arts: Insights from an Australian survey of teachers' subject knowledge. *Research in the Teaching of English, 52,* 288-316.

Maguet, M. L., Morrison, T. G., Wilcox, B., & Billen, M. T. (2021). Improving children's reading comprehension by teaching inferences. *Reading Psychology, 42*, 264-280. https://doi.org/10.1080/02702711.2021.1888351

McCutchen, D., Abbott, R. D., Green, L. B., Beretvas, N., Cox, S., Potter, N. S., Quiroga, T., & Gray, A. L. (2002). Beginning literacy: Links among teacher knowledge, teacher practice, and student learning. *Journal of Learning Disabilities, 35,* 69-86.

McCutchen, D., & Berninger, V. (1999). Those who know, teach well: Teachers master literacy-related subject-matter knowledge. *Learning Disabilities Research & Practice, 14*, 215-226. https://doi.org/10.1207/sldrp1404_3

McMahon-Morin, P., Rezzonico, S., Trudeau, N., & Croteau, C. (2021). Interactive book-reading to improve inferencing abilities in kindergarten classrooms: A clinical project. *Child Language Teaching and Therapy, 37,* 63-84. https://doi.org/10.1177/0265659020974430

McMaster, K. L., van den Broek, P., Espin, C. A., White, M. J., Rapp, D. N., Kendeou, P., Bohn-Gettler, C. M., & Carlson, S. (2012). Making the right connections: Differential effects of reading intervention for subgroups of comprehenders. *Learning and Individual Differences, 22,* 100-111. https://doi.org/10.1016/j.lindif.2011.11.017

McNamara, D. S., & Magliano, J. P. (2009). Toward a comprehensive model of comprehension. In B. H. Ross (Ed.), *Psychology of learning and motivation* (Vol. 51, pp. 297–384). Elsevier Science. https://doi.org/10.1016/S0079-7421(09)51009-2

Memon, M.A., Ting, H., Cheah, J., Thurasamy, R., Chuah, F., & Cham, T.H. (2020). Sample size for survey research: Review and recommendations. *Journal of Applied Structural Equation Modeling, 4,* 1-20.

Moats, L. (2009). Still wanted teachers with knowledge of language. *Journal of Learning Disabilities, 42,* 387-391. https://doi.org/10.1177/0022219409338735

Moats, L. C., & Foorman, B. R. (2003). Measuring teachers' content knowledge of language and reading. *Annals of Dyslexia, 53,* 23-45. https://doi.org/10.1007/s11881-003-0003-7

Morrow, L. M., Tracey, D. H., Woo, D. G., & Pressley, M. (1999). Characteristics of exemplary first grade literacy instruction. *The Reading Teacher, 52,* 462-476.

National Association for the Education of Young Children. (2022, May). Accredited early learning programs. https://families.naeyc.org/find-quality-child-care

National Center for Educational Evaluation and Regional Assistance, Institute for Educational Services (2016). Foundational skills to support reading for understanding in kindergarten through 3rd grade. [practice guide]. United States Department of Education. https://ies/ed/gov/ncee/wwc

National Early Literacy Panel (2008). *Developing early literacy: Report of the National Early Literacy Panel.* Washington, DC: National Institute for Literacy. https://lincs.ed.gov/publications/pdf/NELPReport09.pdf

National Governors Association [NGA] Center for Best Practices and Council of Chief State School Officers (2010). *Common core state standards for English language arts and literacy.* Washington, DC: Authors. https://learning.ccsso.org/wpcontent/uploads/2022/11/ADA-Compliant-ELA-Standards.pdf

Oslund, E., Clemens, N., Simmons, D., & Simmons, L. (2018). The direct and indirect effects of word reading and vocabulary on adolescents' reading comprehension: Comparing struggling and adequate comprehenders. *Reading and Writing, 31*, 355–379. https://doi.org/10.1007/s11145-017-9788-3

Paris, A. H., & Paris, S. G. (2003). Assessing narrative comprehension in young children. *Reading Research Quarterly, 38,* 36-76.

Perfetti, C. A., & Stafura, J. Z. (2015). Comprehending implicit meanings in text without making inferences. In E. J. O'Brien, A. E. Cook, & R. F. Lorch (Eds.), *Inferences during reading* (pp. 1-18). Cambridge University Press.

Powell, R.K. (2018). Unique contributors to the curriculum: From research to practice for speech-language pathologists in schools. *Language, Speech, and Hearing Services in Schools, 49,* 140-147. https://doi.org/10.1044/2017_LSHSS-17-0059

Pressley, M., Wharton-McDonald, R., Allington, R., Collins Block, C., Morrow, L., Tracey, D., Baker, K., Brooks, G., Cronin, J., Nelson, E., & Woo, D. (2001). A study of effective first-grade literacy instruction. *Scientific Studies of Reading, 5,* 35-58.

Rouder, J. Saucier, O., Kinder, R., & Jans. M. (2021). What to do with all those open-ended responses? Data visualization techniques for survey researchers. *Survey Practice,* August. https://doi.org/10.29115/SP-2021-0008.

Sangster, P., Anderson, C., & O'Hara, P. (2013). Perceived and actual levels of knowledge about language amongst primary and secondary student teachers: So they know what they think they know? *Language Awareness, 22,* 293-319. https://dx.doi.org/10.1080/09658416.2012.722643

Silva, M., & Cain, K. (2015). The relations between lower and higher level comprehension skills and their role in prediction of early reading comprehension. *Journal of Educational Psychology, 107,* 321-331. https://dx.doi.org/10.1037/a0037769

Smith, G. (2005). On construct validity: Issues of method and measurement. *Psychological Assessment, 17,* 396-408. https://doi.org/10.1037/1040-3590.17.4.396

Stahl, K. A. (2014). Fostering inference generation with emergent and novice readers. *The Reading Teacher, 67,* 384-388. https://doi.org/10.1002/trtr.1230

Terrell, S.R. (2016). *Writing a proposal for your dissertation*. Guilford Press.

Tompkins, V., Guo, Y., & Justice, L. M. (2013). Inference generation, story comprehension, and language skills in the preschool years. *Reading and Writing, 26,* 403-429. https://doi.org/10.1007/s11145-012-9374-7

van den Broek, P., Beker, K., & Oudega, M. (2015). Inference generation in text comprehension: Automatic and strategic processes in the construction of a mental representation. In E. J. O'Brien, A. E. Cook, & R. F. Lorch (Eds.), *Inferences during reading* (pp. 1-18). Cambridge University Press.

van den Broek, P., Kendeou, P., Lousberg, S., & Visser, G. (2011). Preparing for reading comprehension: Fostering text comprehension skills in preschool and early elementaryschool children. *International Electronic Journal of Elementary Education, 4,* 259-268.

van Kleeck, A. (2008). Providing preschool foundations for later reading comprehension: The importance of and ideas for targeting inferencing in storybook shared interventions. *Psychology in the Schools, 45,* 627-643.

https://doi.org/10.1002/pits.20314

van Kleeck, A., Vander Woude, J., Hammett, L. (2006). Fostering literal and inferential language skills in head start preschoolers with language impairment using scripted book-sharing discussions. *American Journal of Speech-Language Pathology, 15,* 85-95. https://doi.org/10.1044/1058-0360(2006/009)

Wu, M., Zhao, K., Fils-Aime, F. (2022). Response rates of online surveys in published research: A meta-analysis. *Computers in Human Behavior Reports, 7,* 1-11. https://doi.org/10.1016/j.chbr.2022.100206

Zucker, T. A., Justice, L. M., Piasta, S. B., & Kaderavek, J. N. (2010). Preschool teachers' literal and inferential questions and children's responses during whole-class shared reading. *Early Childhood Research Quarterly, 25,* 65-83. https://10.1016/j.ecresq.2009.07.001

APPENDICES

Appendix A
Educator Knowledge of Inference – Preliminary Survey

1. Specify your current role:
   - I am a general education teacher
   - I am a special education teacher
   - I am a reading specialist (interventionist, coach)
   - I am a speech-language pathologist
   - Other: _____

2. Specify the grade level you most closely work/associate with:
   - Early Childhood (3-5 years)
   - Kindergarten - 1st grade - 2nd grade
   - 3rd grade
   - All of the above
   - None of the above (please specify): _____

3. How many years of experience in your current role have you had?
   - Less than 1 - 1 year
   - 2 years
   - 3 years
   - 4 years
   - 5 years
   - 6 years
   - 7 years
   - 8 years
   - 9 years
   - 10 years
   - …
   - More than 20 years

4. What is the highest degree you have earned?
   - Bachelors level degree
   - Masters level degree
   - Masters level + specialty area certification
   - Doctoral degree or higher

5. How much formal (university) instruction you had in teaching inference skills.

   1: No formal instruction
   50: I had a course on reading that covered basic reading and comprehension skills
   100: I had a course specifically related to reading comprehension that covered inference skills

6. In your own words, define inference or inference making skill.

   _____
   _____

Based on a scale of 1-100, with 1 being "not at all confident," 50 being "somewhat confident," and 100 being "extremely confident" answer the following questions:

7. Rate your level of confidence teaching general comprehension skills.

8. Rate your level of confidence teaching inference making skills.

9. Rate your level of confidence in using inference strategies with your students.

10. Rate your level of confidence in understanding the difference between a literal and inference question.

Read the text. Then, answer the questions:

Grace held on tight to the handlebars and peddled as fast as she could. As the sun lowered in the sky, she could hear Momma's dinner bell ringing in the distance.

11. The question, "What was Grace doing?" is an example of a:
    - Literal question
    - Inference question
    - Unsure

12. The question, "Why is Grace in a hurry?" is an example of a:

    - Literal question
    - Inference question
    - Unsure

13. The question, “What did Grace hear?” is an example of a:
    - Literal question
    - Inference question
    - Unsure
14. The question, “Who does the ‘she’ in the second sentence refer to?” is an example of a:
    - Literal question
    - Inference question
    - Unsure

Read the text. Then, answer the questions:

Jerome grabbed the truck, ball, and jump rope. He shoved them in his bag as he hurried outside to meet his friend.

15. The question, “Where did Jerome go?” is an example of a:
    - Literal question
    - Inference question
    - Unsure

16. In order to understand the text, the reader must:
    - Infer Jerome is in a rush because he got home late from soccer practice.
    - Understand the word “them” in the second sentence refers to objects listed in the first sentence.
    - Understand the meaning of the words ‘jump rope’ when used as a noun or label.
    - Infer Jerome’s friend is frustrated because he has been waiting on Jerome all day.

Read the passage. Then, answer the questions:

Kate looked out her window. She saw a small dog. He was wet and looked lost. Kate quickly grabbed her raincoat and boots and ran outside. When Kate arrived back home, she showed her new furry friend her room. She gave him food and a place to sleep. The next day, Kate and her new friend ran, played fetch, and ball. They both loved the company!

17. In order to answer the question, “What was the weather like outside?” the reader must:
    - Infer that Kate found a lost dog.
    - Infer that Kate made a quick, in-the-moment decision to go outside.
    - Infer that Kate needed her raincoat in order to go outside.
    - None of the above

18. In order to answer the question, “Did the dog like spending time with Kate?” the reader must:
    - Infer that the word, “both” in the last sentence refers to Kate and the dog.
    - Infer that Kate brought the dog home with her after going outside.
    - Understand the literal meaning of “gave him food and a place to sleep.” -
        None of the above

19. In order to answer the question, “How do you think Kate was feeling as she ran outside?” the reader must:
    - Infer that Kate went to her room after she arrived home from school.
    - Understand the “her” in the first sentence refers to the subject Kate.
    - Use background knowledge to connect with the character’s action and state.
    - None of the above

20. In order to answer the question, “What did Kate see when she looked outside?“ the reader must:
    - Understand the meaning of the word ‘dog’ when used as a noun or label.
    - Infer that Kate was lonely and in need of company.
    - Understand the “he” in the third sentence refers to the dog in the second sentence.
    - None of the above

21. It is appropriate to begin formal inference instruction in preschool.
    1: Strongly Disagree
    50: Unsure
    100: Strongly Agree

22. It is not appropriate to begin teaching inference strategies until age 7 years or older.
    1: Strongly Disagree
    50: Unsure
    100: Strongly Agree

23. A child must be able to decode text before inference skills can develop.
    1: Strongly Disagree
    50: Unsure
    100: Strongly Agree

24. A text based inference is resolved by connecting information across multiple sentences in the story.
    1: Strongly Disagree
    50: Unsure
    100: Strongly Agree

25. In order to comprehend a story, it is important for a student to resolve pronouns between sentences in a text.
    1: Strongly Disagree
    50: Unsure
    100: Strongly Agree

26. A student's use of background knowledge is necessary to fill-in gaps within a story's text.

    1: Strongly Disagree
    50: Unsure
    100: Strongly Agree

27. Young children cannot establish inferences similarly across visual, oral, and textbased presentations.

    1: Strongly Disagree
    50: Unsure
    100: Strongly Agree

28. Young children can improve their comprehension skills through inference strategy instruction.
    1: Strongly Disagree
    50: Unsure
    100: Strongly Agree

29. How often do you work on inference skills with your students? 1: Never
    50: Occasionally
    100: Daily

30. In my professional practice, I work on inference making skills with my students:
    - As one concept, that of inferencing
    - By distinguishing inferences that are made by referring to something previously stated in the text and inferences made using previous, or background, knowledge
    - By considering multiple categories of inferencing, such as character state, action, and goal
    - I do not work on inferencing with my students

31. I use pictures and videos to work on inferencing with students. 1: Never
    50: Occasionally
    100: Daily

32. I use storybooks to work on inferencing with students.
    1: Never
    50: Occasionally
    100: Daily

33. Are there any additional comments that you would like the researcher to know about your knowledge as it relates to inference making skills? Please feel free to comment here:

    _____

    _____

Appendix B
Final Survey

Educator Knowledge of Inference Making Skills of Young Learners

---

Informed Consent:

Information and Disclosure Section:

The following information is provided to inform you about the research project in which you have been invited to participate. Please read this disclosure and feel free to ask any questions. The investigators must answer all of your questions and please save this page as a PDF for future reference. • Your participation in this research study is voluntary. • You are also free to withdraw from this study at any time without loss of any benefits. For additional information on your rights as a participant in this study, please contact the Middle Tennessee State University (MTSU) Office of Compliance (Tel 615-494-8918 or send your emails to irb_information@mtsu.edu. (URL: http://www.mtsu.edu/irb).

Please read the following and respond to the consent questions if you wish to enroll in this study.

1. Purpose: This research project is designed to help us evaluate educator knowledge of inference making skills of young learners.

2. Description: There are several parts to this project. They are: exploring whether educators possess knowledge of the importance of inference making skill in relation to comprehension abilities for young learners; exploring whether educators have adequate knowledge regarding the inference making capabilities of young learners as identified through previous research; and exploring whether educators are familiar with evidencebased instructional methods for inference making of young learners.

o This consent script only covers surveys conducted online. o
You will NOT be audio recorded or videotaped in this study.

3. IRB Approval Details:

- Protocol Title: Inference Making Skills in Young Learners and Educator Knowledge: Connecting Research to Practice
- Primary Investigator: Barbara Adams
- PI Department & College: Department of Literacy Studies, College of Education
- Faculty Advisor: Eric Oslund
- Protocol ID: 22-1175 2q Approval Date: 07/15/2022 Expiration Date: 07/31/2023

4. Duration: The whole activity should take about 15 minutes

5. Here are your rights as a participant:

- Your participation in this research is voluntary.
- You may skip any item that you don't want to answer, and you may stop the experiment at any time (but see the note below)
- If you leave an item blank by either not clicking or entering a response, you may be warned that you missed one, just in case it was an accident. But you can continue the study without entering a response if you didn't want to answer any questions.
- Some items may require a response to accurately present the survey.

6. Risks & Discomforts: There are no known risks associated with participation in this study.

7. Benefits:

a. Benefits to you: There are no direct benefits to you from this study.

b. Benefits to the field of science or the community: Results from this study will contribute to the currently existing body of research on inference making skills and young learners.

8. Identifiable Information: You will NOT be asked to provide identifiable personal information.

9. Compensation: There is no compensation for participating in this study.

10. Confidentiality: All efforts, within reason, will be made to keep the personal information private but total privacy cannot be promised. Your information may be shared with MTSU or the government, such as the Middle Tennessee State University

Institutional Review Board, Federal Government Office for Human Research Protections, if you or someone else is in danger or if we are required to do so by law.

11. Contact Information: If you should have any questions about this research study or possible injury, please feel free to contact Barbara Adams by email bla3m@mtmail.mtsu.edu OR my faculty advisor, Eric Oslund, at eric.oslund@mtsu.edu. You can also contact the MTSU Office of compliance via telephone (615-494-8918) or by email (compliance@mtsu.edu). This contact information will be presented again at the end of the experiment. You are not required to do anything further if you decide not to enroll in this study. Just quit your browser. Please complete the response section below if you wish to learn more or you wish to partake in this study.

I have read this informed consent document pertaining to the above identified research.

- Yes
- No

The research procedures conducted are clear to me.

- Yes
- No

I confirm I am 18 years or older.

- Yes
- No

I am aware of the potential risks of the study.

- Yes
- No

By clicking below I affirm that I freely and voluntarily chose to participate in this study. I understand that I can withdraw from this study at any time without facing any consequences.

- Yes, I consent.
- No, I do not consent.

Survey:

(Multiple Choice) What is your current role?

- I am a general education teacher
- I am a special education teacher
- I am a reading specialist (interventionist, coach) • I am a speech-language pathologist
- Other (please specify):

(Multiple Choice) Specify the grade level you most closely work/associate with (select all that apply):

- Early Childhood (3-5) years
- Kindergarten
- 1st Grade
- 2nd Grade
- 3rd Grade
- None of the above (please specify):

(Drop Down) How many years of experience in your current role have you had?

- Less than 1 year
- 1 year
- 2 years
- 3 years • 4 years
- 5 years • 6 years
- 7 years • 8 years
- 9 years
- 10 years
- 11 years • 12 years
- 13 years • 14 years
- 15 years • 16 years
- 17 years
- 18 years
- 19 years
- 20 years
- More than 20 years

(Multiple Choice) What is the highest degree you have earned?

- Bachelor's level degree
- Masters level degree

- Masters level degree + specialty area certification or endorsement (please specify):
- Doctoral degree or higher

(Multiple Choice) How much formal (university) instruction have you had in teaching inference skills? (select all that apply):

- I did not have formal instruction in teaching inference skills.
- I had a course on reading that covered basic, foundational reading skills but did not discuss inference skills.
- I had a course on reading that covered basic, foundational skills and comprehension. This course discussed inference skills.
- I had a course specifically on reading comprehension that covered inference skills.
- I had a language development course on listening and reading comprehension that covered inference skills.
- Other (please specify):

(Multiple Choice) In your current role, have you had any additional training on teaching inference skills? (select all that apply):

- I have attended a professional development session at my school or district that has discussed teaching inferencing.
- I have attended a professional development session at a regional conference that has discussed teaching inferencing.
- I have utilized an instructional manual to learn more about teaching inferencing skills.
- Other (please specify):

(Fill-In) In your own words, define inference making skill.

Based on a scale of 1-100, with 1 being "not at all confident," 50 being "somewhat confident," and 100 being, "extremely confident," rate the following:

(Rating Scale) Rate your level of confidence teaching general comprehension skills.
(Rating Scale) Rate your level of confidence teaching inference making skills.
(Rating Scale) Rate your level of confidence in using inference strategies with your students.
(Rating Scale) Rate your level of confidence in understanding the difference between a literal and inference question.

Based on a scale of 1-100, with 1 being "strongly disagree," 50 being "neutral," and 100 being "strongly agree," rate the following statements:

(Rating Scale) It is appropriate to begin formal inference instruction in preschool.
(Rating Scale) It is appropriate to begin teaching inference strategies when students are age 7 years or older.
Rating Scale) A child should be able to decode text before inference skills can be developed.
(Rating Scale) Typical readers benefit more from literal instruction than struggling readers.

Researchers have used the terms local and global to refer to inferences that must be made connecting the information given in a text (local) and those requiring a learner to use background knowledge to fully understand the information being presented (global). Knowing this, and based on a scale of 1-100, with 1 being "strongly disagree," 50 being "neutral," and 100 being "strongly agree," rate the following statements:

(Rating Scale) It is easier for a young learner to form a local inference than it is to form a global inference.
(Rating Scale) In order to comprehend a story, it is important for a student to make a local inference when a pronoun is used to refer to a character that has already been introduced.
(Rating Scale) A student's ability to make a global inference is usually not necessary but can deepen the meaning of the story.

Based on a scale of 1-100, with 1 being "strongly disagree," 50 being "neutral," and 100 being "strongly agree," rate the following statements:

(Rating Scale) If a child understands inferences in a visual presentation, it is likely she will be good at forming inferences in oral discourse and story read-alouds.
(Rating Scale) Young children can improve their comprehension skills through inference strategy instruction.
(Rating Scale) Asking questions after a story read aloud is a more effective strategy for young learners to construct inferences than asking questions during a story read aloud.
(Rating Scale) The use of background knowledge to construct an inference can be directly taught to young learners using a think-aloud strategy.
(Rating Scale) Inference making strategies can be effectively taught during small group instruction for young learners.
(Rating Scale) Inference instruction can improve both literal and inferential comprehension for typical learners.

Answer the following questions by choosing the one answer that fits the best:

(Multiple Choice) I have used the term "inference" with my students.

- Yes
- No

(Multiple Choice) How often do you work on inference skills with your students?

- I do not work on inference skills with students.
- I rarely work on inference skills with students (less than 2 times per month).
- I work on inference skills with students approximately 3-4 times per month.
- I work on inference skills with students approximately once per week.
- I work on inference skills with students daily, or at least four times per week.

(Multiple Choice) In my professional practice, I work on inference making skills with my students:

- As one concept, that of inferencing.
- By distinguishing inferences that are made by referring to something stated in the text and inferences made by using previous, or background, knowledge.
- By considering multiple categories of inferencing, such as character state, action, and goal.
- I do not work on inferencing with my students.
- Other (please specify):

(Multiple Choice) How willing would you be to attend a professional development session about inference instruction for young learners?

- Not at all willing
- Somewhat willing
- Extremely willing

Based on a scale of 1-100, with 1 being, "never," 50 being "occasionally," and 100 being "daily," rate the following statements:

(Rating Scale) I use pictures to work on inferencing with students.
(Rating Scale) I use videos to work on inferencing with students.
(Rating Scale) I use storybook read-alouds to work on inferencing with students.

Based on a scale of 1-100, with 1 being, "not important," 50 being "somewhat important," and 100 being "extremely important," answer the following questions:

(Rating Scale) How important do you think it is to teach phonemic awareness and decoding skills to young students?
(Rating Scale) How important do you think it is to teach inferencing skills to young students?
(Rating Scale) How important do you think it is to teach vocabulary to young students?

(Fill-In) What does inference instruction look like in your classroom or intervention sessions?

(Fill-In) What resources do you use to instruct inference making skills?

Read the text. Then, answer the questions by choosing the one answer that fits the best.

Grace held on tight to the handlebars and peddled as fast as she could. As the sun lowered in the sky, she could hear Momma's dinner bell ringing in the distance.

(Multiple Choice) If a young learner is asked "What is Grace doing in the story?" and answers, "riding a bike" the child has made an accurate inference.

- Yes
- No

(Multiple Choice) If a young learner is asked "What did Grace hear?" and answers, "a bell" the child has made an accurate inference.

- Yes
- No

(Multiple Choice) If a young learner is asked, "Who does the 'she' in the second sentence refer to?" and answers, "Momma" the child has made an accurate inference.

- Yes
- No

Read the text. Then, answer the questions by choosing the one answer that fits the best.

Jerome grabbed the truck, ball, and jump rope. He shoved them in his bag as he hurried outside to meet his friend.

(Multiple Choice) If a young learner is asked, "Where did Jerome go?" and answers, "outside" the child has made an accurate inference.

- Yes
- No

(Multiple Choice) If a young learner identified the word "them" in the second sentence refers to objects listed in the first sentence, the child has made an accurate inference.

- Yes
- No

Read the text. Then, answer the questions by choosing the one answer that fits the best.

Kate looked out her window. She saw a small dog. He was wet and looked lost. Kate quickly grabbed her raincoat and boots and ran outside. When Kate arrived back home, she showed her new furry friend her room. She gave him food and a place to sleep. The next day, Kate and her new friend ran, played fetch, and ball. They both loved the company!

(Multiple Choice) If a young learner is asked, "How do you think Kate was feeling as she ran outside?" and answers, "anxious" the child has made an accurate inference.

- Yes
- No

(Multiple Choice) If a young learner is asked, "What did Kate see when she looked outside?" and answers, "a dog" the child has made an accurate inference.

- Yes
- No

(Multiple Choice) If a young learner is asked, "What was the weather like outside?" and answers, "rainy" the child has made an accurate inference.

- Yes
- No