Early Childhood Educators' Knowledge about Language and Literacy: Associations with Practice and Children's Learning

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Abstract

Educators' language and literacy knowledge is considered important for informing classroom practices and thereby supporting children's early language and literacy development. This includes both disciplinary content knowledge (knowledge concerning how oral and written language are structured and map to one another) and knowledge for practice (knowledge of effective strategies and practices for supporting early language and literacy). In this study, we examined the associations among 485 early childhood educators' content knowledge and knowledge for practice, their observed language and literacy practices, and the emergent literacy learning of 2004 children enrolled in their classrooms. We found significant, positive correlations between measures of educators' content knowledge and knowledge for practice and classroom practice, indicating that early childhood educators with greater levels of knowledge tended to exhibit more desirable classroom language and literacy practices. We also found significant, positive associations between educators' knowledge and children's print concept, letter naming, and phonological awareness learning, but not children's oral language learning. The associations between educators' knowledge and children's print concept learning were mediated by classroom practice. Together, these results reiterate the importance of educators' language and literacy knowledge and also provide some support for practice as the mechanism through which knowledge relates to children's learning.

Keywords: early childhood education, emergent literacy, teacher knowledge of language and literacy, classroom practices

Practitioner Points

- Educators with higher knowledge exhibited more desirable classroom language and literacy practices
- Children whose educators had higher knowledge tended to exhibit greater learning of print concepts, letter naming, and phonological awareness
- Associations between educators' knowledge and print concept learning were indirect and mediated through practice
- Both content knowledge and knowledge for practice may be important targets for preservice early childhood educator preparation and inservice professional development

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Early childhood language and literacy experiences are important for later reading outcomes (National Early Literacy Panel, 2008). Accumulating evidence supports educators' use of high-quality language and literacy practices as facilitators of children's early literacy learning (Piasta, 2016), and numerous studies further highlight the role of educator-child interactions in supporting this early learning (e.g., Mashburn et al., 2008; Pianta, Belsky, Vandergrift, Houts, & Morrison, 2008). Together, this literature indicates the important role of the educator in selecting and implementing practices that facilitate children's early language and literacy development.

Theoretically, educators' practice is guided by their knowledge (Schachter, 2017; Shulman, 1987; Snow, Griffin, & Burns, 2005). Empirically, a growing body of literature has focused on educators' knowledge as it pertains to supporting early language and literacy (e.g., Hindman & Wasik, 2011; McCutchen, Abbott, et al., 2002; McCutchen, Harry, et al., 2002). Moreover, considerable efforts aim to strengthen educators' knowledge to support early language and literacy via professional development (e.g., Cunningham, Etter, Platas, Wheeler, & Campbell, 2015; Neuman & Cunningham, 2009; Piasta et al., 2017). The underlying logic model on which this work is premised is that educators' knowledge informs their practice and is thereby associated with children's learning (Desimone, 2009; Markussen-Brown et al., 2017). However, evidence concerning links among educators' language and literacy knowledge, practice, and children's outcomes is limited and largely drawn from studies of elementary school educators and children (e.g. Carlisle, Correnti, Phelps, & Zeng, 2009; Carlisle, Kelcey, Rowan, & Phelps, 2011; Kelcey, 2011; McCutchen, Abbott, et al., 2002; McCutchen, Harry, et al., 2002; Piasta, Connor, Fishman, & Morrison, 2009). Given the importance of early childhood experiences as a

foundation for later reading, we examined the associations of preschool educators' knowledge with classroom practice and children's emergent literacy learning in the current study.

Educators' Knowledge to Support Early Language and Literacy Development

In early literacy, disciplinary content knowledge regarding how oral and written language are structured and map to one another is critical (Moats, 1994). This includes knowledge pertaining to phonological awareness, grapheme-phoneme correspondences, and spelling regularity (Cunningham, Zibulsky, & Callahan, 2009; Moats, 1994; Snow et al., 2005). Phonological awareness and phonics-related knowledge is particularly important for early childhood educators because these knowledge domains are essential for beginning reading (Cunningham et al., 2015; Cunningham, Perry, Stanovich, & Stanovich, 2004). Additionally, knowledge regarding effective strategies and practices for supporting early language and literacy is important (Cheesman, McGuire, Shankweiler, & Coyne, 2009; Goldschmidt & Phelps, 2010; Neuman & Cunningham, 2009; Snow et al., 2005). For example, early childhood educators need to know strategies for promoting phonological awareness and alphabet knowledge, supporting vocabulary development, working with second-language learners, assessing children's language and literacy skills, and connecting literacy with other aspects of the curriculum (Neuman & Cunningham, 2009).

A growing number of studies provide descriptions of educators' knowledge to support language and literacy (e.g., Bos, Mather, Dickson, Podhajski, & Chard, 2001; Cunningham et al., 2004; Moats, 1994; Moats & Foorman, 2003; Moats & Lyon, 1996; Phelps, 2009; Puliatte & Ehri, 2018; Spear-Swerling, Brucker, & Alfano, 2005; Washburn, Binks-Cantrell, Joshi, Martin-Chang, & Arrow, 2016; Washburn, Joshi, & Binks-Cantrell, 2011). Typically, these studies characterize educators' knowledge as less than optimal. For example, Bos et al. (2001) measured

the literacy-related content knowledge of elementary preservice and in-service educators. Preservice educators averaged 50% correct, and inservice educators averaged 60% correct. Similarly, Puliatte and Ehri (2018) measured second and third grade educators' content knowledge and found out that these educators averaged 63% and 67% correct, respectively. In these and other studies, educators tended to find topics such as identifying and counting phonemes and morphemes particularly challenging. In addition, Cheesman et al. (2009) measured first grade educators' content knowledge and knowledge for practice specific to phonological awareness and phonics. Results showed that these educators averaged 63% correct for content knowledge and 53% correct for knowledge for practice.

Specific to early childhood, only a handful of studies provide descriptions of educators' knowledge to support young children's emergent literacy skills (Bursuck, Munk, Nelson, & Curran, 2003; Crim et al., 2008; Cunningham et al., 2015; Cunningham et al., 2009; Hindman & Wasik, 2011; Neuman & Cunningham, 2009; Troyer & Yopp, 1990). For example, Crim et al. (2008) examined preschool and kindergarten educators' content knowledge for supporting early literacy, including abilities to identify syllables, morphemes, and phonemes. Analyzed by item, educators averaged 68% to 95% correct for syllables, 5% to 33% for morphemes, and 15% to 60% for phonemes. With respect to supporting early language and literacy development, Neuman and Cunningham (2009) found that preschool educators averaged 58% correct on their measure of knowledge for practice. In addition, Cunningham et al. (2015) showed that preschool educators averaged 53% correct and 68% correct on content knowledge and knowledge-for-practice measures related to phonological awareness.

Educators' Knowledge and Practice

Conceptually, educators' knowledge is considered important because it informs how they select and enact classroom practices (Schachter, 2017; Shulman, 1987). Some studies have examined associations between educators' knowledge and practice in the area of early literacy (e.g., Cirino, Pollard-Durodola, Foorman, Carlson, & Francis, 2007; Gersten, Dimino, Jayanthi, Kim, & Santoro, 2010; Hindman & Wasik, 2011; McCutchen, Abbott, et al., 2002; Neuman & Cunningham, 2009; Neuman & Wright, 2010; Puliatte & Ehri, 2018; Schachter, Spear, Piasta, Justice, & Logan, 2016). These studies have, again, tended to primarily focus on elementary educators and, as a whole, provide mixed evidence concerning associations between knowledge and practice. Some studies have demonstrated positive associations between knowledge and aspects of practice (e.g. Cirino et al., 2007; McCutchen, Abbott, et al., 2002; Puliatte & Ehri, 2018), but others have not. For example, Puliatte and Ehri (2018) found moderate positive associations between second and third grade educators' content knowledge and their reported spelling practices. McCutchen, Harry et al. (2002) found that elementary educators who had greater content knowledge tended to use more explicit phonological activities; however, content knowledge was not associated with other types of classroom activities measured. In one study specific to early childhood, Schachter et al. (2016) found that preschool educators' knowledge for practice did not predict the language and literacy learning opportunities offered in their classrooms whereas their content knowledge was positively associated with oral language and vocabulary learning opportunities. The latter was only true, however, for educators who provided higher amounts of such learning opportunities.

Notably, although most studies examining associations between educators' knowledge and practice have been correlational, a few have involved experimental research to investigate

causal relations (Cunningham et al., 2009; Gersten et al., 2010; Hindman & Wasik, 2011; McCutchen, Abbott, et al., 2002; Neuman & Cunningham, 2009; Neuman & Wright, 2010). Typically, these studies have used professional development as a mechanism to improve educators' knowledge and investigated the impact of that increased knowledge on classroom practice. These studies provide some evidence that knowledge may affect practice. For example, McCutchen, Abbott et al. (2002) found that professional development improved kindergarten and first grade educators' content knowledge and, subsequently, increased phonological awareness instruction in kindergarten and increased comprehension instruction in first grade. Gersten et al. (2010) found that professional development utilizing educator study groups improved first grade educators' knowledge for supporting vocabulary and comprehension development and also led to higher quality vocabulary, but not comprehension, instruction. In early childhood, Hindman and Wasik (Hindman & Wasik, 2011; Wasik & Hindman, 2011) showed that the ExCELL professional development improved content knowledge, classroom literacy environments, and instructional quality for Head Start preschool educators.

Educators' Knowledge and Children's Learning

Studies have also examined associations between educators' knowledge and children's literacy learning (e.g., Carlisle et al., 2009, 2011; Cash, Cabell, Hamre, DeCoster, & Pianta, 2015; Kelcey, 2011; Lane et al., 2008; McCutchen, Harry, et al., 2002; Puliatte & Ehri, 2018; Spear-Swerling & Brucker, 2004). Again, the evidence base is mixed. Many studies show partial or no associations between educators' knowledge and children's early literacy learning. For example, Lane et al. (2008) found that elementary educators' knowledge for supporting reading fluency positively predicted first graders' decoding growth and second-graders' oral reading fluency but did not predict third graders' reading fluency. In addition, Puliatte and Ehri (2018)

found that some, but not all, aspects of second and third grade educators' content knowledge were related to children's spelling gains, and Carlisle et al. (2009) found no associations between elementary educators' content knowledge and children's word analysis or reading comprehension gains. In early childhood, Cash et al. (2015) found that preschool educators' knowledge was positively related to children's expressive vocabulary and print knowledge gains but not to receptive vocabulary or phonological awareness gains.

Notably, although the prevailing logic model posits that educators' knowledge affects children's learning through its associations with practice, only a few studies have addressed relations among all these components (Bos, Mather, Narr, & Babur, 1999; Gersten et al., 2010; Markussen-Brown et al., 2017; McCutchen, Abbott, et al., 2002; McCutchen & Berninger, 1999; McCutchen, Green, Abbott, & Sanders, 2009; Piasta et al., 2009; Puliatte & Ehri, 2018). For example, Puliatte and Ehri (2018) showed that aspects of educators' content knowledge and reported practices each uniquely predicted second grade children's spelling gains. In contrast, Cirino et al. (2007) found that educators' content knowledge did not predict kindergarten children's language and literacy outcomes although classroom practices did. Piasta et al. (2009) found an interaction among educators' content knowledge and practice, such that first grade children who experienced more decoding instruction from more knowledgeable educators exhibited the strongest word reading gains. Moreover, some professional development studies report effects on knowledge, practice, and children's early literacy learning (Gersten et al., 2010; Hindman & Wasik, 2011; Markussen-Brown et al., 2017; McCutchen, Abbott, et al., 2002; Wasik & Hindman, 2011). To our knowledge, however, no study has explicitly tested the logic model positing that educators' knowledge is indirectly associated with learning through its associations with practice, which would require a mediation analysis.

The Current Study

In this study, we explored early childhood educators' knowledge about early language and literacy as related to both practice and children's emergent literacy learning. To date, such associations remain unclear. This is particularly true with respect to associations between knowledge and children's outcomes. Although direct associations have been tested in the available research, indirect associations between educators' knowledge and children's learning gains would be expected given the prevailing logic model, hypothesized links among knowledge, practice, and learning, and existing evidence suggesting associations between knowledge and practice. In the current study, we explicitly test these indirect associations via mediation analysis. Moreover, most available studies have been conducted within the context of the elementary grades, despite the critical importance of early childhood experiences for supporting literacy development and a growing need for a knowledgeable and effective early childhood workforce (Hamre, Partee, & Mulcahy, 2017).

Specifically, we addressed the following three research questions: (1) To what extent is early childhood educators' knowledge about early language and literacy, both content knowledge and knowledge for practice, associated with their observed classroom practice? (2) To what extent is early childhood educators' knowledge associated with children's emergent literacy learning? (3) Are associations between early childhood educators' knowledge and children's learning mediated by classroom practice?

Method

Participants

This study involved data collected from educators and children in 485 early childhood classrooms. These data were collected for a larger project involving an evaluation of a

statewide, no-cost professional development program. Participation was open to all early childhood educators who registered for the state professional development, directly taught preschool-aged children, agreed to complete research study activities, and provided informed consent. Notably, the original evaluation project showed no impacts of the professional development on measures of educators' knowledge, no impacts on any child outcomes, and no impacts on the overall quantity or quality of classroom practices (Piasta et al., 2018; Piasta et al., 2017).

All classrooms in which research staff conducted classroom observations or collected child data were included in the present analyses. For those classrooms in which more than one educator participated in the project (e.g., co-lead educators; $n = 55$), data from one educator were randomly selected for inclusion in analyses. The 485 educators were primarily female (98%) and an average age of 42 years ($SD = 10.56$). The majority were White (75%); 17% were Black, and 2% were of other races or multiracial (6% unreported). One percent were Hispanic or Latinx (17% unreported). As the highest degree earned, 16% of educators held a high school diploma, 20% held an Associate's degree, 31% held a Bachelor's degree, and 24% held a graduate degree (11% unreported). Sixty-six percent held some sort of state teaching certification, which included certification to teach children 4 years old or younger (60%), elementary school (37%), special education (25%), or other certifications (23%; many held more than one certification). On average, educators had 11 years of experience teaching children prior to kindergarten entry ($SD = 7.79$). Educators worked in 371 different programs; most classrooms were public school-based (47%) or center-based (36%); (5% home-based; 12% unreported). Classrooms were located in rural (32%), suburban (30%), and urban areas (25%; 13% unreported); some were classified as early childhood special education (26%), and 34% were affiliated with Head Start

(5% unreported). Fifty-two percent reported using a commercially available curriculum in their classrooms (5% unreported), which was typically Creative Curriculum.

We sampled up to five children per participating classroom to complete project assessments. Children were eligible if they (a) had parental consent to participate, (b) were at least 4 years old, (c) were able to speak and understand English at a basic level, and (d) were free of profound disabilities (i.e., did not have any known diagnoses or, if diagnosed with a disability, rated as having moderate or high functioning in the classroom). Criteria (c) and (d) were applied to ensure that project assessments were appropriate for all participating children. Research staff randomly selected children from the pool of those eligible, prioritizing those expected to matriculate to kindergarten in the subsequent school year and stratifying by disability status in early childhood special education classrooms to approximate the inclusion model used in the state. In this manner, 2004 children were selected to participate at the onset of the study. Fifty percent were boys (4% unreported), with an average age of 4.64 years (SD = 0.40). Most were White (70%), 17% were Black, 6% were multiracial, and 4% were of other races (3% unreported); 5% were Hispanic/Latinx (10% unreported). The highest degrees earned by children's mothers included a high school diploma (53%), an Associate's degree (13%), a Bachelor's degree (13%), or a graduate degree (12%); 6% of children's mothers did not hold a high school diploma (4% unreported). Annual family incomes were less than $25,000 for 40% of children, between $25,001 to $50,000 for 23% of children, between $50,001 to $75,000 for 12% of children, and more than $75,001 for 20% of children (5% unreported). Fourteen percent of children had individualized education plans, and 3% of children were dual language learners.

Procedures and Measures

Research staff collected educator knowledge surveys in the fall of the year and coded classroom practice from observations conducted in the fall and spring. Research staff also administered emergent literacy assessments individually to children in the fall and spring.

Educators' knowledge. Educators completed two knowledge measures. The *content knowledge* measure was a version of the widely used Moats (1994) survey, adapted for early childhood educators by Cunningham and colleagues (Cunningham et al., 2009). Educators responded to 19 multiple choice and short answer items that assessed their understanding of oral and written language structures relevant to emergent literacy development. For example, educators identified and manipulated phonemes in words, demonstrated their understanding of concepts such as spelling regularity and consonant blends, and counted the number of syllables in words. Educators received one point for each correct response. Cronbach's α was .75 in the current study. The *knowledge for practice* measure was developed by Neuman and Cunningham (2009). Educators responded to 50 multiple choice and 20 true/false items. The majority of items addressed development of and practices to support children's language and literacy skills (letter knowledge, oral language, phonological awareness, comprehension, and print conventions), literacy curriculum and assessment, strategies for working with second-language learners, and parents' role in emergent literacy development; additional items addressed other aspects of child development and best practices as aligned with the standards of the National Association for the Education of Young Children. Educators received one point for each correct response. Cronbach's α was .74 in the current study.

Classroom practice. Research staff conducted one full-day videotaped classroom observation in both the fall and spring. Research staff worked with educators to select observation days representative of typical instruction (e.g., no field trips or special activities). To

verify representativeness, at the end of each observation, researchers asked educators to rate "How typical of a day was today?" on a scale of 1 (not typical at all) to 5 (very typical); the average rating was 4.2 (*SD* = 1.0). Researchers used two video cameras to record the entirety of in-class instructional time, as defined by the educator; this typically excluded snack, lunch, and free play unless educators indicated that they considered such routines as opportunities for instruction. One stationary camera, outfitted with a wide-angle lens, was placed in the classroom such that it captured as much activity as possible. A second, handheld camera was carried by the researcher and was used to zoom in on activities that might be missed by the stationary camera. Research staff also took field notes during the observation.

Research staff coded the videotaped observations at the research lab using the five language and literacy subscales of the Teacher Behavior Rating Scale (Book Reading, Print and Letter Knowledge, Phonological Awareness, Written Expression, and Oral Language; Assel, Landry, & Swank, 2008). Each subscale measures the quantity and quality of relevant language and literacy practices (e.g., use of comprehension strategies during shared book reading, emergent writing activities and modeling, open-ended questions and multi-turn conversations, activities to support syllable, onset/rime, and phoneme manipulation, classroom print to support letter knowledge and print concepts). Subscale scores are comprised of individual item ratings, as converted to a 4-point scale in which higher scores indicate more desirable language and literacy practices. Subscale scores are averaged to create the overall classroom practice score; these were then averaged across the fall and spring observations to create one score representing typical classroom practice on any given day. Research staff completed training available from the developers, observed master coders, and practiced coding against master-coded videos.

Double coding of a randomly selected 20% of observations showed that interrater reliability, as measured by intraclass correlation (ICC), was .94.

Children's emergent literacy skills. Research staff administered standardized emergent literacy assessments to children in the fall and spring of the year. Assessments were administered individually, at quiet locations in children's early childhood centers. Four emergent literacy skills served as outcomes in the present study. We measured children's *print concept knowledge* via the Preschool Word and Print Awareness assessment (Justice, Bowles, & Skibbe, 2006). Children are asked questions tapping their knowledge of 14 print concepts within the context of a shared book reading (e.g., print directionality, concepts of letters and words). Raw sum scores are converted to item response theory (IRT)-based scores with a mean of 100 and standard deviation of 15. IRT-based reliability is .74 (see Justice et al., 2006), and Cronbach's α was .73 in the current study. We measured *letter naming* via the Uppercase and Lowercase Letter Recognition subtests of the Phonological Awareness Literacy Screening for Preschool (Invernizzi, Sullivan, Meier, & Swank, 2004). Children are asked to name all 26 uppercase letters, presented in a random order, and then to name all 26 lowercase letters, also presented in a random order. The correct number of letters named is tallied, with a maximum possible score of 52. Cronbach's α was .98. We measured *phonological awareness* via the Rhyme Awareness and Alliteration Awareness subtests of the Pre-Reading Inventory of Phonological Awareness (Dodd, Cosbie, McIntosh, Teitzzel, & Ozanne, 2003). Children are presented with sets of four words, presented orally and pictorially, and asked to select the one word that does not rhyme or does not start with the same sound. The number of correct responses on each subtest was tallied and summed across subtests to create a composite score, based on preliminary exploratory factor analysis and parallel analysis which supported a single

phonological awareness construct (see also Anthony & Lonigan, 2004). Cronbach's α was .75. We measured *oral language* via the three core subtests of the Clinical Evaluation of Language Fundamentals Preschool-2 (Wiig, Secord, & Semel, 2004). In the Expressive Vocabulary subtest, children are asked to name depicted objects, actions, and people. In the Sentence Structure subtest, children are presented with sentences featuring increasingly complex syntactical constructions and asked to point to the picture that matches the sentence. In the Word Structure subtest, children are shown pictures and asked to use increasingly complex syntactic constructions to finish an incomplete sentence presented by the assessor. For the present study, subtests were scored as indicated in the manual (i.e., sum across items scores of 0 to 2 for Expressive Vocabulary, 0 to 1 for both Sentence Structure and Word Structure). Subsequently, we linearly transformed the Expressive Vocabulary items to put these on the same 0-to-1 scale as the other subtests and summed across the three subtests to create a composite score, as supported by preliminary exploratory factor analysis and parallel analysis. Cronbach's α was .85.

Results

Correlations and descriptive statistics for educators' knowledge, classroom practice, and children's fall and spring emergent literacy skills are presented in Table 1. Missing data ranged from 1% to 9% for the knowledge and practice variables, 4% to 14% for children's fall skills, and 13% to 23% for children's spring skills. Separate variance *t*-tests supported systematic associations between missingness on variables of interest and other variables in the dataset; we thus imputed 40 multilevel datasets to use in all further analyses. We performed imputation and all analyses using Mplus v7.4 (Muthén & Muthén, 1998-2012). Alpha was set at .05.

To address our first research question, we used the imputed datasets to estimate the correlations between educators' knowledge and practice. Both content knowledge and

knowledge for practice were significantly correlated with classroom practice, with $r = .24$ and $r = .21$ ($ps < .001$), respectively. To address our second research question, we estimated the associations between educators' knowledge and children's emergent literacy learning using multilevel modeling. Multilevel modeling was necessary given that children were nested within classrooms and showed sizable shared classroom variance in their spring skills (ICCs for unconditional models ranged from .17 to .24). For each child outcome of interest (i.e., print concept knowledge, letter naming, phonological awareness, oral language), we estimated separate models for content knowledge and knowledge for practice as predictors. These models also controlled for children's fall scores on the corresponding outcome; fall scores were included as fixed effects for print concept knowledge, letter naming, and phonological awareness, based on preliminary analyses showing that random effects were small and non-significant, and as random effects for oral language. All variables were grand-mean centered. Results of these analyses are presented in Table 2. Content knowledge significantly predicted children's learning of print concepts and phonological awareness but did not meet traditional significance levels when predicting letter naming ($p = .07$). Knowledge for practice significantly predicted children's learning of print concepts, letter naming, and phonological awareness. Neither knowledge measure predicted children's language learning.

To address our third research question, we estimated 2-2-1 multilevel mediation path models (Preacher, Zyphur, & Zhang, 2010) to determine whether associations between educators' knowledge and children's learning were mediated by classroom practice (i.e., whether educators' knowledge is indirectly associated with children's learning through its association with classroom practice). In these models, educators' knowledge and classroom practice were measured at the classroom level (level 2) and children's emergent literacy skills were measured

at level 1. Separate mediation models were estimated for content knowledge and knowledge for practice and for each emergent literacy skill; all models controlled for children's fall skills on the corresponding spring outcome, with fall oral language skills again included as a random effect. All variables were grand-mean centered. The path model and all results are provided in Figure 1. Of relevance to our research questions is the indirect (*ab*) association of educators' knowledge with children's spring skills, as mediated by classroom practice. Classroom practice mediated the association between both content knowledge and knowledge for practice for children's print concept learning, although the magnitude of the association was small. Notably, for content knowledge, the association was only partially mediated, given that the direct association between educator knowledge and children's spring print concept knowledge (c') remained statistically significant. Models did not suggest indirect associations between educators' knowledge and children's letter name, phonological awareness, or language learning.

Finally, given that the data were collected as part of a larger evaluation project, we conducted post hoc analyses in which we re-estimated models after controlling for the professional development condition in which educators originally participated (available from the first author). Results mirrored those reported above with one exception. The indirect association between content knowledge and children's print concept learning was at, rather than below, our alpha threshold, with the unstandardized coefficient = 0.07 and $p = .050$.

Discussion

Our study yielded two major findings. First, our results show that early childhood educators' language and literacy knowledge is significantly associated with both their classroom language and literacy practices and children's emergent literacy gains. Educators with greater levels of knowledge not only tended to exhibit more desirable language and literacy classroom

practices, but children in these classrooms tended to make greater gains in learning print concepts, letter naming, and phonological awareness. Notably, these associations were similar for both measures of content knowledge and knowledge for practice, lending additional confidence to the findings. The magnitude of these associations was small but potentially meaningful. Educators' knowledge accounted for 4% to 6% of the variance in their classroom language and literacy practices when considering content knowledge and knowledge for practice, respectively. Educators' content knowledge accounted for 4% to 6% of the between-classroom variance in children's learning gains, and educators' knowledge for practice accounted for 3% to 4% of the between-classroom variance in these outcomes.

These results extend prior studies documenting early childhood educators' knowledge (e.g., Crim et al., 2008; Troyer & Yopp, 1990) as well as studies within the preschool context that have suggested positive associations between knowledge and practice (Hindman & Wasik, 2011; Schachter et al., 2016). With respect to preschool children's emergent literacy gains, our findings are partially aligned with those of Cash et al. (2015), who documented associations between educators' knowledge and children's gains in print knowledge and expressive vocabulary but not phonological awareness or receptive vocabulary. The differences between our findings and those of Cash et al. may be due to instrumentation. Educator knowledge was measured in Cash et al. by asking educators to categorize specific skills (e.g., "Identify the first sound in a spoken word.") into the corresponding language or literacy domain (e.g., phonological awareness). In contrast, the measures in the current study, and especially our measure of content knowledge, emphasized more discrete knowledge regarding English orthography and phonology and how to facilitate children's orthographic and phonological learning.

Unlike Cash et al. (2015), we did not find any associations between educators' language and literacy knowledge and children's oral language gains. We expected such associations for at least our knowledge for practice measure, given that this measure included attention to language and related classroom practices (see also Neuman & Cunningham, 2009). Again, this difference could be due to instrumentation, either for educator knowledge or the language outcomes. To the best of our knowledge, only four other studies have examined associations between educators' language and literacy knowledge and children's language outcomes, with rather mixed results (Cirino et al., 2007; Gersten et al., 2010; McCutchen et al., 2009; McCutchen, Harry, et al., 2002). In general, available studies have concentrated on code-focused, reading-related outcomes (e.g., print knowledge, phonological awareness, word reading) rather than language outcomes, and the vast majority have utilized knowledge measures that emphasize orthography, phonology, morphology, or supporting code-focused skills (cf. Duguay, Kenyon, Haynes, August, & Yanosky, 2015; Gersten et al., 2010). Given current challenges in facilitating educators' abilities to support young children's language development (Dickinson, 2011; Haley, Hulme, Bowyer-Crane, Snowling, & Fricke, 2017), better understanding educators' knowledge regarding oral language and associations or lack thereof with children's language learning is an important avenue for future research.

Second, our results provide some support for the logic model underlying many studies of educators' knowledge. Namely, we found that educators' knowledge related to children's print concept learning through its associations with classroom language and literacy practices. To our knowledge, this is the first study to empirically test this prevailing logic model. We believe that this correlational work is an important complement to experimental studies showing effects of professional development on educators' knowledge and children's learning, in that the present

results validate a mechanism through which changes in educator knowledge may affect children's outcomes. Although correlational in nature, this work overcomes the fact that many professional development studies couple teaching knowledge with teaching new practices (e.g., Hindman & Wasik, 2011; Neuman & Cunningham, 2009); this confounding makes it difficult to disentangle the individual effects of knowledge on practice or child learning. One next step might involve identifying the sources through which educators acquired their knowledge about language and literacy (e.g. degrees earned, professional experiences while in-service), as this was beyond the scope of the present study. Notably, available research does not provide consistent evidence that knowledge is related to either education levels, general teaching experience, or credentialing (Cunningham et al., 2004; Hindman & Wasik, 2011; Neuman & Cunningham, 2009; Schachter et al., 2016; Troyer & Yopp, 1990), and more specific sources of knowledge may need to be examined, such as the content of language and literacy coursework completed (but see Joshi et al., 2009). Another next step might be to examine how contextual factors, such as characteristics of the centers and schools in which educators work, might moderate associations among educators' knowledge, classroom practice, and children's learning. We did not examine this in the current study but such factors might both relate to how educators acquire their knowledge (e.g., professional development opportunities) as well as how such knowledge is expressed in classroom practice.

Although all but our oral language outcomes were associated with educators' language and literacy knowledge, we are uncertain as to why mediation through practice applied only to print concept learning. We speculate that knowledge must relate to children's learning through some mechanism under educators' control. Possibly, our findings are specific to print concept learning due to our selected classroom practice measure. At least two of the subscales utilized

included practices relevant to supporting print concept knowledge (i.e., Book Reading and Print and Letter Knowledge), and educators exhibited limited scores on the Early Writing and Phonological Awareness subscales (which corresponds to current evidence concerning minimal phonological awareness and writing opportunities in early childhood classrooms; Cunningham et al., 2015; Gerde, Bingham, & Pendergast, 2015; Pelatti, Piasta, Justice, & O'Connell, 2014; Piasta et al., 2018). Thus, alignment between our practice and child outcome measures may have been greatest for print concept knowledge, and use of a different measure of practice better aligned with other outcomes might have yielded additional findings. Similarly, it is conceivable that other or additional aspects of practice unmeasured in the current study may mediate associations between educators' knowledge and children's learning. For example, previous results from Piasta et al. (2009) suggest that educators needed to use their knowledge within the context of explicit literacy instruction to see associations with learning gains. Other aspects of practice through which educator knowledge may relate to children's learning include educators' decision-making, in terms of planning, grouping, sequencing content, and in-the-moment instructional moves, as well as educators' abilities to scaffold or individualize instruction for specific children (Schachter, 2017; Watts-Taffe et al., 2012).

We note that our findings are specific to our particular sample. Although our early childhood educator sample was similar to national US samples on many background characteristics (Maroto & Brandon, 2012; National Survey of Early Care and Education, 2013), all educators and children were located in one particular state and voluntarily participated in this research; it is unclear whether results would generalize to broader populations. Moreover, educators were aware of the classroom observations, and social desirability could influence the classroom practice observed.

In conclusion, the current results align with a growing literature suggesting the importance of educators' language and literacy knowledge for high-quality classroom practices and promotion of children's early literacy learning. Moreover, the results show that these associations are evident for both content knowledge and knowledge more directly related to practice. These findings indicate that both types of language and literacy knowledge should be supported during preservice educator preparation and inservice professional development.

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Table 1

Correlations and Descriptive Statistics for Educators' Knowledge, Classroom Practice, and Children's Fall and Spring Emergent Literacy Skills

	1	*2*	*3*	*3*	*4*	*6*	*7*	*8*	*9*	*10*	*n*	*M*	*SD*	Range
Educators' knowledge														
1. Content knowledge (max of 19)											435	13.78	3.24	3 - 19
2. Knowledge for practice (max of 70)	.47										450	46.81	6.46	17 - 60
3. Classroom practice (max of 3)	.25	.21									479	1.38	0.28	0.41 - 2.18
Children's emergent literacy skills														
4. Print concept knowledge, fall (max of 161)	.07	.08	.20								1891	105.55	15.91	46 - 161
5. Print concept knowledge, spring (max of 161)	.11	.09	.13	.61							1721	114.82	19.12	46 - 161
6. Letter naming, fall (max of 52)	.06	.07	.13	.47	.44						1922	25.16	18.32	0 - 52
7. Letter naming, spring (max of 52)	.07	.09	.13	.42	.47	.82					1744	34.35	16.86	0 - 52
8. Phonological awareness, fall (max of 24)	.09	.08	.10	.41	.42	.41	.34				1724	7.46	4.57	0 - 24
9. Phonological awareness, spring (max of 24)	.11	.08	.10	.51	.58	.48	.48	.59			1539	9.64	5.79	0 - 24
10. Oral language, fall (max of 66)	.09	.08	.08	.57	.57	.44	.42	.46	.52		1897	39.04	10.90	0 - 65
11. Oral language, spring (max of 66)	.08	.04	.09	.57	.66	.44	.48	.44	.58	.81	1726	45.24	10.48	0 - 66

Note. Correlations based on raw data, aggregated to the classroom level. With the exception of the correlation between knowledge for practice and spring oral language, all other correlations were statistically significant at $p < .01$.

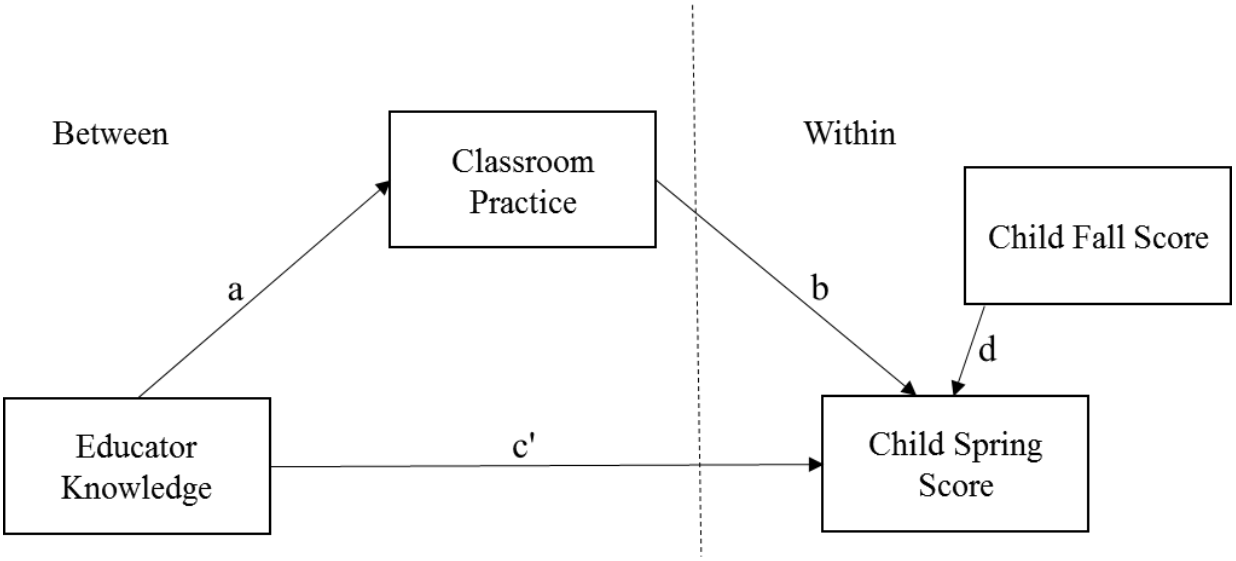
Table 2

Multilevel Model Results: Associations between Educators' Knowledge and Children's Emergent Literacy Learning

	Print concept knowledge		Letter naming		Phonological awareness		Oral language	
	Estimate	*p*	Estimate	*p*	Estimate	*p*	Estimate	*p*
				Content knowledge				
Child level								
Intercept, γ_{00}	114.00	<.001	33.64	<.001	9.27	<.001	44.95	<.001
Fall score, γ_{10}	0.66	<.001	0.75	<.001	0.70	<.001	0.77	<.001
Classroom level								
Educator knowledge, γ_{01}	0.49	<.001	0.17	.070	0.13	.005	0.05	.349
Variance								
Child level, σ^2	201.82	<.001	83.32	<.001	18.67	<.001	29.91	<.001
Classroom level, τ_{00}	25.59	<.001	8.28	.001	2.79	<.001	3.79	.006
				Knowledge for practice				
Child level								
Intercept, γ_{00}	114.00	<.001	33.65	<.001	9.27	<.001	44.95	<.001
Fall score, γ_{10}	0.66	<.001	0.75	<.001	0.71	<.001	0.77	<.001
Classroom level								
Educator knowledge, γ_{01}	0.17	.015	0.10	.024	0.05	.029	-0.01	.675
Variance								
Child level, σ^2	202.23	<.001	83.28	<.001	18.68	<.001	29.95	<.001
Classroom level, τ_{00}	26.33	<.001	8.25	.001	2.83	<.001	3.77	.007

Note. Results based on 40 imputed datasets. Based on preliminary analyses, fall scores were entered as fixed effects for print concept knowledge, letter naming, and phonological awareness. Fall scores were entered as random effects for oral language, with estimate =

0.02 for the fall score random effect in both models and $p = .041$ in the content knowledge model and $p = .042$ in the knowledge for practice model.



	Print concept knowledge			Letter naming			Phonological awareness			Oral language[a]	
Path	β	*b*	*p*	β	*b*	*p*	β	*b*	*p*	*b*	*p*
					Content knowledge						
a	.24	0.02	<.001	.24	0.02	<.001	.24	0.02	<.001	0.02	<.001
b	.20	3.61	.017	.15	1.56	.120	.21	0.64	.188	0.82	.161
c'	.25	0.41	.003	.15	0.14	.151	.11	0.11	.014	0.03	.560
ab	.05	0.08	.032	.04	0.03	.135	.02	0.01	.204	0.02	.175
d	.62	0.66	<.001	.83	0.74	<.001	.59	0.70	<.001	0.77	<.001
					Knowledge for practice						
a	.21	0.01	<.001	.21	0.01	<.001	.21	0.01	<.001	0.01	<.001
b	.23	4.13	.007	.15	1.55	.054	.13	0.74	.130	1.00	.086
c'	.16	0.13	.063	.19	0.09	.054	.16	0.04	.071	-0.02	.463
ab	.05	0.04	.022	.03	0.02	.139	.03	0.01	.151	0.01	.104
d	.62	0.66	<.001	.83	0.74	<.001	.59	0.70	<.001	0.77	<.001

Figure 1. Multilevel path model and mediation results. Results based on 40 imputed datasets. Variables to the left of the dotted line were measured at the classroom level (between classrooms), and variables to the right of the dotted line were measured at the child level (within classrooms). β = standardized coefficient; *b* = unstandardized coefficient; ab = indirect association of educators' knowledge with children's spring scores as mediated through classroom practice and controlling for fall scores. [a]Standardized results cannot be computed for the random effects model.