Preschoolers with Developmental Speech and/or Language Impairment: Efficacy of the Teaching Early Literacy and Language (TELL) Curriculum

M. Jeanne Wilcox, Shelley Gray, Mark Reiser, Arizona State University, Tempe, Arizona

Accepted for Publication: Early Childhood Research Quarterly

October 1, 2019

Author Notes

M. Jeanne Wilcox, Division of Education Leadership and Innovation, Arizona State University, Tempe, Arizona. Shelley Gray, Department of Speech and Hearing Science, Arizona State University, Tempe, Arizona. Mark Reiser, School of Math and Statistical Sciences, Arizona State University, Tempe, Arizona.

This research was supported by the U.S. Department of Education, Institute of Education Sciences, National Center for Special Education Research Grant# R324A110048. The opinions expressed in this article are those of the authors and no official endorsement by the IES should be inferred. We thank Alicia DiDonato, Amy Guimond, Rachel Mayercek, Patricia Chan, Lisa Southerland, Bjorg LeSueur, Shereen Thomas, Jean Brown, Dawn Greer and the numerous graduate research assistants for their contributions to this work. We also thank participating teachers from the Cartwright, Isaac, Kyrene, Osborn, Scottsdale, Tolleson, Union, Gilbert, Paradise Valley, Higley, Deer Valley, Dysart, Littleton, Litchfield, and Cave Creek school districts, their dedication to their students and this project made this research possible.

The TELL curriculum and associated curriculum-based measures are available from the first author. Correspondence concerning this article should be sent to: M. Jeanne Wilcox, Division of Education Leadership and Intervention, Mary Lou Fulton Teachers College, PO Box 871811, Tempe, AZ 85287-1811 email: mjwilcox@asu.edu

Abstract

Problem/Purpose: Young children with developmental speech and/or language impairment (DSLI) often fail to develop important oral language and early literacy skills that are foundational for subsequent schooling and reading success. The purpose of this investigation was to examine the efficacy of the TELL curriculum and associated evidence-based teaching practices in promoting the acquisition of oral language and early literacy skills for preschool children with DSLI.

Participants: Participants included 202 male and 87 female preschoolers with DSLI in the absence of other developmental impairment. Children ranged in age from 43 to 63 months. They were enrolled in 91 inclusive preschool classes and their corresponding classroom teachers were all female.

Method: In this cluster RCT, classroom teachers were randomly assigned to implement the TELL curriculum or to continue with their business-as-usual (BAU) curriculum. Proximal outcomes were assessed with investigator-developed curriculum-based measures (CBM) administered six times over the school year and an investigator-developed assessment of vocabulary targeted in TELL. Standardized tests of oral language (*Clinical Evaluation of Language Fundamentals Preschool - 2nd Edition)*, and early literacy skills (*Test of Preschool Early Literacy*), and a benchmarked early literacy assessment (*Phonological Awareness and Literacy Screening PreK)* were administered at the beginning and end of the school year to determine impact on more distal outcomes.

Results: Results indicated a significant TELL effect for all CBMs at later measurement points with Cohen's *ds* in the medium (.43) to very large (1.25) range. TELL effects were also noted for

the vocabulary measures with small to medium between-group effect sizes (Cohen's f^2 range from .02 to .44). There were no significant TELL effects for the more distal measures.

Conclusion: Based on progress measures, the TELL curriculum was effective for improving the oral language and early literacy skills of young children with DSLI.

Research Highlights

1. Teaching Early Literacy and Language (TELL) is a tier one curriculum that was developed for young children with developmental disabilities and tested in an RCT with 91 teachers and the 289 children with developmental speech and/or language impairment who were enrolled in their preschool classes.
2. Curriculum-based measures developed for TELL were administered to all children at six time points across the school year.
3. Growth curve estimates indicated increased magnitude of growth for children who received TELL with peaks outside the scope of the model for all oral language and eagerly literacy skills that were measured. Children assigned to the BAU classes typically demonstrated a plateau.
4. Comparison of performance at each CBM time point for each skill indicated that children in TELL significantly outperformed their BAU counterparts in all oral language and early literacy skill areas, with medium to large effect sizes.
5. A TELL effect was noted for one of the distal measures (pre-post receptive and expressive vocabulary). No differences between the groups were found on other distal measures.

Preschoolers with Developmental Speech and/or Language Impairment: Efficacy of the Teaching Early Literacy and Language (TELL) Curriculum

It is well established that preschool children's early literacy and oral language skills are associated with subsequent reading achievement (Dickinson, McCabe, Anastasopoulos, Peisner-Feinberg, & Poe, 2003; Shanahan et al., 2008; Storch & Whitehurst, 2002). Early literacy skills, also referred to as code-focused skills, include conventions of print (e.g. directionality), beginning writing (e.g. name writing), grapheme knowledge (e.g. letter names), grapheme-phoneme correspondence (sounds made by each letter), and phonological awareness (e.g. beginning sound awareness). Code-related skills are among the strongest early literacy predictors of later reading decoding [National Early Literacy Panel Report (NELP), 2009]. In terms of language, evidence suggests that oral language skills, including vocabulary, language comprehension, and narratives, are associated with subsequent reading comprehension (for a review see Brinchmann, et al., 2017). However, oral language and early literacy skills also are interdependent and interactively predict some aspects of reading achievement including decoding and reading comprehension (Catts, Herrera, Nielsen, & Bridges, 2015; Lepola, Lynch, Kiuru, Laakkonen, & Niemi, 2016; Piasta, Groom, Khan, Skibbe, & Bowles, 2018).

Risk and Young Children with Developmental Speech and/or Language Disorders

Nearly all preschool programs in the United States provide some form of early literacy and oral language instruction as an essential component of preparing young children for the academic demands of formal schooling. A focus on these skill areas, while important for all young children, is of critical importance for children with development speech and/or language impairment (DSLI) to promote their readiness for school and access to the general curriculum. Young children with DSLI or developmental delay that includes DSLI represent the majority

(80%) of 3-5-yr-old children receiving education services through the Individuals with Disabilities Education Act in preschool classrooms (ED*Facts* Data Warehouse). Children with DSLI typically present with one of three profiles: Those with language impairment, those with speech impairment, and those with speech and language impairment. All groups of young children with DSLI may perform poorly on oral language and tasks when compared to their peers who are developing typically (Catts, Fey, Tomblin, & Zhang, 2002; Conti-Ramsden, St Claire, Pickles, & Durkin, 2012; Lewis et al., 2011; Peterson, Pennington, Shriberg, & Boada, 2009; Schuele, 2004).

Children with DSLI often experience challenges with reading fluency, reading comprehension, and other language-dependent academic tasks during the primary school grades and beyond (Catts, Herrera, Nielsen, & Bridges, 2015; Hayiou-Thomas, Carroll, Leavett, Hulme, & Snowling, 2017; Hulme, Nash, Gooch, Lervåg, & Snowling, 2015; Snowling, Duff, Nash, & Hulme, 2016). The comorbidity of language impairment and reading disabilities ranges from 40-90%, (Catts, 2004) and the comorbidity of speech impairment and reading disabilities is from 25-50% (Peterson et al., 2009). Risk of reading disability for all children with DSLI persists, even when the speech and/or language impairment appears to have resolved (Zipoli & Merritt, 2017). When this elevated risk is considered, in addition to the fact that DSLI is a high incidence condition among young children receiving special education services, the importance of ensuring that these children are prepared for successful reading and schooling outcomes becomes a high priority. .

Research indicates that language and early literacy skills are malleable (NELP, 2009; Diamond, Justice, Seigler, & Snyder, 2013) and instruction in these domains may lead to an increase in children's school readiness (Hill, Gormley, & Adelstein, 2015; Magnuson, Ruhm, &

Waldfogel, 2007; Weiland & Yoshikawa, 2013; Yoshikawa, Weiland, & Brooks-Gunn, 2016). In a recent meta-analysis of early childhood education (ECE) programs, results showed that children who attended an ECE program where teachers provided explicit oral language and early literacy instruction demonstrated higher gains in these domains when compared to children who attended an ECE program that had a more general focus (Kholoptseva, 2016). Similar trends were identified in a recent review of early childhood oral language and early literacy programs (Chambers, Cheung, & Slavin, 2016). Although the benefits of preschool language and early literacy instruction are well documented, research indicates that the actual amount of oral language and early literacy instruction in preschool classes is limited, and often not well-timed or tuned to children's interests and/or abilities (Guo, Justice, Kaderavek, & McGinty, 2012; Justice, Mashburn, Hamre, & Pianta, 2008; Pelatti, Piasta, Justice, & O'Connell, 2014).

Over the past decade, education for young children with developmental disabilities increasingly is structured around a model of multi-tiered systems of support (MTSS), also referred to as response to intervention (Hebbeler & Spiker, 2016). In a MTSS system, instruction for all children begins with a whole class, tier one curriculum. Repeated progress measures monitor children's learning, identifying those who need additional supports to acquire key skills, which may include tier two instruction (e.g., increase in practice opportunities) or tier three instruction (e.g., individualized interventions as indicated on an IEP). Central to the effectiveness of MTSS is provision of a tier one curriculum that has causal evidence for efficacy. This is crucial because in the application of MTSS, when children are not progressing within a tier one curriculum, teachers often decide to move them into a higher instructional tier. However, in the absence of causal efficacy evidence, it is possible that children's lack of progress is due to use of a curriculum that is not efficacious rather than a need for higher tier of instruction.

Preschool Oral Language and Early Literacy Curriculum and Interventions for Children with DSLI: Overview of the Evidence Base

The causal evidence base for tier one oral language and early literacy curricula is minimal. For example, the What Work's Clearinghouse (WWC) intervention reports identify two tier one curricula, *Literacy Express* (Lonigan, Clancy-Menchetti, Phillips, McDowell, & Farver, 2005) and *Doors to Discovery*™ , that showed positive effectives on children's oral language and/or early literacy skills. Only *Literacy Express* showed effects on oral language *and* early literacy skills. Two supplemental literacy programs also showed positive effects for early literacy skills including *DaisyQuest* (online) and *Headsprout Early Reading* (software-based). Most of the early childhood curricula reviewed by the WWC had no effects on preschool children's language or early literacy skills, a situation that creates significant challenges for implementation of a MTSS model. In addition, the majority of preschool language and literacy curriculum studies are with samples of young children who are at-risk due to economic disadvantage or other environmental factors. In contrast, there is little research conducted with samples of young children with developmental disabilities (Hebbeler & Spiker, 2016). Among early childhood curricula reviewed by the WWC, only one, *Literacy Express*, included children with developmental disabilities in the study sample, but findings did not include a separate analysis for these children, making it difficult to determine specific effects for this population.

To date, most efforts to strengthen the oral language and early literacy skills of young children with developmental disabilities, and in particular those with DSLI, rely on interventions targeting specific oral language or early literacy components (e.g., vocabulary, phonological awareness, alphabet knowledge, print conventions) rather than comprehensive, tier one curricula. In the WWC two interventions, phonological awareness training and dialogic reading, are identified as

beneficial for young children with DSLI. Phonological awareness training includes several different strategies focused on improving young children's ability to identify sounds in words independent of meaning.. When young children with DSLI receive phonological awareness training, either within their classrooms or individually, increases in their ability to identify sounds in words and segment words into sounds is documented (Kleeck, Gillam, & Mcfadden, 1998; O'Connor, O'Connor, Jenkins, Leicester, & Slocum, 1993).

Dialogic reading is a set of strategies used by an adult during shared book reading to encourage children's active participation. It is appropriate for use with an individual child or a small group of children. Research indicates that dialogic reading strategies significantly improve oral language skills for preschoolers with DSLI, including receptive and expressive vocabulary targeted during shared book reading (Towson, Gallagher, & Bingham, 2016), number and length of utterances (Crain-Thoreson & Dale, 1999), and correct responses to fact- and inference-based questions about the book (Whalon, Martinez, Shannon, Butcher, & Hanline, 2015). When comparisons were made between shared reading that did and did not include dialogic reading strategies, vocabulary learning and scores on an expressive language vocabulary test was higher for children when their adult readers used dialogic reading strategies (Hargrave & Sénéchal, 2000).

Other targeted oral language and early literacy interventions not included in WWC reviews also appear efficacious when delivered to young children with DSLI. Studies document the effectiveness of shared book reading with embedded explicit print referencing (e.g., directionality of text, book cover, title, identifying letters and words) as an intervention that improves print concepts and alphabet knowledge (Justice, Logan, Kaderavek, & Dynia, 2015; Lovelace & Stewart, 2007). Shared story book reading is also an effective context for embedding language interventions to increase inferential language use (van Kleeck, Vander Woude, & Hammett, 2006). More recently,

digital storybooks with a narrator encouraging active child participation increased higher level vocabulary use for young children with DSLI (Kelley, Goldstein, Spencer, & Sherman, 2015).

A substantial body of experimental and clinical research documents the efficacy of several oral language intervention techniques for young children with DSLI. Although referred to by different names including modeling, recasting, modeling with expansion, linguistic mapping, and focused stimulation, all provide an explicit language model that corresponds to a child's focus of attention and includes the targeted linguistic form (e.g., vocabulary item, syntactic structure). In some techniques the language model includes a conversational request for a child to produce an utterance (e.g., "ball, can you say ball?") while in others, the adult simply provides language models at a high rate, or includes a child utterance in a different or more complex syntactic form. These interventions are delivered to children in settings that range from more naturalistic (e.g., homes or preschool classrooms) to contrived (e.g., treatment at a clinic). Efficacy of these types of interventions is documented for increasing children's receptive and expressive vocabulary, utterance length, use of grammatical morphemes (e.g., past tense), and syntactic structures (e.g., Buschmann et al., 2009; Camarata, Nelson, & Camarata, 1994a; Cleave et al., 2015; Fricke, Bowyer-Crane, Haley, Hulme, & Snowling, 2013; Girolametto, Pearce, & Weitzman, 1996; Johanne Paradis, 2015; Leonard, Camarata, & Camarata, 2008; McCartney, Boyle, Ellis, Bannatyne, & Turnbull, 2011; Roberts & Kaiser, 2011; Wilcox, Kouri, & Caswell, 1991)

Several targeted interventions improve components of oral language and the early literacy abilities of young children with DSLI; however, the extent to which these interventions increase children's readiness for school or subsequent reading success remains undetermined. It seems unlikely that interventions targeting isolated early literacy or oral language skills, by

themselves, offer young children with DSLI the opportunity to develop the complex array of early literacy and oral language skills that are important to early schooling success.

Embedded Instruction and Effective Oral Language and Early Literacy Curricula

Research indicates that children with and without disabilities demonstrate increased learning when oral language and early literacy instruction is embedded in classroom activities or a curriculum that offers sequenced learning opportunities (Horn, 2009; Horn, Lieber, Shouming, Sandall, & Schwartz, 1995; Kholoptseva, 2016; Neuman et al., 2015; Snyder et al., 2015; Terrell & Watson, 2018; Wilcox et al., 1991; Woods, Wilcox, Friedman, & Murch, 2011). Embedded instruction has a long and successful history in interventions delivered to children with disabilities and is a key component of high-quality learning opportunities for young children with disabilities in inclusive settings.

An advantage to instruction embedded within a curriculum is the potential for providing young children with comprehensive learning opportunities to promote acquisition of a broad set oral language and early literacy skills. However, to realize the promise of using embedded instruction in this way, the curriculum must be efficacious, well-designed, and delivered with high fidelity. Efficacious curricula include those with causal evidence for effectiveness. Well-designed curricula are mapped to early learning standards and include a scope and sequence of developmentally appropriate activities and embedded instruction designed to teach children targeted skills (Hebbeler & Spiker, 2016; Kagan & Kauerz, 2006). High fidelity implementation is the extent to which a curriculum is delivered as intended. In addition, especially within an MTSS model, it is important that a curriculum include assessments to document children's progress and to facilitate differentiated instruction. One published curriculum, *Literacy Express*, appears to adhere to all of these components and researchers included young children with

disabilities in their testing sample. The documented efficacy of *Literacy Express* suggests that it may be effective for young children with DSLI, but given the omission of separate data analyses for children with disabilities, the effectiveness for this population remains unknown.

Although young children with DSLI acquire important language and early literacy skills in the same contexts as their peers with typical development, they require higher levels of explicit, embedded instruction to develop key language and early literacy skills that will promote their subsequent schooling success (Carta & Driscoll, 2013). An efficacious tier one curriculum with options for differentiated instruction can provide these higher levels of support, but to date, investigations of tier one curricula efficacy for young children with DSLI are very limited, establishing a clear need to examine curriculum efficacy for children with DSLI.

Purpose of the Present Investigation

The lack of efficacious curricula for young children with DSLI was the primary driver for our development and testing of a tier one, whole class, early literacy and oral language curriculum entitled *Teaching Early Literacy and Language; TELL* (Wilcox, Gray, Guimond, & Lafferty, 2011). The TELL curriculum promotes children's growth in four early literacy skill areas (phonological awareness, alphabet knowledge, print conventions, writing) and three oral language skill areas (vocabulary, sentence length and complexity, and listening comprehension) that are robust predictors of subsequent reading fluency and reading comprehension. A key premise underlying TELL is that language and literacy goals can be taught and practiced in any preschool activity; thus, TELL was designed so language and early literacy learning opportunities are embedded within typical preschool activities, routines, and transitions as well as lessons with a primary focus on other learning areas (e.g., science, math). Further, given data documenting the efficacy of small group instruction for preschool children, including those with DSLI (Ball & Trammell, 2011; Connor,

Morrison, & Slominski, 2006), TELL includes small and whole group instruction. Overall, TELL is designed to increase oral language and early literacy learning opportunities within preschool classrooms through embedded explicit instruction, numerous incidental learning opportunities, lesson plans that are coordinated with effective language and early literacy instructional practices, and supports for ongoing assessment and differentiated instruction to meet children's needs.

Our first test of TELL efficacy was conducted with a small randomized controlled trial (RCT; Author et al, 2011) that included 118 children across 29 classes (19 TELL and 10 contrast). All children presented with DSLI and received special education in inclusive classrooms operated by local school districts. Although the study sample only included children with DSLI, all children within the class (those developing typically and those with disabilities that did not include DSLI) received the TELL curriculum. Outcome measures included two standardized tests of oral language and a benchmarked test of phonological processes and alphabet knowledge. Results indicated that in comparison to a business as usual (BAU) contrast group, children in TELL demonstrated greater gains on the phonological processing subtest of the *Clinical Evaluation of Language Fundamentals – Preschool Second Edition* (*CELF-P2;* Semel, Wiig, & Second, 2004), mean length of response on the *Renfrew Bus Story* (Cowley & Glasgow, 1994), and letter sounds, beginning sound awareness, and rhyme awareness on the *Phonological Awareness and Literacy Screening PreK* (*PALS-PreK*; Invernizzi, Sullivan, Meier, Swank, & Jones, 2004) . Children who received TELL also demonstrated greater gains on an investigator-developed receptive and expressive vocabulary test of the higher-level vocabulary targeted in TELL. There were no differences in performance between the TELL and BAU groups on the CELF-P2 core language, receptive language, or expressive language indices.

While promising, the causal evidence for TELL is limited, and replication with a larger sample of classrooms and children will contribute to an understanding of its efficacy for young children with DSLI. The primary purpose of the present investigation was to continue our investigation of the TELL curriculum with a larger-scale RCT and compare children receiving TELL with their peers who did not receive TELL. Further, we hoped to extend the results for TELL and young children with DSLI through development of curriculum-based measures (CBMs) to monitor growth of oral language and early literacy skills. We hypothesized that the effects of the smaller RCT would be replicated, and through our CBMs extended, by documenting a TELL effect for children's oral language and early literacy skills growth over the preschool year. Specific research questions were as follows:

1. Do young children with DSLI demonstrate increased growth in oral language and early literacy skills targeted in the TELL curriculum (as measured by curriculum-based measures; CBMs) when compared to peers with DSLI who did not receive the TELL curriculum?
2. Do young children with DSLI demonstrate pre-post increases in distal oral language and early literacy skills, as measured by standardized or benchmarked oral language and early literacy instruments and a pre-post vocabulary test, when compared to peers with DSLI who did not receive the TELL curriculum?

Method

We implemented this RCT as a three-cohort design across a three-year period, with preschool teachers serving as the unit of assignment. After securing approval from our IRB and interested school districts, research staff met with preschool teachers to explain the purpose of the research and request their voluntary participation, including acceptance of random

assignment to implement TELL or to continue with their present curriculum. This process was repeated for each cohort and teachers who volunteered were stratified by school district and then randomized (via lottery) to the experimental (TELL curriculum) or business-as-usual contrast (BAU) condition. Some districts had all special education preschool classes on the same campus. When this occurred, there were TELL and BAU teachers on the same campus to ensure that we had both participant groups represented within each school district. We were minimally concerned with contamination because the TELL curriculum implementation requires specialized curriculum materials (books, lesson plans) and specialized training, neither of which were available for BAU teachers. We recruited child participants from consented teachers' classes with the children assigned to TELL or BAU based on their teachers' assignment. All teachers were paid stipends for their participation in the research.

Sample

Fifteen school districts formed the recruitment pool for teachers and young children with DSLI. We selected these districts because they all operated preschool programs through Part B of IDEA for young children with developmental disabilities, and included populations of children with DSLI. Although young children with DSLI may be enrolled in Head Start or other community preschool programs, most of these children are eligible for special education services through school districts. All preschool programs also enrolled tuition-paying neighborhood children with typical development and it should be noted that while we did not monitor progress for these children, they all received the TELL curriculum and their teachers monitored their learning as well as learning for children participating in our research. The sample for the present investigation included 318 preschool children with DSLI and their 98 teachers. Across the three cohorts of data collection nine teachers withdrew from the study (5 TELL and 4 BAU) for

personal reasons (e.g., moved, change in health status, pregnancy) or were they were let go by the school. A total of 29 children (17 TELL and 12 BAU) were lost to attrition because their teachers withdrew or their families moved. Hence a total of 91 teachers (42 TELL, 49 BAU) and 289 children completed participation in all study activities.

Teachers. Teachers were recruited from 58 schools across 15 school districts in a large metropolitan area. All teachers were female, 88% were Caucasian (not Hispanic), 6% were Hispanic, 2% were African-American/Black, and 3.3% were multiracial. One teacher did not provide information regarding her ethnicity/race. The teachers had a mean of 9.98 (SD=8.14) years of teaching experience at any grade and a mean of 5.97 (SD=5.22) years teaching young children with disabilities. All teachers were state-certified in either early childhood, early childhood special education, or special education, 50% had a bachelor's degree and 50% had a master's degree.

All teachers had 10-16 preschool students enrolled in their morning and/or afternoon classes for a total of 140 class sessions. Forty-two teachers had one class daily, either morning or afternoon (16 TELL and 26 BAU), and 49 teachers (26 TELL and 23 BAU) had two classes per day with one group of children in a morning class and the other in an afternoon class. Class composition included tuition-paying peers with typical development (25-50%) and children with DSLI or other developmental disabilities (75 -50%) served through Part B of IDEA. Classes were staffed by the participating lead teachers and one teaching assistant and met for four or five half-days or full days per week. Occasionally a class had two teaching assistants (depending upon total class size and the complexity of the children's needs). Additional related services were provided by physical and occupational therapists and speech-language pathologists (SLPs), as indicated on children's individualized education plans (IEPs).

Children. All children qualified for IDEA Part B preschool services according to state criteria (which is used by all school districts in the state) and had a diagnosis of DSLI in the absence of an intellectual disability or other developmental or physical concerns. As noted earlier, DSLI includes children with speech or language disorders, and in our sample of 289 children, 127 had speech impairment only, and 162 had language or speech and language impairment. The children's eligibility for preschool services was determined by school district testing and all children demonstrated speech and/or language scores that were more than 1.5 *SDs* below the mean on a standardized test of speech and/or language. Additional inclusionary criteria for participation in the research were: (a) the children's oral motor abilities were sufficient for speech, (b) their language skills included the ability to produce simple two- or three-word sentences, and (c) they had sufficient proficiency in English to allow reliable testing in English. English proficiency was determined by children's teachers, confirmed by their parents, and verified by research personnel who conducted classroom observations, noting children's preferred language for participation in preschool activities. The *Kaufmann Assessment Battery for Children - 2nd Edition* (K-ABCII; Kaufman & Kaufman, 2004) was administered to rule out intellectual disability (M=102.45, SD=12.06), with a score of 85 or greater required for inclusion in the research. No significant differences were noted between the TELL and BAU groups on KABC-II scores.

The number of child participants ranged from two to four per class and included a total of 202 males and 87 females ranging in age from 46 to 63 months (M=53.09, SD=3.61). The over-representation of males in the sample is consistent with data showing that males are more likely to have DSLI than females, and males are more likely to be enrolled in services than females (Black, Lindsey, Vahratian, & Hoffman, Howard, 2015; Boyle et al., 2011)The children were in

their pre-kindergarten year and eligible for kindergarten enrollment in the following school year. Parents reported 53.6% of the children being white (not of Hispanic descent), 2.1% as African American/Black, 25.3% as Hispanic, 12% as multi-racial, 1.7% as American Indian, and 3% as Asian. Eighty percent of children spoke English and it was the primary language spoken in their home; for the remaining 20%, English plus another language was spoken in their home. Table 1 lists the range of maternal education and family income for each participant group. There were no significant differences in family income or maternal education between groups.

All children received services from an SLP through their school districts. In addition, 54 children (30 TELL, 24 BAU) received additional education or SLP services from private providers. The duration of the children's intervention or participation in special education services prior to the investigation varied; some children had matriculated from the IDEA Part C system and others were identified at age three as eligible for IDEA Part B services.

The TELL Curriculum

TELL is a tier 1, whole-class curriculum that embeds incidental and explicit oral language and early literacy teaching practices within planned learning opportunities. The connection of evidence-based teaching/intervention practices to the curriculum is an important feature of TELL because it establishes a systematic link between efficacious oral language and early literacy component interventions/teaching practices and embeds them within a standards-based scope and sequence of instruction. The TELL practices are listed in Table 2 and include those known to support early literacy and oral language development and those identified as enabling acquisition of new skills through experimental and quasi-experimental methods and meta analyses (Cleave et al., 2015; Paradis, 2015; Literacy, 2008; Marulis & Neuman, 2010; Roberts & Kaiser, 2011; Wasik & Hindman, 2014). Supportive strategies (i.e., general supporting strategies), by themselves

do not promote skill acquisition, but they are viewed as necessary for acquisition of new oral language and early literacy skills (Smith, Warren, Yoder, & Feurer, 2004). In contrast, practices in the other groups shown in Table 2 enable acquisition of language and early literacy skills (Author et al., 1990; Author et al., 2011).

TELL is theme-based and includes a scope and sequence of instruction mapped to early learning standards, materials (pictures, books, songs), and developmentally appropriate lesson plans that create language and early literacy learning opportunities. Given the importance of a diverse and rich vocabulary for children's subsequent schooling and reading success (e.g., Beck & McKeown, 2007), each theme is structured to provide children with multiple learning opportunities for academic (i.e., tier two) words. These words represent those that are not typically used during conversational interactions with young children outside of school, but contribute to building a diverse and rich vocabulary (e.g., schedule, creature, planet).

In TELL, the oral language and early literacy learning opportunities are embedded within typical preschool activities (e.g., book reading, free play, dramatic play, music, art) and implemented with evidence-based incidental and explicit teaching practices (see Table 2). TELL objectives can also be embedded in lessons that target other important skills and developmental domains. For example, a science or math lesson may be organized to provide opportunities to learn target vocabulary or to promote listening comprehension. The links between the TELL scope and sequence, learning opportunities, and evidence-based teaching practices is by design and eliminates potential challenging situations where teachers are mastering teaching practices while also trying to create learning opportunities for use of that practice to teach specific skills. Hence, TELL structures the learning opportunities and teachers can focus on mastering the evidence-based practices. Figure 1

provides an overview of TELL and its components. TELL was described in detail in a previous article (Author, et al., 2011) and readers are referred to that source for additional information.

TELL offers 34 weeks of instruction during a school year with 14 thematic units that are each two weeks in duration and review weeks that are planned approximately every fifth week. Review weeks vary somewhat to accommodate school vacation schedules. Just prior to a review week, teachers administer CBMs to track children's progress on unit objectives. Teachers review the CBM data to select goals for the review week and plan differentiated instruction that includes small groups, adaptations to lesson plan expectations, strategies for scaffolding children's responses, and a list of TELL materials or supplemental material.

Twelve components structure learning opportunities to promote children's growth in targeted language and early literacy skill areas. The components include a combination of materials (e.g., fact and ABC action cards, fiction and nonfiction books, table cards, social stories) and structured activities (e.g., book sequence, alphabet and phonological awareness games, writing, music and movement, and transitions with embedded language and early literacy learning opportunities). Component implementation occurs in whole group, story time, snack time, writing, and teacher-led activities. Table 3 illustrates the relationship between targeted oral language and early literacy skills and the TELL components that structure the learning opportunities.

Implementation Supports

Ongoing professional development was provided for teachers assigned to the TELL condition to ensure that they could establish and maintain a language and literacy-rich classroom environment and implement the curriculum with high fidelity. The methods for professional development followed those identified as effective in recent research about professional development (Cunningham, Etter, Platas, Wheeler, & Campbell, 2015; Domitrovich et al., 2009;

Dunst, 2015; Kraft & Blazar, 2017; McCollum, Hemmeter, & Hsieh, 2011; Pianta et al., 2017; Snyder et al., 2018) and included group training sessions and individualized, in-class coaching on a weekly basis in the fall and biweekly in the spring. An initial six-hour training session was held prior to the start of the school year to distribute the TELL curriculum and review all the components. Subsequently, there were 10, two-hour group sessions, with three in August and September and the remaining seven from October through April. The group sessions included a combination of brief didactic instruction regarding TELL teaching practices (see Table 4) followed by interactive learning opportunities to facilitate teachers' TELL implementation in their classes (e.g., practice dialogic reading in small groups, using assessment to differentiate instruction, embedding language and literacy learning opportunities in art, music, movement, outside play, science, etc.).

We assigned each teacher a coach from the research project staff. There were four coaches, three with a master's degree in early childhood special education, and one with a master's in reading. All coaches were certified teachers with extensive experience (>10 years) in teaching and/or coaching teachers in preschool classrooms serving young children with developmental disabilities. The coaches were randomly assigned (via lottery) across the classes, but stratified within each cohort to ensure that each coach provided support and coaching to teachers in more than one of the participating school districts.

The coaching cycle included modeling, observation, feedback, reflection, and planning for the next visit. Some modeling and practice took place during the group sessions (e.g., identification of practices from a videotape, video of coach implementing the practice) to promote understanding of the practices being discussed, but most of the coaching took place in the teachers' classrooms. The coaches conducted monthly fidelity checks (described in a

subsequent section) that informed coaching content. To introduce teachers to the TELL supportive and enabling instructional practices and their integration with required curriculum learning opportunity components, the coaches first modeled the practices in each teacher's classroom, usually through co-teaching. Coaches observed the teachers as they implemented practices and the required TELL components (see Table 3) and then met with the teachers, usually immediately after their class sessions, to (a) facilitate teachers' reflection and self-evaluations of the class session, (b) provide feedback about coaching observations, and (c) discuss needed changes for future implementation.

Fidelity

We obtained *procedural fidelity* (i.e., teachers' adherence to the curriculum) in TELL classrooms monthly. We did this with a checklist of the required curriculum components listed in Table 3. Because the transition components each required different learning opportunities, we counted each as a separate component, for a total of 14 possible components. All coaches were trained to a reliable scoring level (>90% exact agreement) through observation of videotapes of several classrooms and comparison of their scores with a master score, before they conducted the first fidelity checks. To assess ongoing reliability of the procedural measure, a trained observer accompanied the coach and independently completed the checklist. We obtained these checks twice during the school year for each coach. Percentage of exact agreement was calculated for each observation and the mean agreement across the coaches was 98% (range of 91-100%).

Given the schedule for TELL curriculum components (see notes in Table 3) it is challenging to observe all 14 components on a single day because some components are only required once (e.g., phonological awareness activity) or twice per week (e.g., fact cards). The coaches tried to schedule the monthly procedural checks on a day where all components could be

observed, but on occasion that was not possible. When a component could not be observed due to scheduling, coaches asked teachers if the activity occurred (or would occur) as indicated in their lesson plans and the component was scored as included or not, as per the teacher report. Fidelity scores were calculated for each teacher as the number of components that were implemented at each of the 10 observation points and then combined for a measure of procedural fidelity in the fall months (August through November), the winter months (December through February) and Spring months (March through May). Results indicated that procedural fidelity was high, with a mean across the teachers of 10.70 (SD=2.8) components implemented during fall months, 13.20 (SD=1.16) in winter months and 13.43 (SD 0.86) in the spring months.

Business as Usual Contrast Group

Teachers in the contrast classes continued with "business as usual" for curriculum and teaching content. TELL materials were not provided to the BAU teachers and we did not provide any additional professional development or implementation support. All BAU teachers received professional development through their respective school districts. Forty-seven percent of the BAU teachers reported using no curriculum. Others reported using *Splash into PreK* (2%), the *Creative Curriculum* (6%) or *High Scope* (1%). Remaining teachers (44%) identified their curricula as either "State Standards" or "*Teaching Strategies Gold*." As confirmed through observations, none of the BAU classes used a curriculum that included a scope and sequence for teaching all of the early literacy and oral language skills that were targeted in TELL. Instruction in all BAU classes reflected state-approved early learning standards and the standards included oral language and early literacy benchmarks that corresponded to the skills targeted in TELL (e.g., letter names and sounds, phonological awareness, higher-level vocabulary, narratives, early writing, book handling, listening comprehension, print awareness).

We considered using the same procedural fidelity measure in the BAU classrooms that we used in the TELL classrooms. However, none of the BAU teachers used any of the TELL components (see Table 3 for a list of components) and a procedural fidelity score of zero was not useful for describing what language and early literacy teaching actually took place in the BAU classes. Hence, observations in the BAU classes focused on whether or not the teachers provided instruction that targeted a skill taught in TELL.

The BAU teachers were observed by research assistants an average of 3.8 times over the school year. Four observations were planned, but the schedules for vacations, teacher professional development days, and teacher absences resulted in only three observations for some teachers. The research assistants were told that observations of the classrooms were required to understand language and literacy teaching in a variety of preschool special education classes. They were unaware of the specifics of the TELL curriculum including the materials, scope and sequence, and activities. Each observation lasted about two and one-half hours. All research assistants were initially trained to a reliable scoring level (>80% exact agreement) through observation of videotapes of several classrooms and comparison of their scores with a master score.

Given that the skills associated with each TELL objective area are well-established as important foundations for subsequent schooling and reading success, and are targeted areas in the state early learning standards, we expected the BAU teachers to implement a variety of activities that targeted TELL objective areas. The observation data is summarized as the mean percentage of BAU teachers who implemented an activity that targeted a TELL objective (see Table 5). As indicated in the table, the majority of BAU teachers taught alphabet knowledge across the school year, followed by practices designed to increase sentence complexity and length (e.g. expanding

or recasting children's utterances). During the fall term, less than half of the teachers targeted phonological awareness, print awareness, early writing, or vocabulary. The percentage of teachers targeting all oral language and early literacy areas increased in the winter observations, but either decreased or remained the same for the spring observations.

Child Measures

Relative to the TELL curriculum objectives, we conducted pre-post testing and then administered curriculum-based measures for skills that were explicitly taught in the TELL curriculum. All pre-post testing for the BAU and TELL classes was conducted by trained research assistants blinded to condition. These research assistants also administered the CBMs to children in the BAU classes. Because the CBMs for the TELL classes served a dual purpose of measuring growth and providing TELL teachers with data to differentiate instruction, the CBMs for the TELL classes were administered by the teachers (after training in administration from their coaches). Coaches observed CBMs several times for each teacher to ensure that there we administered and scored as planned.

Pre-Post Measures. We administered four tests. One measure, the *Clinical Evaluation of Language Fundamentals-Preschool 2nd Edition* (*CELF-P2* Semel, Wiig, & Second, 2004), is a general, standardized test of language ability from which several different indices of oral language abilities may be obtained. We administered components to obtain standard scores for core language, expressive language, and receptive language. A second measure, the *Test of Preschool Early Literacy* (*TOPEL*, Lonigan, Wagner, Torgesen, & Rashette, 2007) was administered to obtain standard scores for the definitional vocabulary and the phonological processing subtest. Our third measure included a benchmarked assessment, the *Phonological Awareness and Literacy Screening PreK* (*PALS-PreK*, Invernizzi, Sullivan, Meier, Swank, & Jones, 2004). Four subtests were

given from the PALS-PreK including upper- and lower-case letter recognition, beginning sounds identification, and letter sound identification.

Our fourth pre-post measure was a receptive and expressive one-word picture vocabulary test that assessed higher level receptive and expressive vocabulary targeted in TELL curriculum and many other preschool curricula. Administration procedures were identical to those for most standardized receptive and expressive vocabulary assessments. We first administered the expressive vocabulary test showing children a picture representing the targeted word and prompting them to produce the word (e.g., "Here is a furry animal, what do we call it?). We subsequently administered the receptive vocabulary test by showing the children an array of four pictures, with one being the targeted vocabulary word. Children were asked, to point to the picture corresponding to the word produced by the examiner (e.g., "Show me which one is a schedule"). To reduce the testing burden for the children, we developed two shorter tests rather than a single longer test, these were administered in August (pre) and December (post), and then again in January (pre) and May (post). The fall test was on vocabulary targeted in the curriculum from August to December and the spring test was for vocabulary targeted January to May.

We developed and validated our picture vocabulary test in an earlier investigation of TELL (Wilcox et al., 2011). Specifically, we examined the concurrent validity between our picture vocabulary test and the *CELF-P2* subtests that comprise the receptive and expressive language indices. Correlation with the CELF-P2 ranged from .31 to .47 for our receptive vocabulary test, and .50-.61 for our expressive vocabulary test (all p-values <.0001).

Curriculum-Based Measures. These investigator-developed measures assessed oral language and early literacy skills targeted in TELL. We administered the CBMs to the children six times during the year with seven brief assessments per time (about 15 minutes total to

administer). All CBMs were scored as the number of correct items. None of the tests were timed. The first CBM set was administered approximately one month after curriculum implementation. Review weeks are built into TELL, and the CBMs are obtained just prior to a review week. This schedule for CBMs is a key aspect of TELL and provides teachers with information to plan both differentiated instruction and what to teach during the review weeks.

We gave the CBMs to children in the BAU classes on the same schedule as that for children in TELL. It could be argued that the BAU children were not provided with an opportunity to learn skills assessed with the CBM. However, our observations of the BAU classes (see Table 5) confirmed that teachers provided instruction targeting these skills, including higher-level vocabulary. The vocabulary targeted in TELL included commonly taught tier two words and during observations in the BAU classes it was noted (anecdotally) that some of the TELL tier two words were included in books or lessons in the BAU classes.

There were four *early literacy* CBMs including beginning sound awareness (8 items, children were shown a picture and asked to produce the sound the word starts with), print conventions (10 items, directionality, parts of book, author, etc.), letter recognition (26 items) and letter sounds (26 items). The same items were used for each of the six CBM assessments. The *oral language* CBMs included a story retell task to assess listening comprehension and a receptive and an expressive vocabulary test. For the story retell task, we scored children's stories for inclusion of components of the original story for a maximum score of 8 points. We used a different story at each measurement point and each story included the same number and type of illustrations, used the same level of vocabulary words that were balanced for nouns and verbs, was the same length, and included the same syntactic structures. We piloted the different stories

with a small group of children developing typically and scores were similar across the children for different stories.

The receptive and expressive vocabulary CBMs assessed the six academic (i.e., tier two) words targeted in themes just prior to administration of the CBMs. Hence, at each of the measurement points we assessed different words for a total of 36 different words assessed over the school year. This provided us a vocabulary assessment that was proximal (in time) to when the words were taught and is in contrast to the more distal pre-post vocabulary tests that assessed all of the higher-level words targeted in the TELL curriculum during the fall and then again during the winter/spring.

Cronbach's alphas for items on the CBMs indicated acceptable levels of internal consistency with values ranging from .83 to .99. Zero order correlations were calculated to determine the relation between our CBMs and other standard language and/or early literacy measures. The themed expressive and receptive vocabulary measures correlated significantly (r= .42 & .34, respectively, p <.01) with the *CELF-P2* receptive language score, as well as the CELF-P2 expressive language score (r = .40 and .36, p<.01). The listening comprehension CBMs correlated significantly with the CELF –P2 receptive and expressive language scores (r = .43 & .47, p<.01) as well as definitional vocabulary subtest (r=.40, p<.01) of the *TOPEL*. The letter recognition, letter sounds, print conventions and initial sound awareness CBMs correlated significantly (r=.62, .73, .65, & .44, respectively, p<.01) with the corresponding PALS-PreK scales (i.e., alphabet recognition, letter sounds, print and word awareness, beginning sounds). Based on these results, we concluded that our CBMs were measuring similar underlying constructs.

Results

In the following sections we discuss the analysis approach and findings for our pre-post child assessments (PALS-PreK, TOPEL, CELF-P2, Expressive and Receptive Vocabulary), children's growth over the school year as measured by the early literacy and listening comprehension CBMs, and findings for the expressive and receptive vocabulary CBMs. Given substantial documentation of the relationship between maternal education and young children's academic outcomes, cognitive development, and speech and language skills (e.g., Dollaghan et al., 1999; Harding, Morris, & Hughes, 2015; Magnuson, Sexton, Davis-kean, & Aletha, 2018), all analyses included maternal education as a covariate. In addition, we conducted a series of one-way ANOVAs to identify possible differences between the TELL and BAU groups for pre-test scores and while there were no significant differences, we conducted all child analyses with pre-test scores as a covariate. We also tested for differences in TELL program effects by cohort and found no significant differences. Hence, child data from each cohort were combined into a single sample to test the effect of TELL on all pre-post and growth measures.

Growth Curve Modeling for Early Literacy and Listening Comprehension CBMs

We administered the four early literacy CBMs and one listening comprehension CBM six times during the school year to the 289 child participants for a total of 1,445 potential measurements (5 CBMs x 289 children) for each time point. Data were missing for 10.7% of these measurement points and we assumed that these data were missing at random (MAR) for all analyses. We coded each of the six time points of CBM administration as weeks from baseline. We examined the multivariate distribution of the six repeated measures for each CBM with chi-square QQ plots and Mardia's test for multivariate normality within each level of treatment. Based on the Mardia's test, we rejected the null hypothesis of multivariate normality for each of the seven CBMs. We examined Chi-square QQ plots and Boxplots to assess the severity of the

departure from multivariate normality. The plots revealed a ceiling effect (i.e., right censored) for some of the CBM scores, particularly for the measurements taken at later time points.

The measures were counts of number correct so we considered the square root transformation but had little success in producing a distribution closer to normal. Therefore, for variables with a ceiling effect, two models were fit, a linear mixed effects model with a normal distribution for the response variable and a linear mixed effects model with a right censored normal distribution for the response variable. We used Bartlett's test to assess homogeneity of covariance matrices across the two treatment groups. We rejected the null hypothesis of homogeneity of variance for each of the five CBMs, due to ceiling effects. If appropriate, we fit models with heterogeneity across groups. Additional details about procedures for growth modeling arep included in the electronic supplement for this article.

Table 6 shows growth parameter estimates for CBM models and Table 7 shows results for each CBM. There were significant main effects for time and condition, with all children improving in skill areas across the school year. There was a significant interaction of linear time x condition, indicating differences in the BAU and TELL groups at specific CBM time points, typically from scores at T3 through T6. In addition, the significant finding for time x time supports quadratic growth in either or both the BAU and TELL conditions for letter sounds, and listening comprehension. The time x time x condition effect for these five CBMs was not significant, indicating no significant differences between the groups in quadratic growth, or quadratic growth in only one of the participant groups. More specifically, for the letter names CBM, both the TELL and BAU groups demonstrated significant quadratic trends that were not significantly different from each other in that both groups trended toward a plateau, but children in TELL demonstrated greater magnitude and trended toward a plateau later than children in the

BAU group. For the listening comprehension CBM, children in the BAU group demonstrated quadratic growth, but children in the TELL group continued to improve while performance of children in the BAU group reached a plateau.

CBMs for early literacy skills. Figures 2 through 4 illustrate results for the CBMs that assessed early literacy skills (i.e., letter recognition, letter names, print concepts, beginning sounds awareness). The figures include the marginal means and standard error bars for each CBM for TELL and BAU at each of the six time points. Approximate peaks of growth were estimated as weeks from baseline and for letter recognition and letter sounds, the peak of the growth curve was far outside the scope of the model for children in BAU and the TELL condition, indicating that all children were continuing to improve at the end of the school year. For the print concepts the peak of growth was outside of the model for children in TELL, but not for those in the BAU condition.

Figure 2 shows the results for the *letter recognition* and the *letter sounds* CBMs. For letter recognition there are significant differences in favor of TELL at T4 [t (90) = 1.36, p = .0247], T5 [t (90) = 1.41, p = .0116] and T6 [t (90) = 1.5, p=.0057] with effect sizes (Cohen's d) in the medium range at with effect sizes in the medium range at .37, .43, .51, respectively. For letter sounds CBMs, significant differences between the groups were noted at T3, [t (90) = 2.06, p = .0423], T4 [t (90) = 2.85, p = .0054], T5 [t (90) = 3.04, p = .0031] and T6 [t (90) = 3.15, p = .0022]. The effect sizes were in the medium range for T3 and T4 (d = .33 and .58) and were large for T5 and T6 (d = .71 and .86). As shown in Figure 3, children who received TELL performed significantly better on the CBM for *beginning sounds awareness* at T4 [t (90) = 2.39, p = .0192], T5 [t (90) = 2.82, p = .006] and T6 [t (90) = 3.20, p = .0019]. Effect sizes were in the medium range at T4, T5, and T6 with d = .40, .52, and .65, respectively. Results for *print concepts*

(Figure 4) indicated significantly higher performance for children who received TELL at T3 [*t* (90) = 2.93, *p* = .0043], T4 [*t* (90) = 4.92, *p*<.0001], T5 [*t* (90) = 5.60, *p*<.0001] and T6 [*t* (90) = 6.08, *p*<.0001]. The effect sizes at T3 at .46 was in the medium range, and effect sizes for T4, T5 and T6 ranged from large to very large (*d* = .78, .95 and 1.13, respectively).

CBM for listening comprehension skills. Figure 5 shows the marginal means with standard error bars for listening comprehension. Children's scores for *listening comprehension* were at the maximum value only 5.5% of the time, so results were obtained from a normal distribution model without censoring. As can be seen in Figure 5, there were significant differences in growth trajectories for both the TELL and BAU conditions. The growth curve for the BAU condition reached a peak at about 27 weeks, but the curve for the TELL condition had not started to plateau and was still increasing linearly at T6, meaning that children who received TELL were continuing to improve at T6 while the children in the BAU group reached a plateau. Children who received TELL scored significantly higher on the listening comprehension CBM at T2 [*t* (90) = 2.08, *p* = .040], T3 [*t* (90) = 3.32, *p* = .001], T4 [*t* (90) = 5.08, *p* < .0001], T5 [*t* (90) = 5.65, *p* < .0001] and T6 [*t* (90) = 8.01, *p* < .0001] with effect sizes in the medium to very large range (*d* = .33, .50, .78, .92, 1.08, respectively).

CBM Results for Targeted Expressive and Receptive Vocabulary

As noted in the Method section, the receptive and expressive vocabulary CBMs were for different words at each time point, and we cannot assume that all words were of equal difficulty, rendering a growth analysis inappropriate. Table 8 includes the marginal means and standard error for each of these measures at each time point with the means indicating ceiling effects for receptive vocabulary and pronounced floor effects for expressive vocabulary. To examine the TELL effect for these two measures, a semi-parametric proportional hazard regression was used.

In this approach, the dependent variable is time to event, i.e., time from the start of the study until a child reaches the maximum score of six on a CBM administration. This method does not assume a particular distribution for the vocabulary scores or for the time to event. In this analysis, the TELL curriculum effect for receptive vocabulary was highly significant ($p<0.0001$). The estimated hazard ratio for the TELL effect was 2.83, meaning that the instantaneous rate of a success (where success is the event defined as achieving a score of 6) was nearly three times higher for children in the TELL group.

To assess the TELL effect for the expressive vocabulary measures, we initially conducted the proportional hazards regression for time to event when a child first achieved the maximum score of 6. In this analysis, the TELL effect was significant ($p<.0001$), however, 50 out of 142 children in the TELL group reached the criterion of six correct, but none of the 147 children in the BAU classes reached the criterion, so it was not possible to calculate the hazard ratio. Switching to a criterion of five correct, there was again a TELL effect ($p=.0145$). The estimated hazard ratio was 14.29, meaning that the instantaneous rate of success was higher in the TELL group when compared to the BAU group.

Pre-Post Testing Results

The mixed models for analysis of pre-posttests (i.e., *CELF-P2, TOPEL, PALS-PreK*, and the TELL Vocabulary) included a random effect for teacher and a fixed effect for time point instead of random intercept and slope terms for trend over time. We selected the unstructured (UN) model for $\boldsymbol{R_i}$ to accommodate heterogeneity of variance. Given the selected covariance structure, we obtained the estimates for model fixed effects with estimated generalized least squares using SAS PROC MIXED software. Table 9 includes the least squares means, after accounting for maternal education and pre-test score, standard error, F, and p-values for all pre-

post measures. After applying the false discovery rate (FDR) adjustment (Benjamini, Benjamini, & Yekutieli, 2001) to each tested construct, there were no significant TELL effects on any of subtests for the *CELF-P2,* the *TOPEL* or any of the PALS-PreK subtests (i.e., lower case letter recognition, beginning sounds identification, and letter sound identification).

For assessment of the TELL academic vocabulary, we administered expressive and receptive vocabulary tests in the fall and again in the spring. The fall test was for words targeted in TELL themes August through December, and the spring test was for words targeted in TELL themes January through early May. Children's scores during fall testing for both receptive and expressive vocabulary and during spring testing for expressive vocabulary were at the maximum possible value less than 5% of the time, so we conducted analyses (in a nested framework with pretest as a covariate) with a normal distribution without censoring. We obtained results for the spring receptive vocabulary testing from the normal distribution with a right-censoring model because 16.67% of the scores were at the maximum possible value.

Table 10 shows the least squares means and standard error for the fall and spring vocabulary. After applying the FDR adjustment, results indicated a TELL effect, with children in the TELL condition outperforming their peers in the BAU condition. Findings for the fall expressive [F (1,276) = 50.71, p<.0001] and receptive [F (1,275) = 7.82, p=0.0055] vocabulary scores were significant, although the effect sizes were small with Cohen's ^ f^2 at .18 and .02, respectively. Significant differences were also noted in the spring expressive [F (1,244) = 80.72 p<.0001] and receptive [F (1, 259) = 38.88, p<.0001] vocabulary scores with Cohen's ^ f^2 effect sizes of .44 and .02, respectively (Selya, Rose, Dierker, Hedeker, & Mermelstein, 2012).

Discussion

As we consider and interpret our findings, we do so with reference to each of our research questions, followed by a discussion of limitations and directions for continuing work in this area.

Research Question One: Children's Growth in Oral Language and Early Literacy Skills

Results of the early literacy and listening comprehension CBM documented increased learning in all skill areas for children who received TELL with large to very large effect sizes by the final measurement point. Analysis of children's acquisition of the tier two TELL receptive and expressive vocabulary also indicated increased expressive word learning for children receiving TELL, especially at later time points. Although we assessed different words at each time point, we think it likely that observed increases in children's time to produce five words on an expressive vocabulary CBM was due to the TELL vocabulary teaching strategies, which are based on those found to be effective in language interventions focused on promoting word acquisition.

Our observations in the BAU classes confirmed that children in those classes received instruction in oral language and early literacy skills targeted in TELL (e.g., Table 5). However, with the exception of alphabet knowledge, the percentage of teachers targeting TELL objectives for early literacy skills never exceeded 60%. A somewhat higher percentage (64%) of BAU teachers targeted oral language skills. Procedural fidelity measures indicated that TELL teachers increasingly implemented all TELL components, which collectively provided children with numerous language and early literacy learning opportunities. As noted in our introduction, if children with developmental disabilities, including those with DSLI, are to develop key language and early literacy skills prior to school entry, they require more intensive levels of support and

explicit instruction than do their peers with typical development. The fact that TELL teachers targeted language and early literacy skills in nearly all curriculum components across the school year suggests that as a group, the children with DSLI had more exposure to learning opportunities for the targeted skills.

We hypothesize that differences in the children's learning in the TELL and BAU classes, as reflected in the CBMs, are the result of four key ingredients that differentiate TELL from curricula or targeted interventions typically provided in BAU classes. *First,* TELL offers a specific scope and sequence for targeted skills so that children can build upon their knowledge as they transition from theme to theme across the school year. The scope of TELL is mapped to common state early learning standards and is also consistent with the Head Start Early Learning Outcomes Framework (2015). This pre-academic focus promotes a strong emphasis on oral language and early literacy activities, which improves these skills (Fuller, Bein, Bridges, Kim, & Rabe-Hesketh, 2017). The schedule for teaching TELL content was informed by the literature on language and literacy development, resulting in systematically sequenced content that provides a foundation for development of more complex skills. An explicit scope and sequence of learning objectives, as evidenced in TELL, is 'an essential component' of effective language and early literacy instruction (Bleses et al., 2018).

A *second* TELL ingredient is the inclusion of whole and small group instruction. Typically, small group instruction is viewed as the second tier of multi-tiered systems of support (MTSS). However, in TELL a standard format for small group instruction is included within the Tier 1 curriculum. Given evidence for the effectiveness of small group instruction, especially for promoting language and early literacy skills (Connor et al., 2006; Gonzalez et al., 2014; NELP,

2009), we think it likely that this specific ingredient contributed to improved outcomes for children who received TELL.

A *third* TELL ingredient is articulation with multi-tiered systems of support (MTSS) through the inclusion of CBMs. Intervention approaches for young children with developmental disabilities (including those with DSLI) increasingly rely on MTSS to facilitate development of pre-academic skills (e.g., language, early literacy, numeracy, social, behavioral) necessary for young children's early school success (Fox, Carta, Strain, Dunlap, & Hemmeter, 2010; Greenwood et al., 2012; Hebbeler & Spiker, 2016). Central to the success of MTSS is ongoing assessment data to inform teachers about children's progress. In TELL, the CBM assessment results enabled teachers to differentiate instructional objectives and identify children who may require additional tier two or tier three supports. With ongoing assessment data teachers can make decisions about content (e.g., increasing learning opportunities for specific skills) and teaching practices (e.g., explicit teaching practices, smaller group teaching) for specific children during planned review weeks and beyond. The CBM data also provides information to share with other interdisciplinary IEP team members (e.g., speech-language pathologists) thereby creating opportunities for collaborations to further increase children's learning opportunities through tier three instruction. While we did not systematically track such sharing, many TELL teachers reported that the CBM data was shared with the children's speech-language pathologists.

The *fourth* key ingredient is the evidence-based, explicit teaching practices that are embedded during TELL learning activities (e.g., book reading, transitions), other pre-academic lessons (e.g., science, math), lessons designed to promote social-emotional competence, and classroom routines (handwashing, lunch, breakfast) and interest centers (e.g., writing, art,

dramatic play). Embedded instruction, sometimes referred to as naturalistic intervention, in combination with explicit teaching practices is a central aspect of learning opportunities that promote acquisition of skills for young children with DSLI. Research indicates that when young children with DSLI (and other developmental disabilities) have access to a sufficient number of high quality, embedded learning opportunities that include explicit instruction, they demonstrate increased learning of targeted skills (Carta & Driscoll, 2013; Kholoptseva, 2016; Rakap & Parlak-Rakap, 2011; Snyder et al., 2015).

Research Question Two: Distal Effects

Our second research question focused on performance of children who received TELL when compared to their BAU counterparts for the distal oral language and early literacy measures. As in our prior investigation (Wilcox et al., 2011) we found that children who received TELL outperformed their peers in BAU classes on the fall and spring pre-post receptive and expressive vocabulary testing. Children in the BAU classes likely had some exposure to these important Tier 2 words, but only children in TELL received explicit and embedded vocabulary instruction. We observed vocabulary learning by children in both conditions with very small between-group effect sizes for receptive and expressive vocabulary in the fall, and receptive vocabulary in the spring (Cohen's ^ f^2 =.02, .18, .02, respectively). In contrast, the effect size for spring expressive vocabulary was in the medium range (Cohen's ^ f^2 =.44) suggesting that over time expressive vocabulary learning was higher for children in TELL relative to their BAU peers.

Results for the distal pre-post receptive vocabulary test were consistent with the receptive vocabulary CBMs, where all children demonstrated increases in receptive vocabulary at each testing point, but higher means were observed for children who received TELL.

Similarly, for children in the TELL group, results for the distal pre-post expressive vocabulary measure were consistent with the expressive vocabulary CBMs. In contrast, performance on the pre-post expressive vocabulary for children in the BAU group was inconsistent with the corresponding CBM. More specifically, children in the BAU condition produced many of the words on the distal expressive vocabulary test but did not produce these same words with the expressive vocabulary CBM. Our hypothesis is that children in the BAU classes likely learned the TELL vocabulary words incidentally and had limited exposure to explicit, embedded vocabulary instruction, particularly within the same timeframe as children in the TELL classes. Over time incidental exposure for children in the BAU classes was potentially sufficient for improved performance on a post-test, but perhaps insufficient the shorter timeframes associated with CBM testing.

Our results for the distal standardized and benchmarked pre-post testing indicated no significant difference in performance between children in the TELL vs. the BAU classes. This is somewhat surprising given research suggesting that for young children, oral language and early literacy skills are highly interrelated and likely function as a single oral language construct (Catts et al., 2015; Dickinson et al., 2003; Foorman, Herrera, Petscher, Mitchell, & Truckenmiller, 2015; LARRC, 2017). Hence, our proximal (CBMs) and distal (*CELF-P2, TOPEL, PALS-PreK*) assessments likely measured the same underlying language ability, but TELL effects were documented only with the CBMs. In addition, a lack of distal effects is inconsistent with our earlier, smaller efficacy trial of TELL (Wilcox et al., 2011) where effects were observed for two measures that were also used in the present investigation, the *PALS-PreK* letter sounds and beginning sounds subtests.

One explanation for observed differences between the present and our earlier investigation relates to the BAU or counterfactual conditions. In the time since our 2011 investigation, federal and state requirements for most public preschool programs have changed and preschool programs are expected to use a curriculum, teach content that conforms to state early learning standards, and include oral language and early instructional activities (e.g., letter names and sounds, print concepts, sound awareness, narrative retells). In turn, early literacy instruction for the BAU classrooms in the present investigation likely had a more explicit focus on teaching early literacy skills and vocabulary than those programs that comprised the counterfactual in our earlier research. Observational results of the BAU classrooms (Table 5) document that BAU teachers provided vocabulary and early literacy instruction, particularly with alphabet knowledge and to a lesser degree, phonological and print awareness. Hence, an improved counterfactual condition may account for differences with our prior work.

Our lack of findings for distal effects are consistent with other oral language and early literacy intervention or curriculum studies for young children with and without disabilities, using the same measures included in the present investigation and other, similar standardized measures (Kelley et al., 2015; Lonigan et al., 2011; Lonigan & Phillips, 2016; Mashburn, Justice, McGinty, & Slocum, 2016; Powell, Diamond, Burchinal, & Koehler, 2010). Although distal measures may be more stringent measures of treatment effectiveness, researchers consistently find a lack of effects attributable to oral language and early literacy interventions. It is worth noting that none of the distal measures in the present investigation, and many of those used in other investigations, were designed to measure growth of skills. The *CELF-P2* is a diagnostic instrument that identifies children with language impairment and describes the functional areas of impairment. Similarly, the *TOPEL* identifies children at-risk for literacy problems, and given

that all children in the present investigation were at-risk, a lack of a TELL effect is not surprising. However, the apparent trend in the literature regarding distal effects creates a challenge, both for our work and that of others, when documenting efficacy of interventions or curricula.

In addition to likely improvements in the counterfactual, there are other factors that may explain a lack of distal findings in the present investigation. One explanation pertains to differences in tasks used to assess constructs in the standardized tests and those used to practice skills representing those constructs in the TELL curriculum. For example, the phonological awareness subtest in the *TOPEL* is based on elision and word blending. For elision, a child is asked to say a word and then say what is left of the word after dropping specific sounds. Elision is not a skill targeted in TELL, nor is it one that is easily acquired without explicit instruction. For blending, a child is asked to listen to separate sounds and then combine them to form a word, while this skill was practiced in TELL it was within a supportive, meaningful context. For the *CELF-P2*, several tasks are used to arrive at a core language score, including following directions, recalling sentences, retrieving vocabulary words, and recall of dialogue from a story. In TELL, children practice all of these important language skills, but unlike the CELF-P2 tasks, oral language and early literacy skills are contextualized within shared book reading or other familiar activities. Generalization of skills from familiar routines and activities to a contrived situation is challenging for young children who are developing typically, and even more so for children with DSLI. It is possible that at the point of post-testing in our investigation, the children may not have stabilized their new oral language and early literacy skills to the degree where task and contextual factors no longer influenced their performance.

Another explanatory factor for a lack of distal effects is that standardized distal measures may not best suited for assessment of curriculum or intervention effects. Improvements for young children with DSLI are often incremental, and it takes a substantial amount of progress for a child to improve one standard deviation. Thus, a child may demonstrate significant progress as documented by CBM, but it may be insufficient for documenting improvement on a standardized instrument. As an alternative for children with disabilities, individual growth and development indicators (IGDIs) may be more sensitive to changes resulting from intervention (Mcconnell, Mcevoy, & Priest, 2002; Missall, Carta, McConnell, Walker, & Greenwood, 2008). Research with early literacy IGDIs, although not extensive, demonstrates the predictive validity of preschool early literacy IGDIs for end of kindergarten and end of first grade in oral reading fluency (Missall et al., 2007). In another investigation, early literacy IGDIs (picture naming, rhyming, and alliteration) were sensitive to longitudinal change and also reflected age-related differences in growth rates from ages three to four years (Roseth, Missall, & McConnell, 2012).

Informal measures represent another viable alternative to standardized measures for young children with DSLI. In the present investigation we found TELL effects with pre-post vocabulary testing. This informal distal measure was aligned with the TELL vocabulary but not with tasks or contexts used to teach vocabulary in TELL or the BAU classes, suggesting that alignment of testing content may be more important than task differences. A large (and growing) body oral language and early literacy intervention research documents efficacious interventions with a variety of informal distal measures that directly align with anticipated intervention outcomes, but are removed from the intervention context (Camarata, Nelson, & Camarata, 1994b; Dale, Crain-Thoreson, Notari-Syverson, & Cole, 1996; Girolametto et al., 1996; C. Greenwood et al., 2013; Kelley et al., 2015; Leonard et al., 2008; Towson et al., 2016; Wilcox et

al., 1991; Ziolkowski & Goldstein, 2008). Such informal measures may include (a) probes to elicit targeted language skills at specified intervals with different words or books, (b) analysis of spontaneous language samples that include use of grammatical morphemes, estimates of vocabulary size, or phonological analyses, or (c) documentation of targeted behavior that generalizes to another setting (e.g., child uses new vocabulary words at school and home).

Informal distal measures, because they are one-step (or more) removed from the intervention context and tasks, potentially may suffice for documenting efficacy. Further, when informal measures are used in the context of well-designed experiments (e.g., RCT, quasi-experimental design, single case experimental research) and show positive effects of an intervention, efficacy is rarely questioned and often confirmed through meta-analyses or other similar procedures (Cleave et al., 2015; NELP, 2009; Marulis & Neuman, 2010; Roberts & Kaiser, 2011).

There are various factors that may explain a lack of distal effects with the instruments used in the present investigation. However, an important question remains: Are standardized distal measures that are administered pre-post intervention necessary to demonstrate efficacy of an intervention or curriculum? We suggest that the answer is “no” if the distal measures do not align well with the instructional objectives. Further, we hypothesize that such alignment may be more critical for a suitable distal measure than task differences. If a distal measure does not directly assess anticipated learning outcomes of a curriculum or intervention, it seems unlikely that intervention/curriculum effects will be found and alternative distal measures are necessary. IGDI’s, well-designed informal assessments, or possibly proximal measures with sound psychometric properties all represent viable alternatives for determining efficacy. We do not suggest that standardized distal measures be omitted from efficacy research. Rather, we suggest

that alignment with anticipated intervention or curriculum outcomes is the central and key factor to consider when selecting distal instruments. Further, few, if any standardized measures of early literacy and oral language skills for preschool children align well with typical instructional or intervention objectives. Hence, at present, IGDIs, informal measures, and sound proximal measures may be the more appropriate way to determine causal effects of a given intervention or curriculum.

Limitations

We acknowledge limitations in this study in four areas. First, our category of children with DSLI included three different groups of children, those with language impairment, those with speech impairment, and those with speech *and* language impairment. As established in our introduction, each of these groups of children are at-risk for poor reading and early schooling outcomes, however, their specific strengths and needs may differ by group. We did not have the sample size to conduct fully powered analysis that considered these different groups, but this may be important to consider in future research to enhance our understanding of the impact of TELL on different groups of children.

A second limitation is that CBM data was collected by TELL teachers, while the BAU data was collected by blinded research assistants. The CBMs provided immediate, important data for teachers to differentiate instruction and to understand each child's skills. Although teachers were trained to administer the CBMs, and periodic checks were conducted for accuracy by research staff, teacher administration of these assessments may have introduced bias into the results. In future research, it will be important to have the CBMs obtained by assessors blinded to condition; but it is equally important to convey results to teachers as quickly as possible to facilitate their planning for differentiated instruction during review weeks. Potentially, the CBMs

could be administered with a tablet device that would generate graphs that are emailed to the teachers as soon as each child's assessment is complete.

A third limitation is the lack of a fidelity measure that was used for the TELL and the BAU classes. We assessed procedural fidelity only in the TELL classes, and although we observed the BAU classes to determine the extent to which TELL skills were targeted, we did not have the same measure for both conditions, although as mentioned earlier, if we had used the same fidelity measure the BAU teachers would have scored a zero at all observation points, because they did not implement any of the TELL components. Nonetheless, a lack of a common measure creates challenges when comparing TELL vs. BAU classes, and identification of a common measure is important to consider in future research with TELL, or other intervention efficacy studies.

A final limitation concerns the supports that were provided for TELL implementation and the extent to which they were needed to promote children's learning. We tested TELL as a package that included implementation supports. At this point it is unknown if gains documented for children who received TELL are due to the TELL curriculum, the implementation supports we provided (e.g., coaching and group sessions), or both. This is something that will be important to determine for future scalability. For example, if weekly coaching and an additional 20 hours of group professional development are important to children's learning, then it will be necessary to consider more cost effective ways to provide these supports because many preschool programs have limited funds and limited personnel resources.

Conclusions and Future Research Directions

A high-quality tier one curriculum is a necessary support to promote young children's acquisition of language and early literacy skills that serve as a foundation for subsequent success

in reading fluency and comprehension. To date, research with designs that can infer causality is limited for tier one curricula that target these skills, with no prior research has examined tier one curriculum efficacy for specifically with young children with DSL. In the present RCT, we establish TELL efficacy for improving targeted oral language and early literacy skills for young children with DSLI. Despite limitations in our research, our work is among the first, larger-scale RCTs that demonstrate the efficacy of a comprehensive oral language and early literacy curriculum for young children with DSLI. When this finding is contextualized within the increasing use of MTSS, it suggests that a tier one curriculum, if implemented with high fidelity, can promote learning of essential pre-academic oral language and literacy skills for young children with DSLI. In addition, the inclusion of TELL CBMs informs differentiated instruction and/or the need for tier two or tier three instruction. The CBMs may also serve as a basis for collaboration with other disciplines who are involved in implementing IEPs. Overall, TELL demonstrates substantial promise for meeting oral language and early literacy needs of preschool children with DSLI.

When thinking of future research, an area meriting investigative attention pertains to longer-term impacts of TELL and other preschool curricula. Increases in children's oral language and early literacy skills during preschool, while predictive of later reading success, may or may not lead to improved school success and reading outcomes for young children with DSLI. In fact, research indicates that in many cases preschool program effects fade rapidly upon kindergarten entry and often disappear by the end of first or second grade grade (Hill et al., 2015; Magnuson & Duncan, 2016; Puma, Bell, Cook, & Heil, 2010; Wake et al., 2015). In contrast, others have found more lasting benefits, both for the overall preschool experience (e.g., Claessens & Garrett, 2014) and targeted early literacy interventions (Justice, Logan, & Kaderavek, 2017). TELL falls

somewhere in-between a comprehensive curriculum and targeted targeted interventions, and children who receive TELL or a similar progrtam may demonstrate lasting gains, but future research is needed to establish such a link.

Another issue for future research pertains to TELL and other curricula efficacy with more diverse populations. To date, TELL has only been tested with populations of young children with DSLI. However, TELL is a whole class curriculum, and because we tested efficacy in inclusive classrooms (e.g., enrolled children with and without disabilities) all children received the curriculum. Although anecdotal teacher reports support the promise of TELL for all children who were in the classroom, the efficacy of TELL for young children who do not have disabilities, and are not otherwise at risk has not been established. At present we (Authors, 2017) are conducting an RCT of TELL for young children with typical development enrolled in Head Start, or other community preschools serving children who are economically disadvantaged. Although preschool teachers in these programs typically are not certified teachers, and have lower levels of educational attainment, with implementation support they are able to achieve high fidelity to TELL. In terms of children, data from two cohorts of participants indicates strong TELL effects when children who receive TELL are compared to their peers in BAU classrooms. Children from economically disadvantaged homes are often viewed as at-risk, albeit the reasons are different from risk for young children with DSLI. Hence, it would also be useful to test the curriculum in early care and education programs that enroll children with more economic diversity, and who likely have more advanced oral language and early literacy skills than the populations we have studied to date.

.

References

Ball, C. R., & Trammell, B. A. (2011). Response-to-Intervention in High-Risk Preschools: Critical Issues for Implementation. *Psychology in the Schools*, *48*(5), 502–513. https://doi.org/10.1002/pits

Beck, I. L., & McKeown, M. G. (2007). Increasing Young Low-Income Children's Oral Vocabulary Repertoires through Rich and Focused Instruction. *The Elementary School Journal*, *107*(3), 251–271. https://doi.org/10.1086/511706

Benjamini, Y., Benjamini, Y., & Yekutieli, D. (2001). The control of the false discovery rate in multiple testing under dependency. *ANNALS OF STATISTICS*, *29*, 1165--1188. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.124.8492

Black, Lindsey, I., Vahratian, A., & Hoffman, Howard, J. (2015). *Communication Disorders and Use of Intervention Services Among Children Aged 3-17 years: United States, 2012.* Retrieved from https://www.cdc.gov/nchs/data/databriefs/db205.pdf

Bleses, D., Højen, A., Dale, P. S., Justice, L. M., Dybdal, L., Piasta, S., … Haghish, E. F. (2018). Effective language and literacy instruction: Evaluating the importance of scripting and group size components. *Early Childhood Research Quarterly*, *42*(September 2017), 256–269. https://doi.org/10.1016/j.ecresq.2017.10.002

Boyle, C. A., Boulet, S., Schieve, L. A., Cohen, R. A., Blumberg, S. J., Yeargin-Allsopp, M., … Kogan, M. D. (2011). Trends in the prevalence of developmental disabilities in US children, 1997-2008. *Pediatrics*, *127*(6), 1034–1042. https://doi.org/10.1542/peds.2010-2989

Buschmann, A., Jooss, B., Rupp, A., Feldhusen, F., Pietz, J., & Philippi, H. (2009). Parent based language intervention for 2-year-old children with specific expressive language delay: A randomised controlled trial. *Archives of Disease in Childhood*, *94*(2), 110–116. https://doi.org/10.1136/adc.2008.141572

Camarata, S. M., Nelson, K. E., & Camarata, M. N. (1994a). Comparison of Conversational-Recasting and Imitative Procedures for Training Grammatical Structures in Children With Specific Language Impairment. *Journal of Speech Language and Hearing Research*, *37*(6), 1414. https://doi.org/10.1044/jshr.3706.1414

Camarata, S. M., Nelson, K. E., & Camarata, M. N. (1994b). Comparison of Conversational-Recasting and Imitative Procedures for Training Grammatical Structures in Children With Specific Language Impairment. *Journal of Speech, Language, and Hearing Research*, *37*(6), 1414–1423. https://doi.org/10.1044/jshr.3706.1414

Carta, J. J., & Driscoll, C. (2013). Early literacy intervention for young children with special needs. In T. Shanahan & C. Lonigan (Eds.), *Early Childhood Literacy: The National Early Literacy Panel and Beyond* (pp. 233–253). Baltimore, MD: Paul H. Brooks.

Catts, H. W., Fey, M. E., Tomblin, J. B., & Zhang, X. (2002). A Longitudinal Investigation of Reading Outcomes in Children With Language Impairments. *Journal of Speech Language and Hearing Research*, *45*(6), 1142. https://doi.org/10.1044/1092-4388(2002/093)

Catts, H. W., Herrera, S., Nielsen, D. C., & Bridges, M. S. (2015). Early prediction of reading comprehension within the simple view framework. *Reading and Writing*, *28*(9), 1407–1425. https://doi.org/10.1007/s11145-015-9576-x

Chambers, B., Cheung, A. C. K., & Slavin, R. E. (2016). Literacy and language outcomes of comprehensive and developmental-constructivist approaches to early childhood education: A systematic review. *Educational Research Review*, *18*, 88–111. https://doi.org/10.1016/j.edurev.2016.03.003

Claessens, A., & Garrett, R. (2014). The role of early childhood settings for 4-5 year old children in early academic skills and later achievement in Australia. *Early Childhood Research Quarterly*, *29*(4), 550–561. https://doi.org/10.1016/j.ecresq.2014.06.006

Cleave, P. L., Becker, S. D., Curran, M. K., Owen Van Horne, A. J., Fey, M. E., & Fey, Marc, E. (2015). The Efficacy of Recasts in Language Intervention: A Systematic Review and Meta-Analysis. *American Journal of Speech-Language Pathology*, *24*, 237–255.

Connor, C. M., Morrison, F. J., & Slominski, L. (2006). Preschool instruction and children's emergent literacy growth. *Journal of Educational Psychology*, *98*(4), 665–689. https://doi.org/10.1037/0022-0663.98.4.665

Conti-Ramsden, G., St Claire, M. C., Pickles, A., & Durkin, K. (2012). Developmental trajectories of verbal and nonverbal skills in individuals with a history of specific language impairment: From childhood to adolesence. *Journal of Speech Language and Hearing Research*, *55*(December), 1716–1735. https://doi.org/10.1044/1092-4388(2012/10-0182)1716

Crain-Thoreson, C., & Dale, P. S. (1999). Enhancing Linguistic Performance: Parents and Teachers as Book Reading Partners for Children with Language Delays. *Topics in Early Childhood Special Education*, *19*(1), 28–39. https://doi.org/10.1177/027112149901900103

Cunningham, A. E., Etter, K., Platas, L., Wheeler, S., & Campbell, K. (2015). Professional development in emergent literacy: A design experiment of Teacher Study Groups. *Early Childhood Research Quarterly*, *31*, 62–77. https://doi.org/10.1016/j.ecresq.2014.12.002

Dale, P. S., Crain-Thoreson, C., Notari-Syverson, A., & Cole, K. (1996). Parent-Child Book Reading as an Intervention Technique for Young Children with Language Delays. *Topics in Early Childhood Special Education*, *16*(2), 213–235. https://doi.org/10.1177/027112149601600206

Diamond, K. E., Justice, L. M., Seigler, R. S., & Snyder, P. A. (2013). *Synthesis of IES Research on Early Intervention and Early Childhood Education (NCER 2013-3001)*. Washington, D.C.

Dickinson, D. K., McCabe, A., Anastasopoulos, L., Peisner-Feinberg, E. S., & Poe, M. D. (2003). The Comprehensive Language Approach to Early Literacy: The Interrelationships among Vocabulary, Phonological Sensitivity, and Print Knowledge among Preschool-Aged Children. *Journal of Educational Psychology*, *95*(3), 465–481. https://doi.org/10.1037/0022-0663.95.3.465

Dollaghan, C. A., Campbell, T. F., Paradise, J. L., Feldman, H. M., Janosky, J. E., Pitcairn, D. N., & Kurs-Lasky, M. (1999). Maternal education and measures of early speech and language. *Journal of Speech, Language, and Hearing Research : JSLHR*, *42*(6), 1432–1443. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/10599625

Domitrovich, C. E., Gest, S. D., Gill, S., Bierman, K. L., Welsh, J. a., & Jones, D. (2009). Fostering High-Quality Teaching With an Enriched Curriculum and Professional Development Support: The Head Start REDI Program. *American Educational Research Journal*, *46*(2), 567–597. https://doi.org/10.3102/0002831208328089

Dunst, C. J. (2015). Improving the Design and Implementation of In-Service Professional Development in Early Childhood Intervention. *Infants & Young Children*, *28*(3), 210–219. https://doi.org/10.1097/IYC.0000000000000042

ELOF. (2015). *Head Start Early Learning Outcomes Framework*. Retrieved from http://eclkc.ohs.acf.hhs.gov/hslc/tta-system/teaching/eecd/Assessment/Child Outcomes/HS_Revised_Child_Outcomes_Framework(rev-Sept2011).pdf

Farver, J. A., Lonigan, C. J., & Eppe, S. (2009). Effective early literacy skill development for young Spanish-speaking English language learners: an experimental study of two methods. *Child Dev*, *80*(3), 703–719. https://doi.org/CDEV1292 [pii]\r10.1111/j.1467-8624.2009.01292.x [doi]

Foorman, B. R., Herrera, S., Petscher, Y., Mitchell, A., & Truckenmiller, A. (2015). The structure of oral language and reading and their relation to comprehension in Kindergarten through Grade 2. *Reading and Writing*, *28*(5), 655–681. https://doi.org/10.1007/s11145-015-9544-5

Fox, L., Carta, J., Strain, P., Dunlap, G., & Hemmeter, M. (2010). Response-to-intervention and the Pyramid Model. *Infants and Young Children*, *23*(June), 3–14.

Fricke, S., Bowyer-Crane, C., Haley, A. J., Hulme, C., & Snowling, M. J. (2013). Efficacy of language intervention in the early years. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *54*(3), 280–290. https://doi.org/10.1111/jcpp.12010

Fuller, B., Bein, E., Bridges, M., Kim, Y., & Rabe-Hesketh, S. (2017). Do academic preschools yield stronger benefits? Cognitive emphasis, dosage, and early learning. *Journal of Applied Developmental Psychology*, *52*, 1–11. https://doi.org/10.1016/J.APPDEV.2017.05.001

Girolametto, L., Pearce, P. S., & Weitzman, E. (1996). Interactive Focused Stimulation for Toddlers With Expressive Vocabulary Delays. *Journal of Speech, Language, and Hearing Research*, *39*(6), 1274–1283. https://doi.org/10.1044/jshr.3906.1274

Gonzalez, J. E., Pollard-Durodola, S., Simmons, D. C., Taylor, A. B., Davis, M. J., Fogarty, M., & Simmons, L. (2014). Enhancing preschool children's vocabulary: Effects of teacher talk before, during and after shared reading. *Early Childhood Research Quarterly*, *29*, 214–226. https://doi.org/10.1016/j.ecresq.2013.11.001

Gray, S., & Wilcox, M. J. (2017). *Efficacy of the TELL Curriculum for Children who are Economically Disadvvantaged.* U.S. Department of Education, Institute for Education Sciences, R305A170068.

Greenwood, C., Carta, J., Kelley, E., Guerrero, G., Young Kong, N., Atwater, J., & Goldstein, H. (2013). Systematic Replication of the Effects of A Supplementary, Technology-Assisted, Storybook Interention for Preschool Children with Weak Vocabulary and Comprehension Skills. *The Elementary School Journal*, *116*(4), 575–599.

Greenwood, C. R., Carta, J. J., Atwater, J., Goldstein, H., Kaminski, R., & McConnell, S. (2012). Is a Response to Intervention (RTI) Approach to Preschool Language and Early Literacy Instruction Needed? *Topics in Early Childhood Special Education*. https://doi.org/10.1177/0271121412455438

Guo, Y., Justice, L. M., Kaderavek, J. N., & McGinty, A. (2012). The literacy environment of preschool classrooms: contributions to children's emergent literacy growth. *Journal of Research in Reading*, *35*(3), 308–327. https://doi.org/10.1111/j.1467-9817.2010.01467.x

Harding, J. F., Morris, P. A., & Hughes, D. (2015). The Relationship Between Maternal Education and Children's Academic Outcomes: A Theoretical Framework. *Journal of Marriage and Family*, *77*(1), 60–76. https://doi.org/10.1111/jomf.12156

Hargrave, A. C., & Sénéchal, M. (2000). A book reading intervention with preschool children who have limited vocabularies: the benefits of regular reading and dialogic reading. *Early Childhood Research Quarterly*, *15*(1), 75–90. https://doi.org/10.1016/S0885-2006(99)00038-1

Hayiou-Thomas, M. E., Carroll, J. M., Leavett, R., Hulme, C., & Snowling, M. J. (2017). When does speech sound disorder matter for literacy? The role of disordered speech errors, co-occurring language impairment and family risk of dyslexia. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *58*(2), 197–205. https://doi.org/10.1111/jcpp.12648

Hebbeler, K., & Spiker, D. (2016). Supporting Young Children with Disabilities. *The Future of Children*, *26*(2), 185–205. https://doi.org/10.1353/foc.2016.0018

Hill, C. J., Gormley, W. T., & Adelstein, S. (2015). Do the short-term effects of a high-quality preschool program persist? *Early Childhood Research Quarterly*, *32*, 60–79. https://doi.org/10.1016/j.ecresq.2014.12.005

Hjetland Brinchmann, Ellen, Lyster, Halaas, Hagtvet, Bente Eriksen, Melby-lervåg, Monica, H. N. (2017). Preschool predictors of later reading comprehension ability: a systematic review. In *Campbell Systematic Reviews* (Vol. 14). https://doi.org/10.4073/csr.2017.14

Horn, E. (2009). Understanding curriculum modifications and embedded learning opportunities in the context of supporting all children's success. *Language Speech and Hearing Services in Schools*, *40*, 406–415.

Horn, E., Lieber, J., Shouming, L., Sandall, S., & Schwartz, I. (1995). Supporting Young Children ' s IEP Goals in Inclusive Settings Through Embedded Learning Opportunities. *Topics in Early Childhood Special Education*, *20*(4), 208–223.

Hulme, C., Nash, H. M., Gooch, D., Lervåg, A., & Snowling, M. J. (2015). The Foundations of Literacy Development in Children at Familial Risk of Dyslexia. *Psychological Science*, *26*(12), 1877–1886. https://doi.org/10.1177/0956797615603702

Invernizzi, M., Sullivan, A., Meier, J., Swank, L., & Jones, B. (2004). *Teacher's Manual PreK: Phonological Awareness Literacy Screening*. Retrieved from https://www.palsmarketplace.com/v/vspfiles/files/learn-more/PALS-Pre-K/PreK_technical_chapter.pdf

Johanne Paradis. (2015). The Development of English as a Second Language With and Without Specific Language Impairment: Clinical Implications. *Journal of Speech, Language, and Hearing Research*, *24*(2), 1–14. https://doi.org/10.1044/2015

Justice, L., Logan, J., Kaderavek, J., & Dynia, J. (2015). Print-Focused Read-Alouds in Early Childhood Special Education Programs. *Exceptional Children*, *81*(3), 292–311.

Justice, L. M., Logan, J., & Kaderavek, J. N. (2017). Longitudinal impacts of print-focused read-alouds for children with language impairment. *American Journal of Speech-Language Pathology*, *26*(2), 383–396. https://doi.org/10.1044/2016_AJSLP-15-0200

Justice, L. M., Mashburn, A. J., Hamre, B. K., & Pianta, R. C. (2008). Quality of language and literacy instruction in preschool classrooms serving at-risk pupils. *Early Childhood Research Quarterly*, *23*(1), 51–68. https://doi.org/10.1016/j.ecresq.2007.09.004

Kagan, S. L., & Kauerz, K. (2006). Preschool Programs : Effective Curricula. *Encyclopedia on Early Childhood Development*, (December), 1–5.

Katherine Magnuson, & Greg J. Duncan. (2016). Can Early Childhood Interventions Decrease Inequality of Economic Opportunity? *RSF: The Russell Sage Foundation Journal of the Social Sciences*, *2*(2), 123. https://doi.org/10.7758/rsf.2016.2.2.05

Kelley, E. S., Goldstein, H., Spencer, T. D., & Sherman, A. (2015). Effects of automated Tier 2 storybook intervention on vocabulary and comprehension learning in preschool children with limited oral language skills. *Early Childhood Research Quarterly*, *31*, 47–61. https://doi.org/10.1016/j.ecresq.2014.12.004

Kholoptseva, E. (2016). *Effects of Center-Based Early Childhood Education Programs on Children ' s Language , Literacy , and Math Skills : A Comprehensive Meta-Analysis. Doctoral Dissertation, Harvard Graduate School of Education.* Retrieved from https://dash.harvard.edu/handle/1/27112693

Kleeck, A. Van, Gillam, R. B., & Mcfadden, T. U. (1998). A study of classroom-based phonological awareness training for preschoolers with speech and/or language disorders. *American Journal of Speech-Language Pathology*, *7*, 66–77. https://doi.org/10.1044/1058-0360.0703.65

Kraft, M. A., & Blazar, D. (2017). Individualized Coaching to Improve Teacher Practice Across Grades and Subjects: New Experimental Evidence. In *Educational Policy* (Vol. 31). https://doi.org/10.1177/0895904816631099

LARRC, C. (2017). Oral Language and Listening Comprehension : *Journal of Speech, Language, and Hearing Research*, *60*(May), 1273–1284.

Leonard, L. B., Camarata, S. M., & Camarata, M. N. (2008). The Acquisition of Tense and Agreement Morphemes by Children with Specific Language Impairment During Intervention: Phase 3. *Journal of Speech Language and Hearing Research*, *51*(1), 120–125. https://doi.org/10.1044/1092-4388(2008/008).The

Lepola, J., Lynch, J., Kiuru, N., Laakkonen, E., & Niemi, P. (2016). Early Oral Language Comprehension, Task Orientation, and Foundational Reading Skills as Predictors of Grade 3 Reading Comprehension. *Reading Research Quarterly*, *51*(4), 373–390. https://doi.org/10.1002/rrq.145

Lewis, B. A., Avrich, A. A., Freebairn, L. aA, Hansen, A. J., Sucheston, L. E., Kuo, I., … Stein, C. M. (2011). Literacy outcomes of children with early childhood speech sound disorders: Impact ofeEndophenotypes. *Journal of Speech, Language, and Hearing Research*, *54*(December 2011), 1628–1644. https://doi.org/10.1044/1092-4388(2011/10-0124)b

Literacy, N. C. for F. (2008). Developing early literacy: Report of the National Early Literacy Panel. *Literacy*, *2*(1), 1–25. Retrieved from http://lincs.ed.gov/publications/pdf/NELPReport09.pdf

Lonigan, C.J., Clancy-Menchetti, J., Phillips, B. M., McDowell, K., & Farver, J. (2005). *Literacy Express: A Preschool Curriculum.* Tallahassee, FL: Literacy Express.

Lonigan, Christopher J., Farver, J. A. M., Phillips, B. M., & Clancy-Menchetti, J. (2011). Promoting the development of preschool children's emergent literacy skills: A randomized evaluation of a literacy-focused curriculum and two professional development models. In *Reading and Writing* (Vol. 24). https://doi.org/10.1007/s11145-009-9214-6

Lonigan, Christopher J., & Phillips, B. M. (2016). Response to instruction in preschool: Results of two randomized studies with children at significant risk of reading difficulties. *Journal of Educational Psychology*, *108*(1), 114–129. https://doi.org/10.1037/edu0000054

Lonigan, Christopher J., Purpura, D. J., Wilson, S. B., Walker, P. M., & Clancy-Menchetti, J. (2013). Evaluating the components of an emergent literacy intervention for preschool children at risk for reading difficulties. *Journal of Experimental Child Psychology*, *114*(1), 111–130. https://doi.org/10.1016/j.jecp.2012.08.010

Lonigan, Christopher J., Wagner, R., Torgesen, J., & Rashette, C. (2007). *Test of Preschool Literacy*. Pro-Ed.

Lovelace, S., & Stewart, S. R. (2007). Increasing Print Awareness in Preschoolers With Language Impairment Using Non-Evocative Print Referencing. *Language Speech and Hearing Services in Schools*, *38*(1), 16. https://doi.org/10.1044/0161-1461(2007/003)

Magnuson, K. A., Ruhm, C., & Waldfogel, J. (2007). The persistence of preschool effects: Do subsequent classroom experiences matter? *Early Childhood Research Quarterly*, *22*, 18–38. https://doi.org/10.1016/j.ecresq.2006.10.002

Magnuson, K. A., Sexton, H. R., Davis-kean, P. E., & Aletha, C. (2018). *Increases in Maternal Education and Young Children ' s Language Skills Source : Merrill-Palmer Quarterly , Vol . 55 , No . 3 , SPECIAL ISSUE : Educational Attainment in Developmental Perspective (July 2009), pp . 319-350 Published by : Wayne State Unive*. *55*(3), 319–350.

Marulis, L. M., & Neuman, S. B. (2010). The Effects of Vocabulary Intervention on Young Children's Word Learning: A Meta-Analysis. *Review of Educational Research*, *80*(3), 300–335. https://doi.org/10.3102/0034654310377087

Mashburn, A., Justice, L. M., McGinty, A., & Slocum, L. (2016). The Impacts of a Scalable Intervention on the Language and Literacy Development of Rural Pre-Kindergartners. *Applied Developmental Science*, *20*(1), 61–78. https://doi.org/10.1080/10888691.2015.1051622

McCartney, E., Boyle, J., Ellis, S., Bannatyne, S., & Turnbull, M. (2011). Indirect language therapy for children with persistent language impairment in mainstream primary schools: Outcomes from a cohort intervention. *International Journal of Language and Communication Disorders*, *46*(1), 74–82. https://doi.org/10.3109/13682820903560302

McCollum, J. a., Hemmeter, M. L., & Hsieh, W.-Y. (2011). Coaching Teachers for Emergent Literacy Instruction Using Performance-Based Feedback. *Topics in Early Childhood Special Education*. https://doi.org/10.1177/0271121411431003

Mcconnell, S. R., Mcevoy, M. A., & Priest, J. S. (2002). "Growing" Measures for Monitoring Progress in Early Childhood Education: A Research and Development Process for Individual Growth and Development Indicators. *Assessment for Effective Intervention*, *27*(4), 3–14. https://doi.org/10.1177/073724770202700402

Missall, K. N., Carta, J. J., McConnell, S. R., Walker, D., & Greenwood, C. R. (2008). Using individual growth and development indicators to measure early language and literacy. *Infants and Young Children*, *21*(3), 241–253. https://doi.org/10.1097/01.IYC.0000324553.85187.dc

Missall, K., Reschly, A., Betts, J., McConneil, S., Heistad, D., Pickart, M., … Marston, D. (2007). *Examination of the Predictive Validity of Preschool Early Literacy Skills*. *36*(3), 433–452.

National Early Literacy Panel Report (2009). *Developing Early Literacy: A Report of the National Early Literacy Panel*. https://doi.org/10.1598/RRQ.45.1.2

Neuman, S. B., Newman, E. H., Dwyer, J., Neuman, S. B., Arbor, A., Newman, E. H., & Dwyer, J. (2015). Educational Effects of a Vocabulary Intervention on Preschoolers ' Word Knowledge and Conceptual Development : A Cluster- Randomized Trial. *Source: Reading Research Quarterly*, *46*(3), 249–272. https://doi.org/10.1598/RRQ.46.3.3

O'Connor, R., O'Connor, R., Jenkins, J., Leicester, N., & Slocum, T. (1993). Teaching Phonological Awareness to Young Children with Learning Disabilities. *Exceptional Children*, *59*(6), 532–546.

Pelatti, C. Y., Piasta, S. B., Justice, L. M., & O'Connell, A. (2014). Language- and literacy-learning opportunities in early childhood classrooms: Children's typical experiences and within-classroom variability. *Early Childhood Research Quarterly*, *29*(4), 445–456. https://doi.org/10.1016/j.ecresq.2014.05.004

Peterson, R. L., Pennington, B. F., Shriberg, L. D., & Boada, R. (2009). What Influences Literacy Outcome in Children With Speech Sound Disorder? *Journal of Speech Language and Hearing Research*, *52*(5), 1175. https://doi.org/10.1044/1092-4388(2009/08-0024)

Pianta, R., Hamre, B., Downer, J., Burchinal, M., Williford, A., LoCasale-Crouch, J., … Scott-Little, C. (2017). Early Childhood Professional Development: Coaching and Coursework Effects on Indicators of Children's School Readiness. *Early Education and Development*, *28*(8), 956–975. https://doi.org/10.1080/10409289.2017.1319783

Piasta, S. B., Groom, L. J., Khan, K. S., Skibbe, L. E., & Bowles, R. P. (2018). Young children's narrative skill: concurrent and predictive associations with emergent literacy and early word reading skills. *Reading and Writing*, *31*(7), 1479–1498. https://doi.org/10.1007/s11145-018-9844-7

Powell, D. R., Diamond, K. E., Burchinal, M. R., & Koehler, M. J. (2010). Effects of an early literacy professional development intervention on head start teachers and children. *Journal of Educational Psychology*, *102*(2), 299–312. https://doi.org/10.1037/a0017763

Puma, M., Bell, S., Cook, R., & Heil, C. (2010). *Head Start Impact Study Final Report*. Retrieved from https://files.eric.ed.gov/fulltext/ED507845.pdf

Rakap, S., & Parlak-Rakap, A. (2011). Effectiveness of embedded instruction in early childhood special education: a literature review. *European Early Childhood Education Research Journal*, *19*(1), 79–96. https://doi.org/10.1080/1350293X.2011.548946

Roberts, M. Y., & Kaiser, A. P. (2011). The Effectiveness of Parent-Implemented Language Interventions: A Meta-Analysis. *American Journal of Speech-Language Pathology*, *20*(3), 180–199. https://doi.org/10.1044/1058-0360(2011/10-0055)amounts

Roseth, C. J., Missall, K. N., & McConnell, S. R. (2012). Early literacy individual growth and development indicators (EL-IGDIs): Growth trajectories using a large, internet-based sample. *Journal of School Psychology*, *50*(4), 483–501. https://doi.org/10.1016/J.JSP.2012.03.001

Schuele, C. M. (2004). The impact of developmental speech and language impairments on the acquisition of literacy skills. *Mental Retardation and Developmental Disabilities Research Reviews*, *10*(3), 176–183. https://doi.org/10.1002/mrdd.20014

Selya, A. S., Rose, J. S., Dierker, L. C., Hedeker, D., & Mermelstein, R. J. (2012). A Practical Guide to Calculating Cohen's f(2), a Measure of Local Effect Size, from PROC MIXED. *Frontiers in Psychology*, *3*, 111. https://doi.org/10.3389/fpsyg.2012.00111

Semel, E., Wiig, E., & Second, W. (2004). *Clinical Evaluation of Language Fundamentals-Preschool-2*. Retrieved from http://www.pearsonclinical.com/language/products/100000316/celf-preschool-2-celf-preschool-2.html

Smith, J., Warren, S. F., Yoder, P. J., & Feurer, I. (2004). Teachers' Use of Naturalistic Communication Intervention Practices. *Journal of Early Intervention*, *27*(1), 1–14. https://doi.org/10.1177/105381510402700101

Snowling, M. J., Duff, F. J., Nash, H. M., & Hulme, C. (2016). Language profiles and literacy outcomes of children with resolving, emerging, or persisting language impairments. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *57*(12), 1360–1369. https://doi.org/10.1111/jcpp.12497

Snyder, P. A., Hemmeter, M. L., McLean, M., Sandall, S., McLaughlin, T., & Algina, J. (2018). Effects of Professional Development on Preschool Teachers' Use of Embedded Instruction Practices. *Exceptional Children*, *84*(2), 213–232. https://doi.org/10.1177/0014402917735512

Snyder, P. a, Rakap, S., Hemmeter, M. L., McLaughlin, T. W., Sandall, S. R., & McLean, M. E. (2015). Naturalistic instructional approaches in early learning: A systematic review. *Journal of Early Intervention*, *37*(1), 69–97. https://doi.org/10.1177/1053815115595461

Storch, S. a., & Whitehurst, G. J. (2002). Oral language and code-related precursors to reading: Evidence from a longitudinal structural model. *Developmental Psychology*, *38*(6), 934–947. https://doi.org/10.1037//0012-1649.38.6.934

Terrell, P., & Watson, M. (2018). Laying a Firm Foundation: Embedding Evidence-Based Emergent Literacy Practices Into Early Intervention and Preschool Environments. *Language Speech and Hearing Services in Schools*, *49*(2), 148. https://doi.org/10.1044/2017_LSHSS-17-0053

Towson, J. A., Gallagher, P. A., & Bingham, G. E. (2016). Dialogic Reading: Language and Preliteracy Outcomes for Young Children With Disabilities. *Journal of Early Intervention*, *38*(4), 230–246. https://doi.org/10.1177/1053815116668643

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 / American Speech-Language-Hearing Association*, *15*(1), 85–95. https://doi.org/10.1044/1058-0360(2006/009)

Wackerle-Hollman, A. K., Schmitt, B. A., Bradfield, T. A., Rodriguez, M. C., & McConnell, S. R. (2015). Redefining Individual Growth and Development Indicators: Phonological Awareness. *Journal of Learning Disabilities*, *48*(5), 495–510. https://doi.org/10.1177/0022219413510181

Wake, M., Levickis, P., Tobin, S., Gold, L., Ukoumunne, O. C., Goldfeld, S., … Reilly, S. (2015). Two-Year Outcomes of a Population-Based Intervention for Preschool Language Delay: An RCT. *Pediatrics*, *136*(4), e838–e847. https://doi.org/10.1542/peds.2015-1337

Wasik, B. A., & Hindman, A. H. (2014). Understanding the Active Ingredients in an Effective Preschool Vocabulary Intervention: An Exploratory Study of Teacher and Child Talk During Book Reading. *Early Education and Development*, *25*(7), 1035–1056. https://doi.org/10.1080/10409289.2014.896064

Weiland, C., & Yoshikawa, H. (2013). Impacts of a prekindergarten program on children's mathematics, language, literacy, executive function, and emotional skills. *Child Development*, *84*(6), 2112–2130. https://doi.org/10.1111/cdev.12099

Whalon, K., Martinez, J. R., Shannon, D., Butcher, C., & Hanline, M. F. (2015). The Impact of Reading to Engage Children With Autism in Language and Learning (RECALL). *Topics in Early Childhood Special Education*, *35*(2), 102–115. https://doi.org/10.1177/0271121414565515

Wilcox, M. J., Gray, S., Guimond, A. B., & Lafferty, A. E. (2011). Efficacy of the TELL language and literacy curriculum for preschoolers with developmental speech and/or language impairment. *Early Childhood Research Quarterly*, *26*(3), 278–294. https://doi.org/10.1016/j.ecresq.2010.12.003

Wilcox, M. J., Kouri, T. A., & Caswell, S. B. (1991). Early Language Intervention: A Comparison of Classroom and Individual Treatment. *American Journal of Speech-Language Pathology*, *1*(1), 49. https://doi.org/10.1044/1058-0360.0101.49

Woods, J. J., Wilcox, M. J., Friedman, M., & Murch, T. (2011). Collaborative consultation in natural environments: Strategies to enhance family-centered supports and services. *Language, Speech, and Hearing Services in Schools*, *42*(3). https://doi.org/10.1044/0161-1461(2011/10-0016)

Yoshikawa, H., Weiland, C., & Brooks-Gunn, J. (2016). When Does Preschool Matter? *The Future of Children*, *26*(2), 21–35. https://doi.org/10.1353/foc.2016.0010

Ziolkowski, R. A., & Goldstein, H. (2008). *Effects of an Embedded Phonological Awareness Intervention During Repeated Book Reading on Preschool Children With Language Delays*. https://doi.org/10.1177/1053815108324808

Zipoli, R. P., & Merritt, D. D. (2017). Risk of reading difficulty among students with a history of speech or language impairment: Implications for student support teams. *Preventing School Failure*, *61*(2), 95–103. https://doi.org/10.1080/1045988X.2016.1202180

Table 1
Family Income and Maternal Education by Participant Group

Variable	TELL (*n* =142)	Contrast (*n* =147)
	n (%)	n (%)
Annual Household Income		
Less than 10,399	11 (7.7)	8 (5.4)
10,400-13,999	1 (0.7)	4 (2.7)
14,000-17,599	3 (2.1)	5 (3.4)
17,600-21,199	1 (0.7)	7 (4.8)
21,200-24,799	4 (2.8)	3 (2.0)
24,800-28,399	3 (2.1)	5 (3.4)
28,400-35,599	8 (5.6)	8 (5.4)
35,600-64,999	29 (20.4)	34 (23.1)
65,000-99,999	21 (14.8)	22 (15.0)
100,000 or more	21 (14.8)	18 (12.2)
Missing/Response not given	40 (28.2)	33 (22.4)
Maternal Education		
Some grade school	-	1 (0.7)
Some high school	8 (5.6)	10 (6.8)
High school graduate	19 (13.4)	21 (14.3)
Some college, no degree (1-3 yrs)	51 (35.9)	38 (25.9)
Associate degree in college (2 yrs)	18 (12.7)	22 (15.0)
Bachelor’s degree	36 (25.4)	39 (26.5)
Master’s degree	9 (6.3)	12 (8.2)
Ph.D.	1 (0.7)	3 (2.0)
Missing/Response not given	-	1 (0.7)

Table 2

TELL Supportive and Explicit Teaching Practices

<table>
<tr>
<td>General Supporting Strategies
1. Uses strategies to help facilitate processing and comprehension (e.g., slows rate of speech, using visual aids)
2. Rephrase questions/comments to simplify when child appears not to understand
3. Engages child prior to talking or providing instructions
4. Provides children with a sufficient amount of time to respond to questions and directives (minimum of 5 seconds)
5. Provides children with choices or options when he/she doesn’t respond to a question (e.g., provides a two-option choice)</td>
<td>Print Concepts and Alphabet Knowledge
1. Points to letters/words and tracks print in books
2. Asks children to find letters or words on a page or in the environment
3. Discusses parts of a book (cover, spine, author, illustrator, where to begin reading on a page, etc.)
4. Points out print in the environment
5. Says letter names and asks children letter names
6. Says letter sounds and asks children about sounds that letters make</td>
</tr>
<tr>
<td>Language Teaching Practices
1. Uses words to describe the environment and relationship among items
2. Uses dialogic reading during story time
3. Demonstrates concepts with appropriate vocabulary and props
4. Uses SEER (see, example, explain, repeat) methods to teach vocabulary
5. Uses linguistic mapping strategies (produces sentences that includes vocabulary or states the meaning associated with a child’s ongoing activity)
6. Recasting and Expansions: Verbally recasts children’s utterances to model more complex grammar and higher level vocabulary
7. Modeling complex vocabulary and elicit more language with explicit prompts with either a direct request (e.g., “Here is a XXX can you all say XXX?) or conversational prompt to extend language (e.g., Yes, this is a fast truck, what else can you tell me about it?).</td>
<td>Phonological Awareness
1. Explains concept of rhyme (e.g., “rhyming words are words that sound alike or sound the same at the end of the word”).
2. Identifies rhyming words in context
3. Asks children questions about rhyming words (e.g., “Which words rhyme?” “What word rhymes with ___?”)
4. Asks children to identify words/objects beginning with an initial sound or letter (e.g., “Which one starts with the letter S or with the sound /ssssss??”)
5. Claps syllables in words, Counts syllables in words, Asks children to count syllables in words
6. Segments words by sounds (e.g., “c-a-t, what word is that?”)</td>
</tr>
<tr>
<td colspan="2">Writing
1. Models writing and letter formation
2. Provides children with opportunities to form, trace, or write letters on paper, chalkboard, etc.
3. Takes dictation during a activities
4. Asks children to write (drawing acceptable) names during activities</td>
</tr>
</table>

Table 3

Required Curriculum Learning Opportunity Components x Activity x Targeted Skill Sets.

Curriculum Learning Opportunity Component		Activity	Targeted Skill Area					
			PA	PC	AK	Wr	Vocab	SLC
1.	[a]ABC warm-up (letter names) followed by PA activity	Teacher-led (small group); Story time (small group); Transition (whole group)	X		X			
2.	Focus book reading	Story time (small group)		X			X	X
3.	Focus book sequence	Story Time (small group)						
	• Picture walk						X	X
	• Dialogic reading			X			X	X
	• Read it again			X			X	X
	• Story re-tell						X	X
4.	Vocab teaching sequence (say word, explain meaning, give example, repeat word)	Whole group [b] Options: Dramatic Play, Science, Math, Art					X	X
5.	Table tent cards (script on back)	Snack			X		X	X
6.	[c]Fact cards (expository, theme-related)	Whole group; story time; snack Options (dramatic play, science, math, art)					X	X
7.	[c]Social story cards	Whole group					X	
8.	ABC action cards (letter chants)	Whole group	X	X	X		X	
9.	Music and movement	Whole group	X				X	
10.	Three transitions (one each for vocab, alphabet knowledge, phonological awareness)	Moving from one activity to another (activities variable)	X	X	X		X	
11.	Writing (drawing, letters, dictation to teacher)	Writing center		X	X	X		
12.	PA warm-up (sound patterns)	Whole group	X					

Note. PA=phonological awareness, PC=print concepts, AK = alphabet knowledge, Wr=interactive writing, Vocab=higher level vocabulary, SLC=sentence length and complexity. The components were required daily, unless otherwise noted.

[a] Required once per week per child, could be implemented daily for different groups of children or once per week with different groups rotating through while the rest of the children were engaged in another activity

[b] Options for activity blocks varied across teachers, allowing customization of the curriculum to meet their preferences

[c] Required twice weekly

Table 4.
Overview of Professional Development & Coaching

When	Topic for Group PD	Topic for Coaching (number of coaching sessions)
July	• Introduction to TELL and review of components and implementation	NA
August	• Curriculum-based assessments and using them to differentiate instruction	NA
August	• Setting up the classroom environment • General supporting practices	(2) Creating a language and literacy rich environment, use of general supporting practices to engage children and promote interaction with each other
September	• Explicit and incidental language teaching practices	(3) Embedding language teaching practices in other activities (e.g., art, music, outdoor play, etc.)
October	• Dialogic reading and teaching vocabulary • Print concepts and alphabet knowledge teaching	(3) Embedding explicit and incidental teaching practices to promote vocabulary, print concepts, and alphabet knowledge during small group book reading and other activities (e.g., dramatic play, art, music, etc.)
November	• Differentiating instruction based on the CBMs	(2) Differentiated instruction within TELL components
December	• Implementation issues and solutions	(3) Embedded learning opportunities that are differentiated for individual children's needs
January	• Phonological awareness teaching practices • Teaching early writing • TELL in action video review and sharing implementation strategies	(3) Embedded, explicit instruction to promote children's phonological awareness, interactive writing,
February	• TELL in action video review and sharing implementation strategies	(3)
March	• TELL in action video review and sharing implementation strategies	(2)
April	• TELL in action video review and sharing implementation strategies	(3)

Table 5.

Average Percent of BAU (n=49) Teachers who Implemented Activities with Learning Opportunities for a TELL Objective x Time of Year.

	Fall	Winter	Spring	Total for the School Year
Total number of different observations	59	35	93	187
Teaching Alphabet Knowledge	74.32	85.25	86.94	82.64
Teaching Phonological Awareness	40.04	59.72	57.69	53.01
Print Awareness	43.75	63.62	66.97	59.00
Interactive Writing	37.48	59.75	58.69	52.64
Teaching Target Vocabulary	41.48	72.99	65.08	60.37
Sentence complexity	58.84	74.47	69.34	67.72

Note. Fall included August-October; Winter included November through January; Spring included February-May. For teachers with morning and afternoon class sessions scores were collapsed across the two classes and it was treated as a single observation.

Table 6.

Growth Curve Estimates for the TELL and BAU Groups

Variable	β_0		β_1		β_2		β_3	
	TELL	BAU	TELL	BAU	TELL	BAU	TELL	BAU
Letter Recognition	11.08***	10.43***	1.53***	1.53***	1.61***	1.20***	-0.034	-0.034
Letter Sounds	3.98**	4.81***	1.25***	1.25***	1.74***	0.99***	-0.029	-0.016
Beginning Sounds	1.27***	1.63***	0.57***	0.57***	0.66***	0.39***	-0.006	-0.006
Print Concepts	4.72***	4.69***	0.13	0.13	0.61***	0.36**	-0.015	-0.015
Listening Comprehension	3.14***	2.40***	0.123*	0.123*	0.35***	0.44***	-0.001	-0.036**

Note. Estimates are for the model $y_{ijkl} = \beta_o + \beta_1 ME_{i(kl)} + \beta_2 t + \beta_3 t^2 + u_{k(l)} + \varepsilon_{ijkl}$, where t = time and ME = Mother's Education.
p*<.01; ** *p*<.001; * *p*<.0001

Table 7.

Growth Curve Results for Curriculum-Based Measures

	Early Literacy Skills								Oral Language	
	Letter Recognition		Letter Sound ID		Beginning Sounds		Print Concepts		Listening Comprehension (Story Re-Tell)	
Effect	df	t	df	F	df	t	df	t	df	F
Maternal Education	90	3.43***	1,273	14.78***	90	4.15*	90	1.50	1,280	2.22
C	90	0.44	1,94.8	5.59 *	90	-0.84	90	-0.07	1,82.3	18.91*
T	90	4.19***	1,75	483.63***	90	3.79***	90	3.36**	1,1284	161.3***
T*T	90	-1.44	1,1029	6.18*	90	-0.57	90	-1.51	1,1268	12.65*
T*C	90	2.69**	1,275	50.41**	90	4.77***	90	5.07***	1,1279	39.14*
T*T*C	90	-0.06	1,687	0.16	90	0.74	90	-0.56	1,846	2.89

Note: C=Condition, T=Time; *p<.01; **p<.001; ***p<.0001

Table 8

Estimated Marginal Means (Standard Error) for Receptive and Expressive Themed Vocabulary Testing x Group x Measurement Point

Average Month Tested	Receptive Vocabulary		Expressive Vocabulary	
	TELL	BAU	TELL	BAU
1	4.84 (.23)	3.16 (.19)	1.56 (5.80)	.09 (8.11)
2	5.77 (.21)	3.79 (.16)	1.85 (6.68)	.42 (5.55)
3.5	6.46 (.21)	4.52 (.16)	2.26 (2.53)	.85 (2.87)
6	7.43 (.21)	5.31 (.17)	2.67 (11.47)	1.26 (1.53)
7.3	7.62 (.22)	5.30 (.17)	2.75 (18.18)	1.36 (2.35)
8.8	7.65 (.26)	5.18 (.21)	2.75 (27.26)	1.38 (4.62)

Note. The words tested at each measurement point were six, tier 2 words that were taught in the preceding two or three thematic units.

Table 9

Least Squares Means, (SE) and Statistical Details for CELF-P2, TOPEL, and PALS-PreK x Group Post-Test Scores

Test	Subtest	BAU (SE)	TELL (SE)	F-value df=1,421	*p*-value	FDR *p*-value
CELF-P2 Standard Scores	Core Language	89.52 (0.86)	90.27 (.91)	0.36	0.5495	0.6182
	Receptive Language	93.11 (1.06)	94.40 (1.12)	0.7	0.4035	0.5943
	Expressive Language	84.98 (0.80)	87.86 (0.85)	6.08	0.0140	0.0630
TOPEL Standard Scores	Definitional Vocabulary	96.16 (1.11)	96.77 (1.18)	0.71	0.7067	0.7067
	Phonological Awareness	91.16 (1.33)	92.74 (1.41)	0.42	0.4168	0.5943
PALS-PreK Number Correct	Upper Case Letter Recognition	7.25 (0.31)	7.72 (0.33)	0.29	0.2945	0.5943
	Lower Case Letter Recognition	23.05 (0.37)	22.60 (0.37)	0.41	0.4118	0.5943
	Letter Names	18.34 (0.73)	17.57 (0.74)	0.46	0.4622	0.5943
	Beginning Sound Awareness	17.67 (0.58)	20.15 (0.62)	8.43	0.0093	0.0630

Note: Reported least squares means are those after accounting for pretest score and maternal eduction; *CELF-P2=Clinical Evaluation of Language Fundamentals Preschool 2nd Edition; PALS-PreK = Phonological Awareness and Literacy Screening Preschool; TOPEL = Test of Preschool Early Literacy.*

Table 10.

Least Squares Means (SE) for Pre-Post Fall and Spring Vocabulary Tests

		Pre-Test		Post-Test	
Test	Subtest	BAU	TELL	BAU	TELL
Fall Vocabulary	Receptive	29.88 (0.55)	31.12 (0.56)	33.01 (0.52)	35.73 (0.49)
	Expressive	11.34 (0.48)	12.39 (0.51)	14.47 (0.54)	18.27 (0.56)
Spring Vocabulary	Receptive	30.97 (0.60)	31.03 (0.59)	33.49 (0.54)	36.75 (0.45)
	Expressive	14.41 (0.57)	14.37 (0.54)	18.44 (0.63)	23.15 (0.68)

Note. We report least squares means after accounting for maternal education.

Figure 1.

Overview of TELL Curriculum, Curriculum-Based Measures, Components, and Implementation Supports

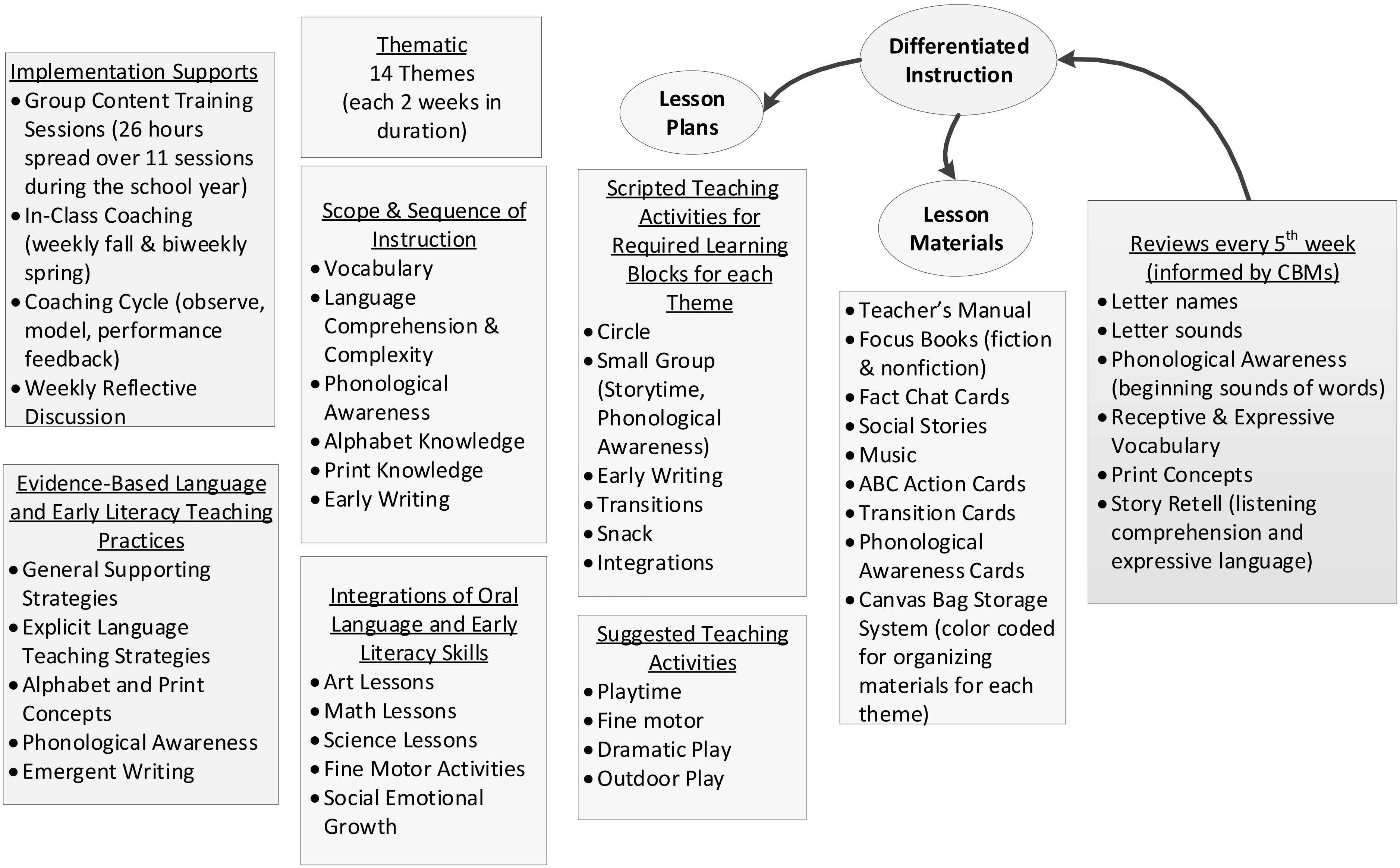
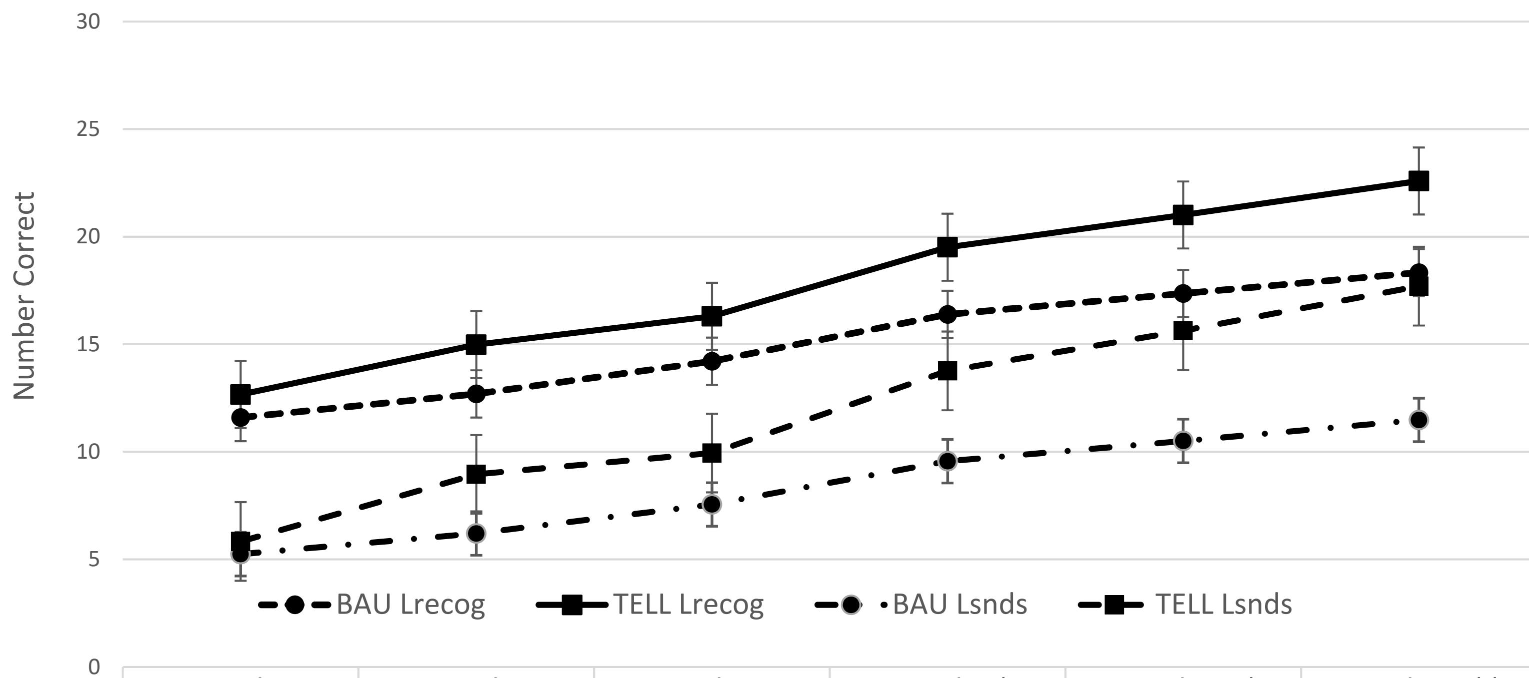


Figure 2.

BAU and TELL Letter Recognition & Letter Sounds (Lrecog, Lsnds) Estimated Marginal Means, Standard Error Bars and Significant Differences x Average Month of School Year CBM was Administered

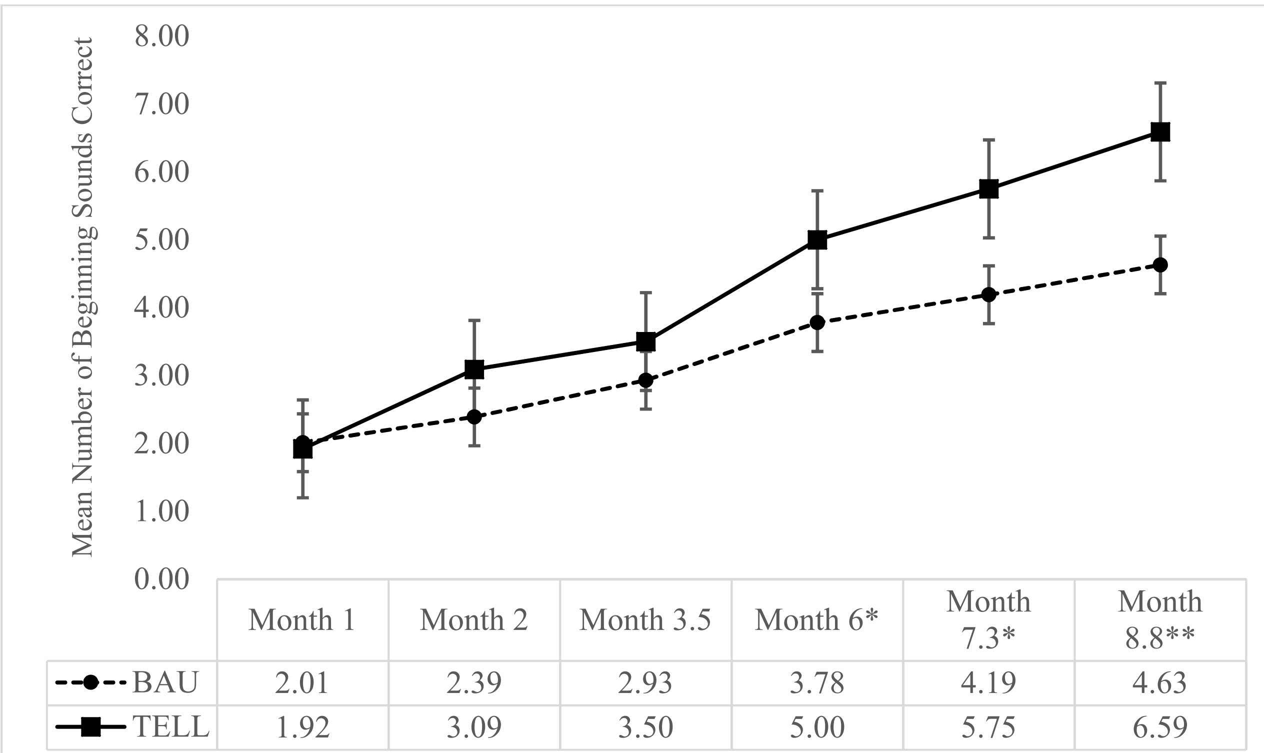


	Month 1	Month 2	Month 3.5	Month 6*	Month 7.3*	Month 8.8**
BAU Lrecog	11.59	12.69	14.21	16.39	17.36	18.33
TELL Lrecog	12.66	14.98	16.3	19.51	21.01	22.59
BAU Lsnds	5.24	6.2	7.55	9.56	10.5	11.48
TELL Lsnds	5.83	8.95	9.94	13.76	15.63	17.7

*p<.05; **p<.005

Figure 3.

Beginning Sounds Awareness Estimated Marginal Means, Standard Error Bars and Significant Differences x Average Month of School Year CBM was Administered

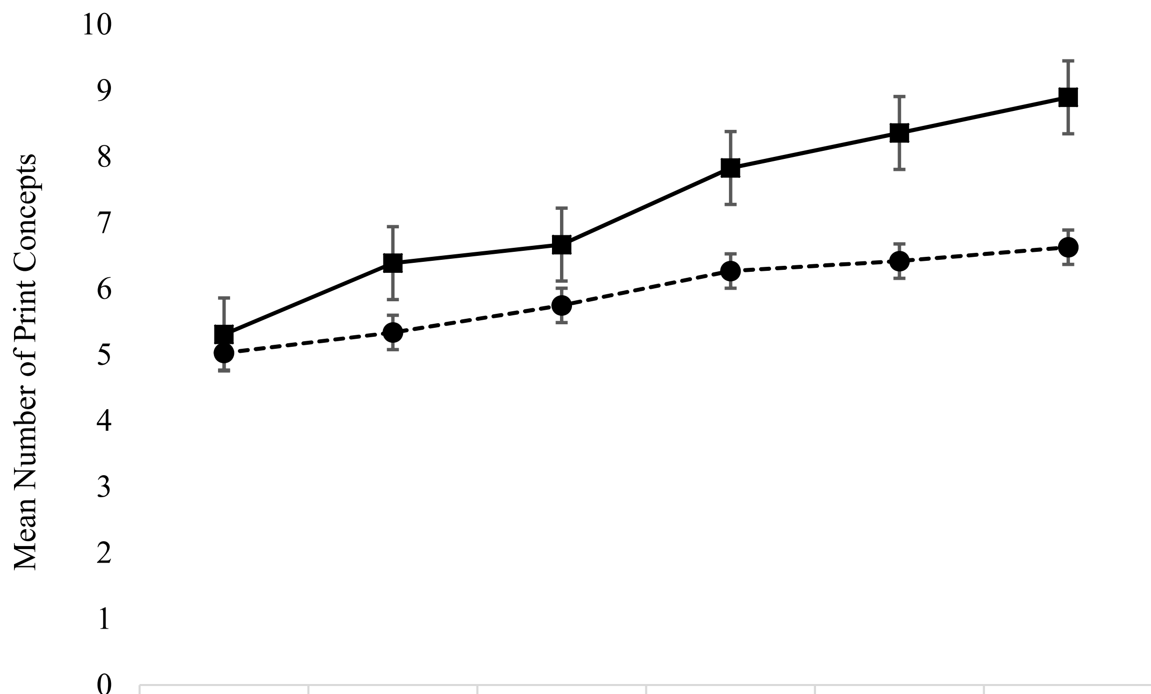


	Month 1	Month 2	Month 3.5	Month 6*	Month 7.3*	Month 8.8**
BAU	2.01	2.39	2.93	3.78	4.19	4.63
TELL	1.92	3.09	3.50	5.00	5.75	6.59

*p<.05; **p<.005

Figure 4.

Print Concepts Marginal Means, Standard Error Bars and Significant Differences x Average Month of School Year CBM was Administered

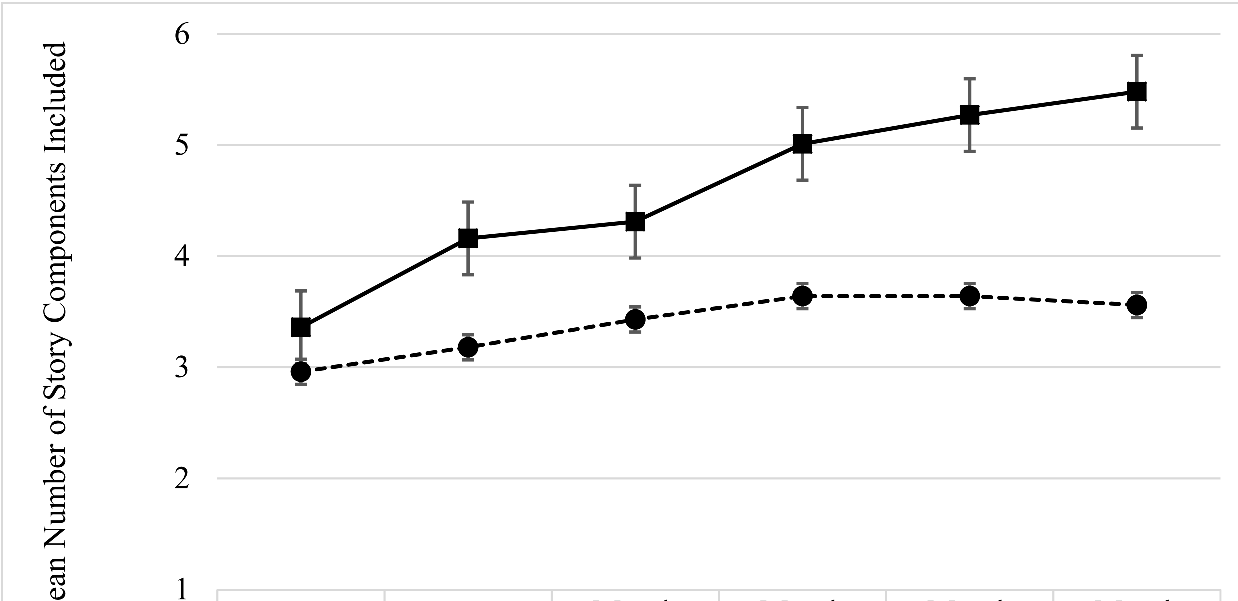


	Month 1	Month 2	Month 3.5	Month 6*	Month 7.3*	Month 8.8**
BAU	5.03	5.34	5.75	6.27	6.42	6.63
TELL	5.31	6.39	6.67	7.83	8.36	8.9

p<.005; *<.0001

Figure 5.

Listening Comprehension Estimated Marginal Means, Standard Error Bars and Significant Differences x Average Month of School Year the CBM was Administered



	Month 1	Month 2*	Month 3.5**	Month 6***	Month 7.3***	Month 8.8***
BAU	2.96	3.18	3.43	3.64	3.64	3.56
TELL	3.36	4.16	4.31	5.01	5.27	5.48

*p<.05; **p<.005; ***p<.0001

ELECTRONIC SUPPLEMENT

Model for Normal Distribution

A linear mixed model using a normal distribution without censoring for the response variable was used with fixed effects factors for treatment and time, random effects for teachers, and random coefficients at the child level. Child is crossed with time, but children were nested within teachers, and teachers were nested within treatment level. Teachers had only one or two classrooms in the study and an average of three children per class; thus, there were too few children per class and classrooms per teacher to consider an effect for classrooms nested within teachers. Similarly, school nesting was not included in the model because there were not enough classrooms per school to estimate the effect of school after classroom effect was in the model. The design is essentially a split plot with an added random factor for teachers. The treatment factor had two levels, TELL vs BAU. The mixed model specified random coefficients for intercept and linear slope, so each child had his or her own growth trajectory, and the random intercept and slope terms accommodate heterogeneous variance and covariance across time. Because the random intercept and slope terms accommodate correlation and heterogeneity of variance across time, the independence structure $\sigma_\varepsilon^2 I$ was selected for the covariance matrix of the random error terms for the six measurements on child i. Variance components were estimated by the method of restricted maximum likelihood. We used the Kenward-Rogers (KR) method to calculate approximate degrees of freedom for *F* tests of model fixed effects. The likelihood ratio test and the Bayes Information Criterion (BIC) were used to compare models with heterogeneity of variance across treatment groups. LOESS curves were examined to suggest the degree of the polynomial to represent trends across time prior to estimation of the fixed effects for the growth curve model. The model fixed effects were estimated by the method of generalized least squares

using SAS PROC MIXED. This model was used for analysis of two CBMs, listening comprehension and beginning sounds identification.

Model for Right/Left-Censored Distribution

There were ceiling effects for three of the early literacy CBM (print concepts, letter recognition, letter names) with scores at the maximum for 10.4%, 21.25% and 24% respectively. In addition, scores on the receptive vocabulary CBM were highly skewed, with 52% of the children scoring at the maximum of six correct overall and 88% scoring at the maximum at the final measurement point. In contrast, 29% of scores for the expressive vocabulary CBM were at the minimum value of 0 correct and only 6% were at the maximum value of 6 correct. For each of these CBM, results were obtained a linear mixed effects model with a right (or left) -censored normal distribution for the response variable (Vock, Davidian, Tsiatis, & Muir, 2012). This approach is sometimes known as a Tobit model. Y_{ijkl} would have been observed if there had been no censoring. However, due to censoring, we observe Q_{ijkl}, which takes on the value Y_{ijkl} for $Y_{ijkl} < l_{ij}$ and takes on the value l_{ij}, the known upper limit, otherwise. For each CBM, the known upper limit l_{ij} was the same for all time points and treatment levels. Variance components and fixed effects parameters were estimated by the method of maximum likelihood. Parameter estimates from the linear mixed effects model without right censoring were used as start values for maximum likelihood estimation of the right censored model.

The right (left)-censored model was estimated with SAS PROC NLMIXED, which presents some limitations compared to SAS PROC MIXED. The primary limitation is specification of a maximum of two random components, necessitating a choice between random effect at the child or the teacher level. Estimation of the right (left)-censored model with random effect at the child level encountered substantial difficulties with convergence, and the right-(left)

censored model with both random intercept and random slope rarely converged. Therefore the right (left)-censored models were estimated with random teacher effect.

Because the structure of the covariance matrix for the six measurements across time may have been misspecified in the right-censored model, the robust "sandwich" estimator (White, 1980; Liang and Zeger, 1986) was used for estimated standard errors and t tests of fixed-effect parameters. Comparing results from the SAS PROC MIXED model and the right censored-model, the same model fixed effects were found significant in both approaches. Usually the TELL effect was larger in magnitude under the right-censored model, which is intuitively reasonable since TELL children tend to reach the maximum possible score at an earlier time point. Hypothesis tests on fixed effects parameters were conducted using Wald statistics. Whereas the Kenward-Rogers denominator degrees of freedom from SAS PROC MIXED are over 900, the degrees of freedom for t-tests (square root of Wald statistics) are obtained from the number of teachers and were usually equal to 57. Degrees of freedom equal to 57 is large enough so that the distribution of the test statistics is quite close to normal.