Read Writ (2011) 24:305–337
DOI 10.1007/s11145-009-9214-6

Promoting the development of preschool children's emergent literacy skills: a randomized evaluation of a literacy-focused curriculum and two professional development models

Christopher J. Lonigan · JoAnn M. Farver · Beth M. Phillips · Jeanine Clancy-Menchetti

Published online: 29 October 2009

Abstract To date, there have been few causally interpretable evaluations of the impacts of preschool curricula on the skills of children at-risk for academic difficulties, and even fewer studies have demonstrated statistically significant or educationally meaningful effects. In this cluster-randomized study, we evaluated the impacts of a literacy-focused preschool curriculum and two types of professional development on the emergent literacy skills of preschool children at-risk for educational difficulties. Forty-eight preschools were randomly assigned to a business-as-usual control, a literacy-focused curriculum with workshop-only professional development, or a literacy-focused curriculum with workshop plus in-class mentoring professional development conditions. An ethnically diverse group of 739 preschool children was assessed on language and literacy outcomes. Results revealed significant and moderate effects for the curriculum and small, mostly nonsignificant, effects of professional development across child outcomes and classroom measures.

C. J. Lonigan (✉)
Department of Psychology, Florida State University, 1107 W. Call Street, Tallahassee, FL 32306-4301, USA
e-mail: lonigan@psy.fsu.edu

J. M. Farver
Department of Psychology, SGM 501, University of Southern California, Los Angeles, CA 90089-1061, USA
e-mail: farver@usc.edu

C. J. Lonigan · B. M. Phillips · J. Clancy-Menchetti
Florida Center for Reading Research, 2010 Levy Ave., Suite 100, Tallahassee, FL 32310, USA

B. M. Phillips
e-mail: bphillips@fcrr.org

J. Clancy-Menchetti
e-mail: jmenchetti@fcrr.org

Keywords Preschool · Curriculum · Early literacy skills

Introduction

The development of reading and writing skills is a critical and significant educational achievement for children in a literate society. Literacy skills form the foundation for acquiring content knowledge in numerous domains in school and throughout life, and they have become increasingly important as employment opportunities have shifted toward technology and information-oriented jobs. Unfortunately, many children in the United States struggle with learning to read. According to the National Assessment of Educational Progress (NAEP; National Center on Educational Statistics [NCES], 2007), 33% of 4th graders and 26% of 8th graders are unable to read at a basic level, which is defined as "partial mastery of prerequisite knowledge and skills that are fundamental for proficient work at a given grade" (NCES, p. 6), and only 33% of 4th graders and 31% of 8th graders score at or above proficient levels in reading.

Knowledge about the causes, correlates, and predictors of school-age children's reading successes and failures has increased over the past three decades (National Institutes of Child Health and Human Development [NICHD], 2000; Snow, Burns, & Griffin, 1998). A growing research base has highlighted the significance of the preschool period for the development of three key early (or "emergent") literacy skills (Lonigan, Schatschneider, & Westberg, 2008a; Whitehurst & Lonigan, 1998). This research indicates that preschool children's emergent skills in the domains of oral language, phonological awareness, and print knowledge are strong and independent predictors of how quickly and how well they will read once they are exposed to formal reading instruction (Lonigan, Burgess, & Anthony, 2000; Lonigan et al., 2008a, b; Wagner, Torgesen, & Rashotte, 1994; Wagner, Torgesen, Rashotte, & Hecht, 1997).

Although, for most children, these early literacy skills originate and develop throughout the preschool period (Bryant, MacLean, Bradley, & Crossland, 1990; Butler, Marsh, Sheppard, & Sheppard, 1985; Lonigan, Burgess, Anthony, & Barker, 1998; Lonigan et al., 2000; Lonigan et al., 2008a, b; Whitehurst & Lonigan, 1998), many children arrive at kindergarten lacking in these skills, making it less likely that they will benefit from the reading instruction they will receive in the early elementary grades. In the absence of targeted intervention, individual differences in these reading and reading-related skills are highly stable from the late preschool period forward (Lonigan et al., 2000; Wagner et al., 1994, 1997). Children classified as poor readers at the end of the first grade almost never acquire average-level reading skills by the end of elementary school (Francis, Shaywitz, Stuebing, Shaywitz, & Fletcher, 1996; Juel, 1988; Torgesen, Rashotte, & Alexander, 2001). Additionally, there is a significant relation between family socioeconomic status and the likelihood that children will have less developed early literacy skills and will experience significant difficulties in learning to read (Lonigan, 2003; NAEP, 2007), suggesting that children from lower socioeconomic backgrounds may benefit most from exposure to preschool programs designed to enhance early literacy skills.

Effective classroom practices for promoting preschool early literacy skills

Despite the importance of skilled reading for academic success and the growing recognition of the significance of the preschool period for laying the foundation for learning to read well, there have been few high-quality studies of programs designed to promote the development of early literacy and other pre-academic skills. Whereas two recent large-scale studies support the general benefits of early childhood education (U.S. Department of Health and Human Services, 2005; Wong, Cook, Barnett, & Jung, 2008), questions remain regarding how to structure preschool learning environments so that children at risk of significant reading difficulties receive maximum benefit. The *High/Scope Curriculum* and the *Creative Curriculum*, which are the most frequently used curricula in Head Start and other early childhood education programs that serve children at-risk of academic difficulties (Jackson et al., 2007; U.S. Department of Health and Human Services, 2005), account for between 59 and 70% of these early childhood classrooms; however, neither of these curricula have causally interpretable research evidence to indicate that their use results in increased development of early literacy or other pre-academic skills relative to alternative curriculula.[1] As understanding of the significance of the preschool period for the development of skills needed for later academic success has increased, preschool programs and practices have often not kept pace. To date, there have been only a limited number of published studies that have evaluated the impact of different preschool curricula or practices that allow unambiguous conclusions, including recent studies by Assel, Landry, Swank, and Gunnewig (2006), Barnett et al. (2008), and Fischel et al. (2007), as well as Byrne and Fielding-Barnsley's (1991a) study of their *Sound Foundations* preschool phonological awareness curriculum (Byrne & Fielding-Barnsley, 1991b).

Assel et al. (2006) randomly assigned, within program type, 76 Head Start, Title I, and universal pre-kindergarten programs to a business-as-usual control group, a group that used the *Doors to Discovery* curriculum (Wright Group, McGraw Hill, 2001), or a group that used the *Let's Begin* curriculum (Abrams & Company, 2000). Assel et al. also assigned classrooms in the *Doors to Discovery* and *Let's Begin* curriculum groups to either mentoring or no mentoring conditions. Whereas Assel et al. reported a complex set of interactions involving program type, curriculum, and mentoring condition, analyses of curriculum impacts revealed no significant or substantive effects of the *Doors to Discovery* curriculum on measures intended to assess oral language, print knowledge, or phonological awareness skills. Analyses of curriculum impacts revealed that the *Let's Begin* curriculum also did not result in statistically significant differences in children's end-of-year scores, compared to the

[1] Although the Perry Preschool Project (e.g., Schweinhart, Barnes, & Weikart, 1993) is often cited as evidence for the efficacy of the High/Scope Curriculum, the design of that study limits internally valid conclusions about differences between children exposed to the *High/Scope Curriculum* and children who had no preschool. Although often described as a randomized study, post-randomization manipulation of the sample reintroduced potential selection biases into the results. Moreover, because children in the control group received no preschool experience and because children in the High/Scope group also received weekly home visits as a part of the experimental conditions, any observed differences between children in the *High/Scope* condition and children in the control condition cannot be unambiguously attributed to the curriculum even if internally valid conclusions were possible.

control condition; however, effect sizes were positive and educationally significant for measures designed to assess print knowledge and phonological awareness. Surprisingly, effect sizes tended to be larger for both curricula in the no-mentoring than in the mentoring condition when results were collapsed across site type.

Barnett et al. (2008) randomized 274, 3- and 4-year-old children to either a *Tools of the Mind* (TOM; Bodrova & Leong, 1996) curriculum group or a business-as-usual group in which they were exposed to the curriculum in use at their school for the previous 3 years. All children attended the same preschool; 8 classrooms used the TOM curriculum and 11 classrooms used the business-as-usual curriculum. Teachers were randomized to classrooms. In analyses taking into account clustering, Barnett et al. reported that there were no statistically significant or substantively important impacts of TOM on children's oral language or early literacy skills; however, children in TOM classrooms were rated as having fewer problem behaviors by their teachers than were children in the control classrooms.

Over a 3-year period, Fischel et al. (2007) randomly assigned 27 Head Start classrooms to a business-as-usual control group, a group that used the *Let's Begin* curriculum, or a group that used the *Waterford Early Reading* program (Waterford Institute, Inc., 2001). In their report, Fischel et al. included a mix of 27 randomized classrooms and eight classrooms studied for a second year in their assigned condition. No control classroom was studied for a second year, and the reported analyses appeared to include these eight repeating classrooms as independent analysis units. Taking into account just the initial year of implementation, the results revealed that there were no significant or substantive effects of either the *Let's Begin* curriculum or the *Waterford* program on measures intended to assess oral language or print knowledge compared to the business-as-usual control group.

Byrne and Fielding-Barnsley (1991a) randomly assigned 126, 4- and 5-year-old preschool children to either a condition in which they received their regular preschool program plus 12 weeks of exposure to the *Sound Foundations* (Byrne and Fielding-Barnsley, 1991b) curriculum or a control group that received their regular preschool program and 12 weeks of exposure to an intervention designed to teach semantic categories. The *Sound Foundations* program involved explicit teaching of specific phonemes in words during 25- to 30-min weekly small-group lessons. Immediate posttest results revealed that children in the *Sound Foundations* group scored significantly and substantially higher than did children in the comparison group on measures of phonological awareness. Some of these gains were maintained through first and second grade (Byrne & Fielding-Barnsley, 1993, 1995). An uncontrolled trial in which regular preschool teachers implemented the curriculum yielded substantially smaller effects and large variation in the fidelity of program implementation (Byrne & Fielding-Barnsley, 1995). These findings raise questions about the potential success of such a focused training program under non-experimental conditions.

Results from these curriculum studies reveal that there is little published evidence showing that specific preschool curricula have broad impacts on children's skills in early literacy domains. In contrast, there is published evidence that specific, typically researcher-implemented, intervention programs that focus on oral language development or on the development of the precursors to code-related literacy skills produce sizable, generalized, and lasting improvements in children's

skills (e.g., see Landry & Fischel, 2008; Lonigan & Phillips, 2007; Lonigan et al., 2008b; Lonigan, Shanahan, & Cunningham, 2008c, for reviews). Explanations for the general absence of broad impacts for preschool curricula include the possibility that these curricula do not include an adequate translation of the efficacious components of researcher-implemented interventions, that there is insufficient guidance for teachers in the curricula for specific teacher-directed instructional activities, or that the intensity (e.g., focus, explicitness, duration, and matching to children's current skills) of the instructional activities in the curricula is insufficient to affect substantial change in children's skills. Another possible explanation concerns the type of teacher professional development provided, both generally and in support of a specific curriculum delivery.

Professional development in early childhood education

The increased emphasis on educational objectives for early childhood programs in the past several years has brought with it a call for more and higher quality professional development for the early childhood educator workforce (e.g., Ginsberg et al., 2006; Pianta, 2006; Ramey & Ramey, 2006). However, despite widespread agreement about the need for this support of early childhood educators, little empirical research exists to guide policymakers and educators regarding the type, intensity, and duration of professional development that is most effective in helping early childhood educators acquire and implement background knowledge and mastery in instructional strategies that lead to improved child outcomes (Maxwell, Field, & Clifford, 2006; Snow, 2006). Although several previous studies have attempted to affect teachers' language and instructional behaviors within the classroom via professional development (Dickinson & Brady, 2006; Dickinson & Caswell, 2007; Girolametto, Weitzman, Lefebvre, & Greenberg, 2007; Landry, Swank, Smith, Assel, & Gunnewig, 2006; O'Connor, 1999) and have reported changes in classroom environments and some teacher behaviors (i.e., book reading, environmental print, and use of abstract language), these studies either did not measure or found no or only small changes in child outcomes.

Only a few studies to date specifically compared levels of professional development and linked them to child literacy outcomes (Cusumano, Armstrong, Cohen, & Todd, 2006; Jackson et al., 2006; O'Connor, 1999). In a quasi-experimental study conducted in kindergarten, O'Connor compared a traditional workshop-only model to one that included a 2-week summer institute as well as weekly embedded mentoring that involved observations and discussions between the researchers and teachers throughout the school year, and a control condition that included no additional professional development. Reported results indicated that children in classrooms representing both active professional development groups had higher outcomes on several literacy measures than did children in the control group classrooms, and there were significant differences in favor of the children from the more intensive professional development classrooms in letter naming, word identification, and spelling. However, analyses for this study were conducted without taking clustering into account; therefore, it is likely that many of the reported between group differences would not reach statistical significance if analyzed correctly. Although this study

provided some support for the claim that in-class mentoring involving modeling, feedback, and opportunities for co-teaching, may be more advantageous for children's skill development than strictly didactic models (Bransford, Brown, & Cocking, 1999; Putnam & Borko, 2000), the studies by Cusumano et al. and Jackson et al., both quasi-experimental studies involving preschool teachers, failed to find evidence that mentoring enhanced children's literacy outcomes.

Given the large gaps in knowledge about how to affect classroom practices to improve critically important early literacy skills for preschool children at-risk of academic difficulties, the goals of this study were to evaluate the impact of a preschool curriculum that focused on the three key early literacy skill domains and to evaluate different models of professional development. To this end, we tested the effects of a literacy-focused comprehensive early childhood curriculum and developed two models of professional development for teachers based on the curriculum. The *Literacy Express Preschool Curriculum* (*LEPC*, Lonigan, Clancy-Menchetti, Phillips, McDowell, & Farver, 2005) was designed to provide a balance between teacher-directed activities that were specifically connected to the key emergent literacy domains (oral language, phonological awareness, print knowledge), teacher-initiated activities that would provide opportunities for children to learn and practice their developing skills in these areas, and a classroom context in which children could engage in self-initiated activities to use and further develop their skills in these and other areas. Additionally, rather than producing a highly scripted curriculum, the goal was to give teachers a high degree of choice in the activities they could integrate into their classrooms. One professional development model employed workshops in which teachers were taught to use the curriculum, and the other professional development model included both the workshops and in-class mentoring that allowed teachers to see aspects of the curriculum enacted and provided opportunities to be observed and receive feedback.

Description of the early literacy curriculum

The curriculum included 10 thematic units that were sequenced in order of complexity and sophistication of the demands placed upon children. Thematic units were used to provide a coherent and integrated environment for children to learn emergent literacy skills and other information across a consistent context. For instance, one unit was "Safety First". During this unit, books with safety-related themes were used in small-group dialogic reading and other shared reading episodes; the target vocabulary to be taught included words related to safety (e.g., helmet, fire engine, ladder, fire hydrant, smoke, siren, alarm, escape); and suggestions for large-group activities included opportunities to use the vocabulary and concepts associated with safety (e.g., developing classroom rules in case of an emergency, teaching about using 911, dramatic play involving safety personnel and materials, artwork making traffic signs to use in play, and science "exploration centers" to teach safe versus unsafe things to touch). Within each unit, there were three types of teacher-directed small-group activities that had prior evidence of positively impacting the skill that was targeted (e.g., Lonigan, 2004).

One type of small-group activity, intended to promote oral language skills, involved a form of shared reading known as dialogic reading (Arnold, Lonigan, Whitehurst, & Epstein, 1994; Lonigan & Whitehurst, 1998; Whitehurst et al., 1988, 1994). In dialogic reading, the typical role of adults and children is reversed. In typical shared reading, the adult reads and the children listen; however, in dialogic reading, the adult uses different scaffolding techniques (e.g., asking specific types of "Wh-" and open-ended questions, modeling, using expansions and repetitions) derived from research on language development to encourage children to talk about the pictures in the book and learn to "tell the story". Across dialogic reading sessions, both within a single book and across time, adults shift their scaffolding strategies from relatively simple questions about the things pictured in the book (vocabulary development), to increasingly complex questions that require children to describe relations between things pictured in the book (grammatical development), and to those that require children to connect aspects of the book to other elements like intentions, internal states, plot, or personal experiences (narrative development). Across numerous studies, dialogic reading has been shown to increase oral language skills of young children (see Lonigan et al., 2008c, for review).

Another small-group activity, intended to promote the development of phonological awareness, included a series of word games that used picture-puzzles and other manipulatives to teach children to recognize that words are made up of smaller sound units. The sequence of exposure to these phonological awareness games followed the developmental sequence of phonological awareness (Anthony, Lonigan, Driscoll, Phillips, & Burgess, 2003; Phillips, Clancy-Menchetti, & Lonigan, 2008). Initial activities focused on large and concrete units of sounds in words (i.e., words in compound words), then moved to smaller units of sounds in words (i.e., syllables in words), and then to smaller and more abstract units of sounds in words (i.e., onsets and rime units in syllables, phonemes). The use of manipulatives to represent the different sound units provided children with a concrete representation of the task (e.g., saying the individual words in the compound word "popcorn") and provided teachers with materials that they could use to model and explain the task (e.g., separating the two pieces of a picture-puzzle that showed a tub of popcorn while saying the separate words). In studies of preschool and kindergarten children, explicit phonological awareness instructional activities have resulted in significant increases in children's phonological awareness, reading, and spelling skills (see Lonigan et al., 2008b, for review).

The final type of small-group activity, intended to promote the development of print knowledge, used pictures, letters, and writing to teach children about the alphabet (letter names and letter sounds) and the uses of print. Initial activities focused on recognition of letters and other features of children's names and the names of their classmates; later activities introduced the names of letters. Other activities were used to teach the sounds associated with letters. These included asking children to select their name (or the first letter of their name) from a group of names, matching letters based on their name or the sound, sorting letters, and writing. There is surprisingly little experimental data concerning the impact of teaching children about the alphabet (e.g., see Lonigan et al., 2008b). Children exposed to focused instruction on letter names and sounds learn more about the alphabet than children not exposed to such

instruction (Lonigan, 2004; Piasta, Purpura, & Wagner, 2009), and there is evidence that instructional activities for phonological awareness are more effective when instruction in print knowledge is included (Lonigan et al., 2008b).

Focus of this study

In this study, we experimentally evaluated the impact of this empirically based, literacy-focused preschool curriculum relative to traditional versions of early childhood curricula with a relatively large group of children at-risk of educational difficulties associated with poverty, and we evaluated the relative benefits of two models of professional development for assisting teachers to implement *LEPC*. Key differences between *LEPC* and traditional early childhood curricula involve the use of specific teacher-initiated instructional activities that focus on key language and early literacy skills, a specific scope and sequence, and a significant use of small-group instructional activities provided to all children on a daily basis in *LEPC*. Business-as-usual classrooms within this study used traditional versions of either *High/Scope* or *Creative Curriculum* that are more frameworks than curricula; that is, neither specifies instructional activities that follow a scope and sequence. Instead, both offer guidance to teachers concerning classroom organization and activities.

The *High/Scope* model follows a "plan, do, review" approach in which children identify their planned activities for the day at the start of the day, engage in the activities throughout the day, and discuss these activities with the teacher, peers, or both at the end of the day (Hohmann & Weikart, 2002). Teachers are to set up play-based active learning opportunities within the classroom related to a set of "key experiences" designed to enhance cognitive and social development in 10 broad developmental areas (e.g., classification, initiative and social relations, and movement). The teacher's role is primarily one of supporting and encouraging the play explorations within the classroom environment. Similarly, the traditional *Creative Curriculum* model follows an approach of establishing an engaging classroom environment in which children explore through play and in which the teacher's role is primarily one of scaffolding learning through individualized interactions with children during their play. Teachers are to create play-based learning activities to support children's progress through a developmental continuum of 50 objectives across four broad domains of social/emotional development, physical development, cognitive development, and language development (Dodge, Colker, & Heroman, 2002).

Both *High/Scope* and *Creative Curriculum* are very child-centered and child-directed, following a constructivist approach in which children's learning is supported through self-directed exploration and engagement with their environments. Children self-select most activities during the day, and there is little teacher-initiated explicit instruction. In contrast, *LEPC* includes significant teacher-initiated instructional activities, both in small- and large-groups, and follows a specific scope and sequence that is keyed to known developmental sequences of language and literacy skills. Children in *LEPC* classrooms also engage in self-directed and self-initiated learning activities in centers and other contexts that are designed to support the use of the language and literacy skills that are the focus of the small- and large-group activities. The small-group approach to core instructional activities

maximizes the likelihood that instructional activities are delivered at children's current skill levels and allows teachers to individualize and scaffold children's acquisition of language and literacy skills. Consequently, *LEPC* is child-centered and makes use of both teacher- and child-directed activities.

The overall goals of the study were to determine (a) if a research-based curriculum could be successfully implemented by traditional preschool teachers, (b) if this curriculum would have meaningful impacts on children's early literacy skills compared to outcomes of traditional early childhood curricula, (c) if the form of professional development provided to teachers affected their implementation of the curriculum or the impact on children's early literacy skills, and (d) how the use of the curriculum affected classroom environments. We expected that teachers would be able to implement the curriculum successfully and that there would be observable differences between classrooms using the experimental curriculum and classrooms using traditional early childhood curricula. We expected that use of the curriculum would result in higher end-of-year early literacy skills for children on the specific skills that were specifically targeted by the curriculum (i.e., oral language, phonological awareness, print knowledge). Finally, given the scarcity of literature demonstrating positive effects of professional development, we expected that there would be, at best, a small effect of professional development on teachers' activities and children's outcomes.

Methods

Participants

Participating preschools

Forty-eight preschool centers were recruited for the study: 18 in Tallahassee, Florida and 30 in Los Angeles, California. Most of the centers were Head Start programs (77%); the rest were Title I school district preschools. In cases where a center had more than one 4-year-old preschool classroom, either all 4-year-old classrooms were included in the study or one classroom was targeted as the focus of the study. The preschool site directors determined which classroom or classrooms participated in the study, and classroom selection was completed before assignment to experimental condition. A majority of the centers were using the *High/Scope Curriculum* prior to the study (all centers in California used High/Scope); however, some were using the *Creative Curriculum* (approximately half of the centers in Florida used *Creative Curriculum*). Centers assigned to the Control Group continued to use these curricula throughout the study.

Student sample

Informed consent and some data were obtained for 808 children who ranged in age from 36 months to 69 months at the time of the fall assessment ($M = 50.63$ months; $SD = 5.86$). Of these 808 children, 739 (91.6%) completed at least some parts of the posttest assessment. Children who took part in both the fall and the posttest

assessments ranged in age from 36 to 69 months ($M = 50.74$ months; $SD = 5.85$). The average scaled-score for children's cognitive abilities, computed from three subtests of the Stanford-Binet IV (see below), was 41.98 ($SD = 4.82$), which indicated that the average child who participated in both baseline and posttest assessments scored in the below-average range. Consequently, as a group, these children were at-risk for academic difficulties.

The sample consisted of 378 boys (51%) and 361 girls. The majority of the children were African American (56.3%); 34.8% were Latino; 7.7% were Caucasian; and 1.2% were of other ethnicities (e.g., Asian, American Indian, or multi-racial children). The ethnic distribution of the children was different between the Florida and the California sites, $\chi^2(df = 3, N = 739) = 279.13$, $p < .001$. In Florida, 76% of the children were African American; 18% were Caucasian; 3% were Latino; and 3% were of other ethnicities. In California, 58% of the children were Latino and 42% were African American; no children were Caucasian or of other ethnicities. Based on consultation with children's teachers, observation of the children, and informal screening, children were classified as either English-only or Spanish-speaking English language learners (ELL). In the California sample, 54% of the children were classified as ELL, whereas in the Florida sample, less than 1% of children were so classified.

Measures

Children received a battery of assessments to measure their general cognitive ability, oral language, print knowledge, and phonological processing skills in the fall and near the end of the school year. All of these assessments were conducted with all children in English.[2]

General cognitive abilities

Three subtests of the *Stanford-Binet, 4th Edition* (Thorndike, Hagen, & Sattler, 1986) were administered to children during the fall assessment to obtain an estimate of nonverbal cognitive ability. The Pattern Analysis subtest ($\alpha = .85$–$.90$) requires children to complete shape-puzzles and replicate increasing complex geometric patterns. The Copying subtest ($\alpha = .88$) requires children to build or draw a pattern following a model (e.g., stacking four cubes, making a stair-like structure with cubes). The Bead Memory subtest ($\alpha = .87$–$.89$) requires children to recall visually presented bead-like objects or to reproduce a series of stacked beads from a picture. Standard age scores ($M = 50$, $SD = 8$) for these three subtests were averaged to create a nonverbal cognitive ability composite score.

[2] English-language assessments were used in this study to provide a common outcome metric by which to measure the impacts of the intervention. Because almost all instructional activities were conducted in English, regardless of children's language background, these measures also provide the most direct measure of child outcomes. Moreover, in California and elsewhere, educational outcomes of interest are English-language outcomes.

Oral language

Children's oral language skills were assessed using the *Preschool Language Scale, 4th Edition* (PLS-IV; Zimmerman, Steiner, & Pond, 2002). The PLS-IV is a measure of vocal development, social communication, semantics, structure, and integrative thinking in receptive (Auditory Comprehension subscale) and expressive (Expressive Communication subscale) domains. For this study, the Expressive Communication subscale was used. The measure has high reliability (i.e., αs of .84–.88) and good evidence of validity with children of this age group (e.g., rs $> .85$ with previous versions of the measure).

Phonological awareness

Children completed two measures of phonological awareness from the *Preschool Comprehensive Test of Phonological and Print Processing* (P-CTOPPP; Lonigan, Wagner, Torgesen, & Rashotte, 2005). The P-CTOPPP was the development version of the *Test of Preschool Early Literacy* (Lonigan, Wagner, Torgesen, & Rashotte, 2007) and was designed as a downward extension of the *Comprehensive Test of Phonological Processing* (CTOPP; Wagner, Torgesen, & Rashotte, 1998). The P-CTOPPP included a 21-item Blending subtest, on which children are required to combine word sounds to make a new word, and an 18-item Elision subtest, on which children are required to remove a sound from a word to make a new word. Both subtests were constructed according to the developmental progression of phonological awareness (i.e., word awareness to phoneme awareness; Anthony et al., 2003), and use both recognition and expressive formats. Internal consistency reliabilities for these two subtests are high for 3-, 4-, and 5-year-old children (i.e., αs = .85–.87), and both subtests have moderate validity coefficients with other measures of phonological awareness (rs = .33–.53).

Print knowledge

Children completed the Print Knowledge subtest from the P-CTOPPP (Lonigan et al., 2005). This subtest consists of 36-items that assess early print concepts, alphabet recognition, letter-name knowledge, and letter-sound knowledge. Internal consistency for this measure is very high for 3-, 4-, and 5-year-old children (i.e., αs of .89–.95), and it has moderate to high validity correlations with other measures of alphabet and print knowledge (e.g., $r = .58$ with the *Test of Early Reading Achievement-III*; Reid, Hresko, & Hammill, 2001).

Other phonological processing skills

In addition to the phonological awareness and print knowledge subtests, the P-CTOPPP includes three subtests that measure both auditory short-term memory

and lexical access (see Wagner & Torgesen, 1987).[3] The NonWord Repetition subtest requires children to repeat increasingly longer nonwords (e.g., "teeg", "bawdoyb", "vode-gee-faw-dife") constructed following English phonology. The test consists of 3 practice and 20 test items; however, administration is discontinued following four errors in a row. The test has high internal consistency (i.e., αs of .85–.89), and it is moderately correlated with the Working Memory subtest of *Woodcock-Johnson Tests of Achievement-3rd Edition* (Woodcock, McGrew, & Mather, 2001; $r = .32$). The Word Span subtest requires children to repeat lists of common words (e.g., face, car, bat). The test consists of 2 practice and 21 test items. The items begin with one-word lists and increase to seven-word lists in sets of three. Administration is discontinued when all items within a set are failed. The test has acceptable internal consistency (i.e., αs of .74–.82), and it correlates with scores from the Working Memory subtest of the *Woodcock-Johnson Tests of Achievement-3rd Edition* ($r = .24$).

On the Rapid Object Naming subtest, children are timed as they name pictures of five common objects (i.e., man, car, tree, dog, ball) arranged in rows in a random order as quickly as possible. Two trials of the task were given. Test–retest reliability (alternate forms) ranges from .80 to .82 for this age-group. Scores on the measure correlate (rs = .45–.55) with the Rapid Naming subtests of the CTOPP.

Classroom measures

Two observational measures were used to assess the impact of curriculum and professional development conditions on classroom materials, activities, and teaching behaviors. The *Early Language and Literacy Classroom Observation Toolkit* (ELLCO; Smith & Dickinson, 2002) consists of several measures that assess classroom language and literacy activities and resources. According to the technical documentation provided by Smith and Dickinson, these ELLCO measures have adequate to high levels of internal consistency. A 25-item Classroom Environment Checklist ($\alpha = .84$) assesses the availability, content, and diversity of reading, writing, and listening materials. An observational rating system assesses the General Classroom Environment ($\alpha = .83$; i.e., organization, contents, technology, quality of classroom support for literacy) and the Language and Literacy Curriculum ($\alpha = .86$; i.e., reading and writing instruction, oral language use, cultural sensitivity, and assessment). Finally, two observational checklists are used to record the frequency and duration of nine literacy behaviors focused on Book Reading ($\alpha = .92$) and Writing ($\alpha = .73$).

The *Early Childhood Classroom Observation Measure* (ECCOM; Stipek & Byler, 2004) consists of 32 items to assess instructional practices that are rated on a 1 (practice rarely seen) to 5 (practices predominate) scale. The items yield "constructivist" subscales and "didactic" subscales for instruction, management, and social climate. Stipek and Byler reported adequate to high internal consistencies

[3] Although the curriculum did not target phonological short-term memory or lexical access, and we, therefore, did not anticipate any measured impacts on these measures, we included all of the subtests of the P-CTOPPP to provide descriptive information on the full spectrum of phonological processing skills.

for the constructivist (αs = .73–.89) and didactic subscales (αs = .82–.91). Classrooms that score high on the constructivist subscales represent classrooms in which the teacher helps children work toward achieving a goal, employs individualized performance standards, builds on children's prior knowledge, includes children as active participants in learning activities, uses a broad array of experiences and approaches for different content, provides children with choice in the context of both free-play and teacher-directed activities, gives children developmentally appropriate responsibilities, uses brief and non-disruptive discipline, and provides a warm, responsive, and attentive social climate. Classrooms that score high on the didactic subscales represent classrooms in which the teacher holds children to a common learning standard, employs lessons focusing on discrete skills, uses instructional approaches that focus on facts and procedural knowledge, controls classroom conversation and activities, focuses on activities that are not embedded in meaningful contexts (e.g., reciting the alphabet, rote counting), provides children with little free-choice outside of free-play, determines and imposes rules and routines unilaterally, and tends to promote individual and non-interactive, teacher-driven work among children.

Procedure

Recruitment and assessments

Letters describing the project and consent forms were sent home to parents/guardians either as part of the centers' enrollment packets or were distributed during parent meetings held at the centers. Recruitment continued during the initial 2 months of classes, as children enrolled in the preschools. The fall assessment commenced as soon as several consents from a center had been returned and continued through October. Posttest assessments were completed during a 5-week window at the end of the preschool year. Trained research staff administered all child assessments at both the fall and posttest assessment without a fixed order. In addition, all classrooms were observed twice during the school year (winter, spring) by trained observers. Observations lasted 3 h on average, during which time observers completed the two classroom environment measures. Two observers simultaneously completed 22% of these observations on the same classroom. Scores between raters were highly correlated for the ELLCO (rs = .88–.99) and the ECCOM (rs = .81–.94). To the extent possible, assessment staff and observation staff were blind to a center's assigned condition and were unaware of the study's hypotheses. Before data collection for this study, all assessment and observation staff received training and practice on the assessment (or observation) measures they used. Training on the ECCOM was conducted by one of the measure's developers.

Design and assignment

A cluster-randomized design was used for this study, with preschool center serving as the unit of assignment. Preschool centers were randomly assigned to one of three conditions with the constraint that approximately equal numbers of centers were

assigned to each condition. The conditions included (a) a "business-as-usual" control group (Control Group, 18 centers), (b) a group that used the *LEPC* and received all professional development through workshops (Workshop Group, 15 centers), and (c) a group that used the *LEPC* and received professional development through both workshops and weekly in-class mentoring visits (Mentor Group, 15 centers). Teachers in the Control Group continued to use their existing curriculum (*High/Scope* or *Creative Curriculum*) and they did not receive professional development from members of the research staff as a part of the study. These teachers, however, continued to receive the professional development supplied by their preschool organizations.[4]

LEPC curriculum materials

The curriculum included a teacher manual that explained emergent literacy skills and their development, basic usage of the curriculum, suggestions for how to select and schedule the small- and large-group activities in different types of daily schedules (e.g., half-day vs. full-day preschool), general descriptions of scaffolding and how to do it, methods for tracking children's progress, descriptions of how to adapt the curriculum activities for individual children, and general advice on structuring the classroom environment to support the curriculum. The curriculum included ten individual unit guides that detailed the specific small-group activities for that unit, the target skills for the unit (e.g., specific vocabulary words, specific level of phonological awareness, specific print knowledge), lists of books that could be used in dialogic reading, circle-time, and in centers-including the books that contained the target vocabulary for the unit, suggestions of activities to be used in large-groups, art, cooking, outside play, and centers, as well as lists of additional resources, such as age- and activity-appropriate websites related to the theme. Approximately 8–10 trade books were provided for each theme; these books were identified as appropriate for use in dialogic reading and included the target vocabulary for the unit. Also provided with the curriculum were all of the manipulative materials for the small-group phonological awareness and print knowledge activities and an assortment of other materials to be used in centers and other areas of the classrooms.

Professional development

In the two *LEPC* conditions, project staff provided all curriculum materials and training. The Head Start or preschool directors provided the materials and training for the existing curriculum that was in use in the control preschools. Most teachers and aides in the classrooms assigned to the *LEPC* groups began implementing the curriculum at the start of the school year, and all classrooms implemented their assigned curriculum within the first month of the school year. Teachers and

[4] Despite the large number of children who were Spanish-speaking English language learners in the Los Angeles sites, most of the preschool personnel were monolingual English speakers, and virtually all of the instructional activities in the preschool centers were conducted in English.

classroom aides attended a 2-day professional development workshop near the start of classes in the fall and four additional half-day professional development workshops evenly spaced throughout the remainder of the school year.

These workshops provided curriculum-specific professional development that involved explanation and demonstration of the curriculum activities introduced to children in the upcoming months (e.g., how to implement the small-group activities) and general professional development that covered the key emergent literacy skills (e.g., regarding the description and developmental progression of these skills and their relation to each other and to conventional reading ability), scaffolding children's skill development, classroom organization, scheduling issues, and basic behavior/classroom management. All workshops included both a didactic component and a hands-on component, which allowed teachers to practice with materials (e.g., dialogic reading, small-group phonological awareness and print knowledge activities) and to receive feedback from the project's professional development staff. About half of each workshop was used for the didactic/demonstration component and half was used for the hands-on component. All teachers and aides within site (i.e., CA, FL) attended the same workshop sessions, regardless of whether they were assigned to the Workshop Group or the Mentor Group. For classrooms assigned to the Mentor Group, the project's teacher-mentors visited classrooms once a week throughout the school year. The three Florida and two California mentor teachers were BA- or MA-level individuals who were trained and supervised by the co-authors of the curriculum. During classroom visits, the mentors observed teachers and aides, gave feedback on curriculum implementation, modeled curriculum activities, and collaborated on problem solving related to impediments to implementation with the classroom teachers and aides.

Results

Overview of impact analyses

Because of the nested structure of the data for children's skills, (i.e., preschool centers, not children, were assigned to conditions), analyses of child outcomes used multi-level modeling that treated preschool center as a random factor.[5] All analyses of child measures were conducted using restricted maximum likelihood estimation

[5] Use of multi-level modeling analysis is required because children within the same preschool site are likely to be similar to each other in measured outcomes, particularly by the end of a school year after being exposed to the same teacher, classroom activities, and classroom context. This can create a "clustering" effect in which variability between children within a preschool site is reduced (generally indexed by the intra-class correlation coefficient [ICC]), resulting in a reduction in the size of the error term in an analysis, which inflates the significance level of an inferential test of the differences between means. Multi-level analyses adjust the inferential tests by accounting for the "cluster variable" in the model (in the reported analyses for this study, by treating preschool site as a random factor in the model). Analyses using classrooms as a random factor, either alone or with preschool center, did not alter the results. Children were not "clustered" within small-groups because small-group membership in *LEPC* classrooms was not assigned and is intended to vary across the school year as children's skills change.

and raw scores on the measures. Only raw scores are available for the P-CTOPPP measures, and raw scores on the PLS-IV Expressive Communication subscale were used for consistency across analyses. To control for age effects in raw scores and to control for variation in scores due to general cognitive ability, both children's chronological ages and children's standard scores on the nonverbal cognitive ability composite variable were used as covariates in all analyses. Preliminary analyses revealed some significant site effects and a significant relation between children's scores and their ethnicity. Because of the significant differences between sites in the ethnicity of the children, children's ethnicity also was covaried in the analyses. Most classroom teachers began using their assigned curriculum on the first day of classes; however, fall assessments of the children began after the start of classes and continued for up to two and a half months. Therefore, fall assessments do not represent "pretest scores". Consequently, fall scores were not used as covariates in the impact analyses, given that scores on these measures were likely affected by several weeks to a couple of months of exposure to the curriculum to which the classroom was randomly assigned.[6]

Across the seven child outcome measures, separate 3 (Experimental Group: Control, Workshop, Mentor) by 2 (Site: Tallahassee, Florida; Los Angeles, California) mixed model analyses were conducted. Two comparisons were of primary interest to the goals of this study. One comparison addressed the question of the impact of *LEPC* on children's emergent literacy skills. For this contrast, the Workshop Group and Mentor Group were combined and compared to the Control Group. The second comparison addressed the question of the impact of the type of professional development received by teachers in classrooms using *LEPC*. For this contrast, the Workshop Group and the Mentor Group were compared to each other. Two additional comparisons were deemed of interest to specify more clearly the impact of the combined curriculum/professional development conditions. For these contrasts, the Workshop Group and the Mentor Group were each compared to the Control Group. For each outcome measure, tests of site effects and the interaction of site with experimental group were conducted.

Because of the multiple non-independent comparisons, the Benjamini-Hochberg procedure (Benjamini & Hochberg, 1995) was used to protect against increases in Type I error. The Benjamini-Hockberg procedure uses a sequential Bonferroni-type adjustment to critical p-values to control the false discovery rate. The correction is applied only to contrasts that yield statistically significant results, given that non-significant results would be non-significant with or without correction. All significance testing was conducted with alpha = .05. For all planned contrasts involving curriculum group or professional development group, student-level effect sizes were computed using Hedges' g, which represents the standardized mean difference between groups and is computed as the difference between means or adjusted means over the pooled within-group *SD*.

[6] Any pre-existing group differences are controlled in the analyses through the use of the nonverbal cognitive ability covariate, which was unlikely to be affected by exposure to the curriculum.

Preliminary analyses and fall child scores

As noted above, overall attrition of students for the study was less than nine percent, and within the three experimental groups, attrition was similar (Control Group = 9%, Workshop Group = 9%, Mentor Group = 7%). Scores on all outcome measures collected during the fall assessment were examined to determine if there were substantial differences between the curriculum or professional development groups using the contrasts described above. These analyses were restricted to children who also completed at least some part of the posttest assessments. Descriptive statistics for scores on the fall measures are shown in Table 1.

After Benjamini-Hockberg correction, none of the four planned contrasts were statistically significant for age, the nonverbal cognitive ability composite variable, or any of the seven emergent literacy outcome measures. There were no statistically significant interactions between experimental group and site (all $ps > .21$). There were, however, statistically significant site differences on the nonverbal cognitive ability composite variable, $F(1, 56.61) = 26.71$, $p < .001$, the Elision subtest of the P-CTOPPP, $F(1, 61.18) = 4.79$, $p < .04$, the Nonword Repetition subtest of the P-CTOPPP, $F(1, 57.24) = 4.65$, $p < .04$, and the Rapid Naming subtest of the P-CTOPPP, $F(1, 59.44) = 4.29$, $p < .05$. On the nonverbal cognitive ability composite variable, children in the Florida sample ($M = 43.42$, $SD = 5.16$) scored higher than children in the California sample ($M = 40.84$, $SD = 4.20$). On the Elision, Nonword Repetition, and Rapid Naming subtests, children in the California sample (Elision: $M = 6.76$, $SD = 2.92$; Nonword Repetition: $M = 8.88$, $SD = 4.52$; Rapid Naming: $M = 57.94$, $SD = 24.67$) scored better than did the children in

Table 1 Descriptive characteristics of the completer sample based on fall assessments by different curriculum and professional development groups, adjusted for covariates

Variable	Control group Adj. *M* (*SD*)	Literacy Express Curriculum groups		
		Combined PD groups Adj. *M* (*SD*)	Workshop group Adj. *M* (*SD*)	Mentor group Adj. *M* (*SD*)
Age (months)	50.86 (6.00)	50.86 (5.77)	51.14 (5.76)	50.58 (5.78)
Cognitive abilities (SS)	42.03 (4.59)	42.10 (4.93)	41.97 (4.67)	42.13 (5.12)
Expressive language	40.71 (18.22)	45.00 (13.47)	44.56 (14.85)	45.56 (12.36)
Blending (PA)	11.17 (4.89)	11.86 (4.72)	11.50 (4.90)	12.19 (4.59)
Elision (PA)	6.37 (3.20)	6.23 (3.13)	6.32 (2.95)	6.12 (3.26)
Print knowledge	9.72 (6.71)	10.09 (7.26)	9.24 (6.97)	10.61 (7.46)
NonWord repetition (PM)	8.66 (4.90)	7.70 (4.20)	7.75 (4.09)	7.61 (4.27)
Word span (PM)	8.03 (2.88)	7.77 (2.71)	8.02 (2.69)	7.61 (2.72)
Rapid naming (PM)	62.13 (23.61)	59.64 (24.07)	61.51 (25.59)	57.78 (22.87)

Scores are adjusted raw scores unless otherwise indicated. All scores, except age and cognitive ability are adjusted for age, nonverbal cognitive ability, and child ethnicity. Age and cognitive ability are adjusted for child ethnicity only

PD professional development, *SS* scale score, *PA* phonological awareness, *PM* phonological memory, *Adj. M* mean scores adjusted for covariates used in analyses (age, cognitive ability, and child ethnicity)

the Florida sample (Elision: $M = 5.82$, $SD = 3.45$; Nonword Repetition: $M = 7.18$, $SD = 4.30$; Rapid Naming: $M = 63.65$, $SD = 22.88$; note that a higher score on rapid naming represents lower performance). There were no statistically significant site differences for the other fall assessments ($ps > .12$).

Impact of curriculum condition on children's skills

Descriptive statistics, including student-level effect sizes, for the contrasts comparing children in the experimental groups receiving *LEPC* to children in the Control Group are shown in Table 2. Children in classrooms in which *LEPC* was used as the curriculum scored significantly higher than did children in Control Group classrooms on the PLS-IV Expressive Communication subscale, the Elision subtest of the P-CTOPPP, and the Print Knowledge subtest of the P-CTOPPP. All of these statistically significant effects were significant following the Benjamini-Hockberg correction. There were no statistically significant contrasts on any of the other variables. With the exception of the results for the Blending subtest of the P-CTOPPP, these null results were expected because the curriculum was not designed to promote children's short-term phonological memory (Nonword Repetition subtest, Word Span subtest) or lexical access (Rapid Naming subtest) skills.

Impact of professional development condition on children's skills

Descriptive statistics, including student-level effect sizes, for the contrasts comparing children in the two LEPC professional development groups and the Control Group are shown in Table 3. Contrasts between the Workshop Group and

Table 2 Descriptive statistics for impact of curriculum conditions on child outcome measures using age, nonverbal cognitive ability composite variable, and child ethnicity as covariates

Outcome variable	Curriculum group				Student-level effect size
	Control ($n = 242$)[a]		Literacy Express ($n = 497$)[a]		
	Adj. *M*	(*SD*)	Adj. *M*	(*SD*)	
Expressive language	50.50	(9.70)	52.93	(8.75)	.27*
Blending (PA)	13.41	(4.47)	14.03	(4.46)	.14
Elision (PA)	7.37	(3.54)	8.74	(3.93)	.36**
Print knowledge	14.80	(7.83)	17.58	(9.18)	.32*
NonWord repetition (PM)	9.54	(4.36)	8.94	(4.15)	−.14
Word span (PM)	8.52	(2.54)	8.77	(2.56)	.10
Rapid naming (PM)	49.59	(16.93)	48.15	(17.14)	.09

PA phonological awareness, *PM* phonological memory, *Adj. M* mean scores adjusted for covariates used in analyses (age, cognitive ability, child ethnicity)

[a] Not all children completed all measures at posttest. These numbers reflect the maximum analysis sample for these measures. The actual analysis sample varies by 0–10 children per variable

* $p < .05$; ** $p < .01$

Table 3 Descriptive statistics for impact of professional development/curriculum conditions on child outcome measures using age, nonverbal cognitive ability composite variable, and child ethnicity as covariates

Outcome variable	Professional development/Curriculum conditions									Student level effect sizes		
	Control ($n = 242$)[a]			Workshop ($n = 213$)[a]			Mentor ($n = 284$)[a]			Workshop vs. control	Mentor vs. control	Workshop vs. mentor
	Adj. *M*	(SE)	(*SD*)	Adj. *M*	(SE)	(*SD*)	Adj. *M*	(SE)	(*SD*)			
Expressive language	50.50	(.73)	(9.70)	52.44	(.74)	(9.68)	53.34	(.70)	(7.97)	.20^{+}	.32**	.10
Blending (PA)	13.41	(.45)	(4.47)	14.17	(.46)	(4.34)	13.92	(.44)	(4.54)	.17	.11	−.06
Elision (PA)	7.37	(.34)	(3.54)	8.84	(.35)	(3.79)	8.66	(.33)	(4.03)	.40**	.39**	−.05
Print knowledge	14.80	(.82)	(7.83)	16.22	(.85)	(9.21)	18.57	(.79)	(9.16)	.18	.45**	.26*
NonWord repetition (PM)	9.54	(.46)	(4.36)	9.27	(.47)	(3.96)	8.70	(.44)	(4.29)	−.06	−.18	−.14
Word span (PM)	8.52	(.22)	(2.54)	8.83	(.23)	(2.42)	8.72	(.22)	(2.66)	.12	.08	.04
Rapid naming (PM)	49.62	(1.31)	(16.93)	48.53	(1.40)	(20.36)	48.29	(1.24)	(14.34)	.06	.09	−.04

PA phonological awareness, *PM* phonological memory, *Adj. M* mean scores adjusted for covariates used in analyses (age, cognitive ability, and child ethnicity)

[a] Not all children completed all measures at posttest. These numbers reflect the maximum analysis sample for these measures. The actual analysis sample varies by 0–10 children per variable

$^{+}$ $p = .067$; * $p < .05$; ** $p < .01$

the Mentor Group revealed a statistically significant difference only for the Print Knowledge subtest of the P-CTOPPP. Children in the Mentor Group scored significantly higher on this measure than did children in the Workshop Group. Contrasts comparing the Mentor Group to the Control Group revealed statistically significant effects on the PLS-IV Expressive Communication subscale, the Elision subtest of the P-CTOPPP, and the Print Knowledge subtest of the P-CTOPPP. In all cases, children in the Mentor Group scored significantly higher on these measures than did children in the Control Group. Contrasts comparing the Workshop Group to the Control Group revealed a statistically significant effect on the Elision subtest of the P-CTOPPP. Children in the Workshop Group scored significantly higher on this measure than did children in the Control Group.

All of these statistically significant effects were significant following the Benjamini-Hockberg correction. In addition, there was a marginally significant difference favoring the Workshop Group over the Control Group on the PLS-IV Expressive Communication subscale ($p < .07$). There were no statistically significant contrast effects on any of the other variables. As with contrasts involving curriculum condition, with the exception of the results for the Blending subtest of the P-CTOPPP, these null results were expected because neither the curriculum nor the professional development was designed to promote children's short-term phonological memory or lexical access skills.

None of the analyses resulted in a statistically significant experimental group by site interaction (all $ps > .12$).[7] There were statistically significant site differences on the Nonword Repetition subtest of the P-CTOPPP, $F(1, 59.96) = 4.34$, $p < .05$, and the Rapid Naming subtest of the P-CTOPPP, $F(1, 57.59) = 9.01$, $p < .005$. For both measures, children in the California sample (Nonword Repetition: $M = 9.86$, $SD = 3.98$; Rapid Naming: $M = 45.84$, $SD = 15.95$) scored better than did children in the Florida sample (Nonword Repetition: $M = 8.48$, $SD = 4.55$; Rapid Naming: $M = 51.78$, $SD = 18.46$).

Impacts of curriculum and professional development conditions on classrooms

Analyses of classroom observations used the same four contrasts as the analyses of child outcomes. Descriptive statistics, including effect sizes, for the classroom observations completed in the winter and spring using the ELLCO are shown in Table 4. None of the planned contrasts for any ELLCO subscale reached the level of statistical significance for winter, spring, or combined winter and spring observations. However, as shown by the effect sizes, there were some trends evident. Classrooms in the Workshop Group were rated higher than classrooms in the Control Group on general classroom environment overall ($p < .10$) and at the winter observation ($p < .09$), and classrooms in the Mentor Group were rated higher than classrooms in the Control Group on book reading activities ($p < .07$) at the winter observation. There was a significant effect of time of observation on the Literacy

[7] Additional analyses were conducted to examine what, if any, influences the curriculum in use before the study had on outcomes. As with the site variable, there were no statistically significant experimental group by original curriculum interactions. Additionally, there were no statistically significant differences for scores of children in control classrooms using *High/Scope* versus *Creative Curriculum.*

Table 4 Descriptive statistics for winter and spring classroom observations on the Early Language and Literacy Classroom Observation

Scales	Winter observation/Classroom condition			Spring observation/Classroom condition			Overall effect sizes[a]			
	Control *M* (*SD*)	Workshop *M* (*SD*)	Mentor *M* (*SD*)	Control *M* (*SD*)	Workshop *M* (*SD*)	Mentor *M* (*SD*)	LE-C	M-W	W-C	M-C
Literacy environment checklist	22.82 (4.51)	20.64 (8.84)	23.19 (8.62)	23.22 (8.73)	24.39 (6.46)	25.01 (6.38)	.05	.21	−.07	.15
General classroom environment	19.32 (5.03)	22.16 (3.84)	19.94 (4.88)	19.63 (3.56)	21.61 (4.33)	20.42 (4.93)	.35	−.38	.60^{+}	.16
Language, literacy, and curriculum	21.20 (7.06)	24.22 (8.20)	24.71 (7.55)	22.02 (6.68)	25.53 (7.22)	24.77 (7.32)	.43	−.02	.45	.44
Book reading activities	1.06 (.70)	1.03 (1.24)	1.92 (1.81)	1.45 (1.47)	1.61 (1.25)	2.01 (2.29)	.26	.37	.05	.42
Writing activities	3.04 (2.37)	3.56 (2.34)	3.82 (3.00)	3.04 (2.40)	3.64 (2.41)	3.79 (2.51)	.13	.04	.11	.14

LE Literacy Express Preschool Curriculum group, *C* control group, *W* workshop group, *M* mentor group

[a] Effect sizes for planned contrasts for combined winter and spring observations

$^{+}$ $p < .10$

Environment Checklist ($p < .05$) and a marginal effect of time of observation for Book Reading Activities ($p < .09$). In both cases, scores increased from the winter to the spring observation. There were no group by time interactions overall or for any contrast (all $ps > .40$).

Descriptive statistics, including effect sizes, for the classroom observations completed in the winter and spring on the ECCOM are shown in Table 5. Planned contrasts revealed statistically significant differences between experimental conditions for the constructivist scales but not the didactic scales. Comparisons of classrooms using LEPC to classrooms in the Control Group revealed statistically significant differences favoring the LEPC group on the Constructivist Instruction subscale overall and on the Constructivist Instruction and Constructivist Climate subscales at the spring observation. Classrooms in the LEPC condition also were rated marginally higher than classrooms in the Control Group on the Constructivist Management subscale at the spring observation ($p < .10$). None of the contrasts between classrooms in the Workshop Group and the Mentor Group were significant (all $ps > .14$).

Contrasts comparing the Workshop Group to the Control Group revealed that, on the Constructivist Instruction subscale, classrooms in the Workshop Group were rated significantly higher at the spring observation and marginally higher overall ($p < .07$) than were classrooms in the Control Group. Contrasts comparing the Mentor Group to the Control Group revealed that classrooms in the Mentor Group were rated significantly higher overall and at the spring observation on the Constructivist Instruction subscale, and significantly higher at the spring observation and marginally higher overall ($ps < .10$) on both the Constructivist Climate and Constructivist Management subscales than were classrooms in the Control Group. With the exception of the contrast between classrooms in the Mentor Group and classrooms in the Control Group on the Constructivist Management subscale, all of these statistically significant contrasts remained significant following the Benjamini-Hockberg correction.

There were significant effects of time of observation on the Constructivist Instruction ($p < .001$) and the Constructivist Climate ($p < .005$) subscales, which revealed overall increases in classroom scores from winter to spring observations. There were significant group by time interactions on the Constructivist Instruction subscale overall ($p < .01$), for the LEPC versus Control Group contrast ($p < .005$), the Workshop Group versus Control Group contrast ($p < .06$), and the Mentor Group versus Control Group contrast ($p < .003$), and on the Constructivist Climate subscale for the Mentor Group versus Control Group contrast ($p < .02$). In each case, classrooms in the LEPC, Workshop, or Mentor Groups were rated significantly higher at the spring than at the winter observation, whereas the ratings of the Control Group did not increase.

Discussion

Despite a more than 40-year history of providing U.S. children from high-poverty backgrounds with early educational services to help them succeed in school and to

Table 5 Descriptive statistics for winter and spring classroom observations on the Early Childhood Classroom Observation Measure

Domain Subscale	Winter observation/Classroom condition			Spring observation/Classroom condition			Overall effect sizes[c]			
	Control *M* (*SD*)	Workshop *M* (*SD*)	Mentor *M* (*SD*)	Control *M* (*SD*)	Workshop *M* (*SD*)	Mentor *M* (*SD*)	LE-C	M-W	W-C	M-C
Instruction										
Constructivist	2.14_{a} (1.17)	2.50_{a} (1.29)	2.70_{a} (1.17)	2.24_{a} (1.16)	3.18_{b} (1.01)	3.70_{b} (0.78)	.75**	.33	.55^{+}	.93**
Didactic	1.84_{a} (.47)	1.92_{a} (.64)	1.95_{a} (.80)	1.88_{a} (.80)	1.84_{a} (.62)	1.83_{a} (.66)	.04	.01	.03	.04
Climate										
Constructivist	2.83_{a} (1.46)	3.04_{a} (1.00)	3.07_{a} (1.12)	2.85_{a} (1.11)	3.31_{ab} (1.05)	3.74_{b} (0.71)	.42	.23	.28	.50
Didactic	1.60_{a} (.43)	1.77_{a} (.65)	1.95_{a} (.88)	1.85_{a} (.62)	1.59_{a} (.67)	1.69_{a} (.73)	.04	.19	−.08	.14
Management										
Constructivist	2.69_{a} (1.55)	3.13_{a} (1.20)	3.19_{a} (1.06)	2.71_{a} (1.25)	3.07_{a} (1.19)	3.50_{a} (1.04)	.43	.22	.30	.52^{+}
Didactic	2.07_{a} (.94)	1.95_{a} (.83)	1.88_{a} (.74)	2.04_{a} (.85)	1.82_{a} (.86)	1.79_{a} (.74)	−.24	−.06	−.19	−.27

Means for variables within a row and time not sharing a common subscript differ from each other significantly after Benjamini-Hockberg correction for multiple contrasts

LE Literacy Express Preschool Curriculum group, *C* control group, *W* workshop group, *M* mentor group

[c] Effect sizes for planned contrasts for combined winter and spring observations

$^{+}$ $p < .10$; * $p < .05$; ** $p < .01$

break the cycle of poverty that is often associated with school failure, this is one of the few large-scale studies that examined the benefits of a specific preschool curriculum using a causally interpretable design, was conducted in real-world educational environments, and employed typical preschool teachers. Additionally, this is one of the first studies that used a causally interpretable design to evaluate the effects of different professional development models on child outcomes. Overall, the results indicated a clear advantage of an academic-skills focused curriculum relative to traditional early childhood curricula for increasing the early literacy skills of children who are at-risk of later academic difficulties and a limited impact of the type of professional development used.

Impacts on children's skills

Results revealed a moderate effect of *LEPC* on oral language, phonological awareness, and print knowledge skills, which are the three key early literacy skill domains and the specific skills targeted by *LEPC*. In addition to the positive effects of *LEPC* on children's early literacy skills, there was a small advantage for a more intensive professional development model on the print knowledge measure. In general, for classrooms where teachers received guidance in using *LEPC* both outside (workshop) and inside (mentoring) the classroom, the effects of the curriculum on children's early literacy skills were more consistently positive, as evidenced by the effect sizes for the contrasts between each professional development group and the control group. However, the most significant factor responsible for increases in children's early literacy skills was the curriculum. Compared to effect sizes for curriculum impact, the effect sizes for professional development (i.e., the contrasts between Workshop and Mentor Groups) were much smaller and, in all but one case, were not statistically significant.

With the exception of the results for the Blending subtest, the obtained pattern of impacts matched the predicted impacts of the curriculum, suggesting good correspondence between the specification of the target constructs in the curriculum and the child skills that were affected. Importantly, the measures on which these impacts were obtained were broad measures of the skills, which did not measure specifically the content of the curriculum activities. That is, although the constructs assessed by the outcome measures were aligned with the constructs that the curriculum was designed to impact, the specific items in the measures were not aligned with the specific content that was the focus of the instructional activities (e.g., the expressive language measure did not specifically sample the target vocabulary of the curriculum, the print knowledge measure did not specifically sample the print concepts, letters names, or letter sounds that were taught in the curriculum). Consequently, the obtained impacts reveal a generalized increase in children's emergent literacy skills. Effects for the Blending subtest were in the right direction; however, the reason for the absence of a statistically significant effect is unclear. In evaluations of researcher-implemented phonological awareness interventions similar to the small-group instructional activities included in *LEPC* (e.g., Lonigan, 2004), impacts typically have been larger on blending measures than on elision measures.

The results of this study indicate that *LEPC*, partially moderated by more versus less intensive professional development, had meaningful impacts on the emergent literacy skills that it was designed to impact, relative to traditional early childhood curricula. Effect sizes for use of the curriculum ranged from .27 to .36 on three of four measures of the three key emergent literacy domains. Children in the *LEPC* classrooms outscored children in the control classrooms by about 1/3 of a standard deviation on these measures at the end of their preschool year. Significant effect sizes for the Mentoring Group ranged from .32 to .45 on measures of expressive language, phonological awareness, and print knowledge. Children in these classrooms scored between approximately 1/3 to almost 1/2 of a standard deviation higher on these measures than did children in control group classrooms. Significant effect sizes for the Workshop Group ranged from .20 to .40 on the expressive language and phonological awareness measures. Children in these classrooms scored between 1/5 and 2/5 of a standard deviation higher on these measures than did children in control group classrooms.

Although these effect sizes fall into the range that Cohen (1988) defined as small to medium, they are higher than the averages for much educational research. For instance, Nye, Hedges and Konstantopoulos (1999) estimated that the effect size of the Tennessee Class Size Experiment, in which class sizes were reduced from 22 to 26 students per class to 13 to 17 students per class, was about .10 on standardized reading measures. Similarly, Kane (2004) estimated that one full year of elementary school attendance increased student academic achievement by an effect size of approximately .25.

Overall, these findings have significant implications for creating more optimal learning environments for preschool children who are at-risk of later academic difficulties. In light of the relative absence of sizable curriculum effects in published studies of teacher-implemented interventions (e.g., Assel et al., 2006; Barnett et al., 2008; Bryne & Fielding-Barnsley, 1995; Fischel et al. 2007), as well as the relatively small impacts obtained in the experimental evaluation study of Head Start (U.S. Department of Health and Human Services, Administration for Children and Families, 2005) and the evaluation of the Early Reading First Program (Jackson et al., 2007), it seems clear that the majority of instructional interventions to which children at-risk of educational difficulties are exposed are not powerful enough to help close the gap in skills between children at-risk and children not at-risk. The results of this study show that it is possible to create early learning environments for children at-risk that include more powerful instructional interventions than are typical of early childhood education; however, these environments include a higher level of teacher-directed activities, focused activities, as well as small-group and individualized instruction than is provided typically by traditional early childhood curricula.

To date, the majority of studies evaluating the relation between the instructional quality of early childhood education settings and children's cognitive or academic outcomes (e.g., Loeb, Fuller, Kagan, & Carrol, 2004; NICHD Early Child Care Research Network [ECCRN], 2000, 2003; Peisner-Feinberg et al., 2001) have measured quality as a combination of structural (i.e., teacher qualification, teacher-child ratio) and process (i.e., teacher verbalizations, teacher affective presentation)

characteristics. Whereas the results from these naturalistic studies, including several different analyses of the ECCRN early childcare cohort, showed significant longitudinal relations between classroom quality and children's cognitive development, the data are correlational and not necessarily causal (Burchinal et al., 2000; ECCRN, 2000, 2003). Moreover, studies that have implemented causal-hypothesis-driven statistical controls (e.g., ECCRN, 2003) have not yielded strong evidence for a specific link between high quality and positive outcomes for children, suggesting that many of the naturally observed relations between quality and outcomes are a function of non-random selection of early childhood environments. Regardless, the coarse nature of the measures of instructional quality used in these studies is unlikely to reveal many specific instructional strategies that promote key early academic skills.

Impacts on teachers and classrooms

The results of this study indicated that the introduction of *LEPC* into classrooms substantially altered the nature of the interactions between teachers and children. Although observations using the ELLCO did not reveal differences between classrooms in the different curriculum or professional development groups that achieved statistical significance, observations using the ECCOM did reveal statistically significant differences between classrooms in the different curriculum groups. Examination of the obtained effect sizes and descriptive statistics for classroom observations indicated that the majority of effects were in the predicted direction and approached moderate magnitude. In general, classrooms in the *LEPC* groups were rated higher on literacy activity ratings and constructivist teacher behavior dimensions, and they scored higher over time. There was a large degree of variability between preschool centers within experimental group, however. This high variability, coupled with the relatively low statistical power of the analyses (i.e., 48 preschool centers in 3 conditions), likely explains the absence of a greater number of statistically significant observational findings.

To put these observational data in context, examination of the ELLCO summary variables provided by Smith and Dickinson (2002) from their development samples suggested that classrooms in all three experimental conditions were scored at about the same levels on the Literacy Environment Checklist, the General Classroom Environment rating, and the Language, Literacy, and Curriculum rating scale as were classrooms in the Smith and Dickinson sample (Means = 21.57, 20.64, and 24.16, respectively). In contrast, regardless of curriculum or professional development condition, classrooms in this study were scored lower on Book Reading Activities and higher on Writing Activities than were classrooms in the Smith & Dickinson sample (Means = 2.86 and 2.10, respectively). Compared to the ECCOM subscale means reported by Stipek and Byler (2004) for their sample of 127 kindergarten and first-grade classrooms, classrooms in all three experimental conditions were scored lower on the Didactic Climate, Didactic Management, and Didactic Instruction subscales than were classrooms in the Stipek and Byler sample (Means = 2.73, 2.65, and 2.51, respectively), as would be expected given differences in structure and instructional imperatives between preschools and

elementary schools. Conversely, only classrooms in the Workshop or Mentor Groups were scored higher on the Constructivist Climate, Constructivist Management, and Constructivist Instruction subscales than were classrooms in the Stipek and Byler sample (Means = 2.91, 3.06, 2.37, respectively).

Despite the specific skills focus and the inclusion of teacher-directed activities, the classrooms that used the *LEPC* were rated as no more didactic in style than were the classrooms that continued to use a traditional early childhood curriculum. Significantly, however, classrooms using the *LEPC* were rated as more constructivist in style, regardless of the professional development model used, than were classrooms that continued to use a traditional early childhood curriculum. These findings indicate that it is possible to introduce a skills-focused curriculum that includes key teacher-directed activities into a preschool classroom without the classroom becoming "developmentally inappropriate". Of course, a specific design focus of the *LEPC* was the use of small-groups, careful attention to children's developmental levels, and use of scaffolding that introduces a high-level of individualization not typical of traditional direct instruction.

Implications for early childhood education

The results of this study speak to long-standing issues within early childhood education. Within the early childhood education community, there has been a continuing debate about educational practices for preschoolers (e.g., Elkind, 2001; Whitehurst, 2001). To a large extent, views are polarized between direct-instruction and child-centered approaches, with the latter often referred to as "developmentally appropriate practice" (DAP). Concerns are often raised that a focus on preschoolers' cognitive development is not developmentally appropriate and will have negative impacts on children's socio-emotional development and academic-related motivation (e.g., Marcon, 1993, 1999; Stipek, Feiler, Daniels, & Milburn, 1995). The theoretical underpinnings of DAP follow from a constructivist model of learning in which children are seen as actively constructing their learning environments and learning is enhanced by children's opportunities to engage their environments. DAP classrooms are to be organized to facilitate each child's individual, developmental, and cultural characteristics.

Whereas a DAP approach does not eschew large-group, structured, or teacher-directed activities, the dominant learner-engagement is defined by consistent usage of varied child-initiated activities. However, the theoretical and empirical literature concerning DAP is diverse, complex, and often conflicting. Classrooms with an academic skills focus, a high proportion of teacher-directed activities, or a moderate proportion of activities in which all children produce the same product are often declared "developmentally inappropriate". The nuance of what is empirically supported versus what is deemed "best practice" is often not present among practitioners. Consequently, the relative amount of teacher-directed (versus child-directed) activities is often set to zero.

The results of this study speak directly to the debate concerning DAP. Observations revealed that use of the *LEPC* resulted in classrooms that were higher on constructivist domains than were classrooms using traditional early

childhood curricula. These findings indicate that the tendency toward an all-or-none approach concerning definitions of DAP does not adequately capture the complexities of children's educational needs. Whereas we believe that activities that are outside the capacity of young children (e.g., worksheets, large-group choral recitation) are not the most effective means of providing children with skills (e.g., they are beyond the attentional or motoric capacities of most preschoolers), it is apparent that a skills-focused curriculum that does include significant teacher guidance can be effective. Our experiences and the results of this study suggest that a balance between intentional and focused teaching strategies that are sensitive to the developmental capacities of children and incidental teaching strategies represents an appropriate way to promote the development of key skills in young children-particularly those with significant risk of educational difficulty.

Limitations

Although this study is one of a very small number of large-scale studies concerning the benefits of a specific preschool curriculum that used a causally interpretable design, was conducted in real-world educational environments, and employed typical preschool teachers, there are some potential limitations of the study. First, because the study employed a business-as-usual control group, we cannot definitively rule-out the possibility that the obtained effects were solely the result of increased frequency or quality of professional development received by the teachers. In both of the *LEPC* conditions, two things varied relative to the control group: the curriculum used and the professional development received. It seems unlikely that the results were due to professional development because (a) teachers in the control condition continued to receive some professional development, (b) the professional development effects were smaller than the curriculum effects, and (c) the professional development in the *LEPC* conditions was specific to *LEPC*. Second, in the absence of long-term follow-up data, it is unknown whether the obtained effects at the end of preschool resulted in meaningful differences in later grades. Given the high degree of mobility of this population of children, it is difficult to track sufficient children to maintain the interpretive advantages of a randomized design. Given the high correlations between early literacy skills (e.g., Lonigan et al., 2000, 2008a; Wagner et al., 1994) and later reading skills, it seems likely that the benefit of the curriculum will be evident as children begin formal reading instruction. Regardless, future studies should address longer term impacts by obtaining follow-up data.

Conclusions

Given the potentially severe negative consequences of reading difficulties, there is increasing focus on identifying points on the continuum of educational opportunities that children experience where intervention may be successfully applied. For many children, the genesis of their success or failure in acquiring skilled reading takes place even before they receive formal reading instruction. Many children from high-poverty homes have significantly less well-developed skills in oral language,

phonological awareness, and print knowledge than their peers from higher socioeconomic homes (e.g., Bowey, 1995; Hart & Risley, 1995; Juel, Griffith, & Gough, 1986; Lonigan et al., 1998; MacLean, Bryant, & Bradley, 1987; Raz & Bryant, 1990; Whitehurst, 1996). This slower development of skills in key areas related to success in learning to read puts these children on a path toward early and enduring difficulties in school. Clearly, it is important to continue developing a more complete understanding of the effects of different instructional methods, teacher style, and classroom environments on preschoolers' academic and socio-emotional development. Such an understanding will identify the most appropriate early childhood education practices for different groups of children from different backgrounds and with different skill levels in particular domains. Given the severe negative consequences of early academic difficulties and the increasing importance of literacy and other academic skills, doing the same thing that has been done for the past 40 years is not a viable option. Too many children enter and leave school without the skills necessary to prosper in an increasingly technology-driven and global society. The results of this study point to one potentially successful means of reducing children's risk for later academic difficulties.

Acknowledgements This work was supported by an Interagency Education Research Initiative grant (REC-0128970) to JoAnn M. Farver and Christopher J. Lonigan through the National Science Foundation. The views expressed herein have neither been reviewed nor endorsed by the granting agency. We wish to acknowledge the significant contributions to this project by Stephanie Eppe, Kimberly McDowell, and Patricia Byler, and we thank the teachers, schools, children, and research assistants involved in the project.

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