

Randomized Field Trial of an Early Literacy Curriculum and Instructional Support System¹

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Interest in the readiness of young children for school has increased during the past two decades because of changing social and workplace conditions, an upsurge in the research on the development of young children, and heightened public awareness. Early childhood researchers and educators and education policy makers have sought ways to strengthen knowledge about preschool literacy and interventions that can enhance children's skills.

Recent research findings document significant school readiness differences among children from low-income neighborhoods and their more advantaged peers (Lee & Burkam, 2002; U.S. Department of Education National Center for Education Statistics, 2001). Other studies confirm that if children start school behind, they are likely to remain behind (Juel, 1988; Perie, Moran, & Lutkus, 2005; Snow, Burns, & Griffin, 1998; Thompson & O'Quinn, 2001). It is clear that if we are to close the achievement gap that exists among children in the K-12 system, we must develop and test strategies that address the readiness gap that already exists prior to entry into kindergarten.

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Changes in the workplace have significantly increased the numbers of children under the age of five placed in some type of outside-the-home care (West, Hausken, & Collins, 1993). The quality of that outside-the-home care most often is mediocre and too frequently of such low quality that it is harmful to children's well-being (Cost, Quality and Child Outcomes Study Team, 1995). Concomitantly, studies reveal that children who participate in high-quality early care and learning are more likely to develop better cognitive and language skills, with the strongest effects for children from low-income families and neighborhoods (Barnett, 1995; Currie, 2001; Frank Porter Graham Child Development Institute, ND; Karoly, Greenwood, et al., 1998; Magnuson & Waldfogel, 2005; Peisner-Feinberg & Burchinal, 1997; Schweinhart, Barnes & Weikart, 1993).

However, transforming early care programs into high-quality early care and learning programs presents major challenges. Child care teachers vary greatly in the amount and type of preparation they have, resulting in substantial challenges to move from a custodial mode to one that focuses on high-quality, research-based early learning and care. Limited formal training with minimal licensing requirements characterizes the current child care industry, as does the lack of ongoing research-based professional development opportunities (Clifford, 1999; Cosgrove, 2001; Gilliam & Marchesseault, 2005; Zaslow & Tout, 2002). Moreover, our understanding of how young children acquire emergent literacy skills and other important school readiness skills must be refined (Bowman, Donovan & Burns, 2001; Carnegie Corporation, 1994; Connor & Tiedemann, 2005; Grossen, 1997; McCain & Mustard, 2002; Shonkoff & Phillips, 2000). What we know about the learning capabilities of young children, especially in the area of emergent literacy, is not aligned with current practice.

The *Early Literacy and Learning Model (ELLM)*, a research- and standards-based early literacy curriculum and instructional support system, was developed to address many of these issues. This paper presents the results of an investigation using data collected in a complementary study, part of the longitudinal study of the U.S. Department of Education Institute of Education Services *Preschool Curriculum Evaluation Research (PCER)* program. This study was designed to determine if *ELLM* is more effective than traditional approaches in improving the emergent literacy abilities of 4-year-old preschool children from low-income neighborhoods using a random clinical trial design in multiple settings.

ELLM Program Theory

ELLM consists of five interconnected facets, each grounded in current research. Each facet addresses challenges we face in improving the quality of children's early literacy experiences, particularly those of children from low-income neighborhoods. The first facet is an early literacy *classroom curriculum* aligned with rigorous standards. The curriculum content domains were selected based on early literacy research and provide clear guidelines for expected child outcomes and daily literacy activities. Teachers receive materials and resources to support classroom implementation of the literacy activities. The second facet is *family involvement* that includes explicit strategies to link families with activities taking place in the classroom. Families are provided resources to encourage them to talk and read with their children. The third facet is an *instructional support system* for professional development that is focused on instruction and child learning. *ELLM* includes explicit coaching for teachers, with literacy coaches interacting weekly with teachers in their classrooms, and a training and support system for the literacy coaches. This component is designed to build capacity and effectiveness of both teachers and

coaches. *Working partnerships*, the fourth facet, strengthen collaboration among teachers and families and among practitioners and researchers. Partner organizations provide support for classroom implementation, problem-solving, and family involvement. Finally, *ELLM* includes an *ongoing evaluation research agenda* that encourages teachers and coaches to refine current practices, use rigorous research-based criteria to identify alternatives, assess the impact of strategies and materials on children's early literacy achievement, and use results to guide instruction and inform action. The facets of *ELLM* and their interrelationships are depicted in the concept map in Appendix A.

The facets and relationships are articulated in the *ELLM* theory-of-action. A key assumption for the design of *ELLM* is that improving children's performance requires changing environmental, curricular, instructional, and assessment quality. *ELLM* incorporates an evidence-based early literacy curriculum and an instructional support system for preschool classroom teachers and the children and families with whom they work. The next two sections of the paper will provide a detailed description of these two facets and the research bases that support each, as these are the school facets that are most likely to impact children's learning. The third section of the paper describes the study, using a random clinical trial design in multiple settings, to determine if *ELLM* is more effective than traditional approaches in improving the emergent literacy abilities of 4-year-old preschool children from low-income neighborhoods. The final section of the paper presents a discussion of the findings and conclusions from the study.

ELLM Early Literacy Classroom Curriculum

The *ELLM* curriculum consists of learning materials and strategies that classroom teachers use for at least one hour each day to provide emergent literacy experiences and help

children acquire literacy skills. The experiences include oral language, listening, and vocabulary development activities; reading aloud and emergent comprehension activities; and independent reading activities. Literacy skills include letter and sound knowledge, print concepts, phonological awareness and the phonics connection, and emergent writing. The curriculum is supported by instructional materials and strategies based on research and performance standards.

Print-rich environments are fundamental to all of these experiences and skills. Research confirms the importance of a print-rich environment on children's emergent literacy development (Pressley, Rankin, & Yokoi, 1996; Taylor, Pearson, Clark, & Walpole, 1999; Wade & Moje, 2000). Teachers who support young children's exploration and experimentation with written language provide many opportunities for the children to observe and respond to written language. In print-rich environments, young children explore written language by looking at and pointing to written symbols rather than pictures, pretending to read familiar books aloud, pretending to write lists, pretending to read catalogs, recipes cards, and order forms, and identifying familiar signs. As a result of these experiences, children broaden their consciousness of written symbols and recognize the connection between speaking and writing. In *ELLM* classrooms teachers operationalize "print-richness" by labeling furniture, providing space and supplies for early writing experiences, and flooding classrooms with shape and alphabet posters, charts, print books, audio books, magazines, picture and word walls, storytelling props, flannel boards, manipulative letters, and letter stamps. Classrooms include books in many genres, including narratives, stories, and informational texts.

ELLM Emergent Literacy Experiences

Oral language provides children with an opportunity to understand how to access their knowledge in ways that will help them understand words in context (Watson, 2003). Acquisition of oral vocabulary occurs naturally, but vocabulary size varies among children. Vocabulary is influenced by children's environments, and children who have greater vocabularies and greater understanding of their spoken language possess higher reading scores (Whitehurst & Lonigan, 2001). *ELLM* teachers use several strategies to teach vocabulary including the concept wheel, list-group-label, text talk, picture walk, and word walls. Teachers present words that are meaningful to children and provide context clues rather than teaching words in isolation. Whenever possible, teachers attach pictures to words to provide children a visual reminder of the word. Children see and use the targeted words daily.

Children's oral language experiences can be expanded through deliberate instruction (Beck & McKeown, 1991; Neuman & Dickinson, 2001; Snow et al., 1998; Stahl & Fairbanks, 1986). The *ELLM* oral language experiences include conversation, active engagement, repetition, frequent print exposure, and a variety of vocabulary-related instructional methods. Children's oral language experiences are linked to learning to read, as oral vocabulary is linked to reading vocabulary (Reutzel, Hollingsworth, & Eldridge, 1994; Snow et al., 1998; Snow & Tabors, 1993).

Because listening is the source of early decoding skills, it serves as a foundation for reading. Listening involves the ability to attend to directions, connect sounds to letters, recognize patterns in rhyming words, process the meaning of information, store information in long-term memory, and act on information received. Reading aloud is critical for building language knowledge; providing opportunities for listening, interpreting, and discussing text relationships;

increasing word recognition, fluency, and conceptual understanding; and providing opportunities to learn words that are not routinely spoken (DeBruin-Parecki, Paris, & Siedenburg, 1997; Morrow, Strickland, & Woo, 1998; Whitehurst & Lonigan, 1998). Reading aloud to children enriches children's background knowledge, develops vocabulary and comprehension, and increases interest in reading and writing (National Reading Panel, 2000). Four times each day *ELLM* teachers read aloud to their children from high-quality books and then engage them in literacy skills and experiences that link to and extend understanding of books and language. During these short, scheduled reading episodes, *ELLM* teachers draw attention to unfamiliar words and discuss and explain parts of the story that might be confusing for the children. Dialogic reading actively involves the children as the teacher poses questions to the children, asks children to describe the pictures, and extends the story through discussion that make reading more interactive (Snow et al., 1998; Whitehurst & Lonigan, 2001).

Independent reading for young children includes activities such as pretending to read and reading environmental print. This early modeling of reading and practicing provides children experiences with books that help them to develop understanding of the functions of print (Purcell-Gates, 1996; Teale, Farr, & Sulzby, 1986). The *ELLM* curriculum includes emergent reading experiences, including reading independently, as strategies to increase children's experiences of handling books and learning the functions of print.

ELLM Emergent Literacy Skills

Letter and sound knowledge is a key component of early literacy. In fact, the single best predictor of future reading achievement is the child's knowledge of and ability to recognize and name the upper- and lowercase letters of the alphabet (Adams, 1995; Honig, 2001; Riley, 1996;

Stahl, 1997). A child with fluid recognition of letters will find learning about letter sounds and word spellings easier than a child who lacks this skill (Wood & McLemore, 2001). Whitehurst and Lonigan (2001) reported that interventions which include both sound and letter knowledge training produce stronger effects on reading skills than either sound or letter knowledge alone. Knowledge of letters precedes children learning to match phonemes and graphemes (Byrne, 1998).

Children must develop the ability to name letters, that is, to recognize specific letters and assign a name to the letter based on the unique features of its shape and form. The first letters children learn are the letters in their first names. Because letter naming is necessary but not sufficient for reading and writing, intentional instruction in letter sound recognition, letter sound recall, and letter reproduction is critical in the classroom. For development of letter sound recognition, children listen to a sound and then identify a visual representation of that sound. This process requires the auditory sense, a matching mental process, and then the use of visual abilities to identify the letter symbol. Letter sound recall is more difficult (Dodd and Carr, 2003). This process requires the child to use the visual sense to see the letter and mentally process this symbol in an attempt to identify and match the visual representation with the sound of one of the many sounds stored in the brain. After mentally locating the correct sound, the child will produce an auditory representation (Berko Gleason, 1997). Letter reproduction is a process of hearing the letter sound and mentally processing this sound in an attempt to identify a mental sound. In doing so, the children may repeat the sound. After identifying this sound, the children seek a graphic mental representation for a symbol and produce the symbol (Duncan & Seymour, 2000). At this point the alphabetic code has been realized. Some children attempt to use sounds

to formulate words, while other children attempt to combine the use of letter names and letter sounds to formulate words (Foulin, 2005).

Phonological awareness is also a predictor of reading success and is a critical ingredient in learning to read and spell words (Gunning, 2000; Juel, 1994; Snow et al., 1998). Phonological awareness and the phonics connection begin to develop over the preschool years as children learn the letters of the alphabet, attend to the sounds of words, and begin to connect the letters with the sounds they hear. When developing phonological awareness skills, children become aware of syllables in words and the different sounds in words. They also separate words into syllables and are able to hear initial and final sounds. Children then become able to combine consonants to create new sounds and to hear and discriminate rhymes. Explicit instruction in phonological awareness decreases the incidence of reading failure (Adams, 1995; Snow et al.; Stanovich, 1993). Each day *ELLM* children engage in explicitly taught phonological awareness activities.

Print awareness is the third emergent literacy skill emphasized in *ELLM*. Many children from low-income neighborhoods begin school with few of the print awareness and emergent writing experiences that are critical to school success (Clarke, 1988; Clay, 1991; Torgeson & Davis, 1996; Whitehurst & Lonigan, 2001). To compensate for the lack of these experiences, print-rich environments that foster children's meaningful interactions with print and understanding of the purposes and conventions of print are an integral part of the *ELLM* environment. *ELLM* teachers also help children develop print awareness skills through emergent writing, beginning with drawing and scribbling and inventive spelling experiences.

Instructional Materials and Resources

Within ELLM classrooms, whole-group literacy instruction is extended in learning centers. Literacy centers offer children multiple opportunities to explore, practice, and build understanding of skills learned in whole-group instruction. During center time, children work in small groups and use their language skills to describe, explain, and inquire. The learning centers used in *ELLM* classrooms include the listening center, letter center, and writing center. At the listening center, children listen to familiar books and songs on tape. In the letter center children manipulate shapes and letters using sorting trays and simple shape and letter board games. In the writing center children use various writing instruments to draw and form shapes, letters, and words. As children work in the literacy centers, the *ELLM* teacher is stationed at a “teaching table” where individual and small-group instruction continues.

Extensive *ELLM* materials and instructional strategies support the implementation of the curriculum and the instructional support infrastructure. Literacy performance standards identify the intended outcomes. Monthly literacy packets and accompanying books support classroom instruction. Teachers receive several resource guides that include materials such as phonological awareness learning activities, suggestions for developing and using word walls, and alphabet and thematic songs and poems. *ELLM* families have access to many resources, including a classroom book lending library that enables children to take home books daily to share with their parents; monthly family tips and literacy calendars, suggesting literacy activities families can do with children; and opportunities to engage in activities with other families throughout the year.

Literacy coaches provide weekly one-hour training for teachers designed to enhance the learning processes through more effective instructional practices. For example, coaches help teachers use children’s ability to identify the letters of the alphabet to focus instruction on the

needs of the children. Children having difficulty learning the letters receive small-group instruction for letter and sound knowledge and participate in small-group phonological awareness activities. The instructional support system of *ELLM* is described more extensively in the section that follows.

ELLM Instructional Support System

The goal of the *ELLM* instructional support system is to increase literacy achievement and school readiness of young children by enhancing teacher behavior through research-based practices. The instructional support system involves two programs. One program supports the development of teachers, many of whom are inexperienced, non-degreed, and uncredentialed or are fully qualified but resistant to change. The other supports the development of coaches who work with the teachers. Both programs are grounded in the concept of continuous improvement, which has roots in Total Quality Management (Mahoney & Thor, 1994). The instructional support system was developed and has been frequently modified using several knowledge bases. Standards for professional development informed development of the system (National Association for the Education of Young Children, 2001; National Board for Professional Teaching Standards, 2001; National Staff Development Council, 2001). Additional knowledge bases include research and theory on effective professional development design (Garet, Birman, Porter, Desimone, & Herman, 1999; Reitzug, 2002); coaching and learning science research (International Reading Association, 2004; Walpole & McKennan, 2004); novice-to-expert studies (Berliner, 1988; Sternberg & Horvath, 1995); and leadership research (Leithwood, Louis, Anderson, & Wahlstrom, 2004). The early literacy and learning literature (e.g., Adams, 1995;

Allington, 1998, 2001; Allington & Woodside-Jiron, 1999; National Reading Panel, 2000; Snow et al., 1998) was used to define the content knowledge included.

ELLM Professional Development

The ELLM instructional support system is grounded in the research identifying critical elements of professional development: for example, effective professional development is job-embedded and collaborative; provides opportunities for sharing among teachers; focuses on instruction and learning; extends over a long period of time; and is supported through intensive and ongoing assistance (Loucks-Horsley, Hewson, Love, & Stiles, 1998; Reitzug, 2002; U.S. Department of Education, 1998).

Professional development for prekindergarten and child care teachers begins with a two-day intensive summer training session highlighting the content and strategies teachers are expected to know and be able to do. During this training teachers learn the components that make up *ELLM*, review the research supporting each component, and participate in demonstrations. After school begins, teachers receive weekly follow-up training and support from a literacy coach who demonstrates, observes, provides feedback, and answers implementation questions in one-hour weekly visits. Teachers receive learning materials and strategies designed to help them focus instruction on children's emergent literacy skills and to increase children's literacy experiences. Teacher networking activities provide opportunities for teachers to continue to develop knowledge and skills through information sharing and problem-solving. Monthly site-based literacy team meetings and quarterly regional teacher gatherings support reflection and new learning.

Through review of the research, *ELLM* developers delineated four critical strategic components used to define what coaches do to effect teacher change and consequently improve student achievement. Coaches must have knowledge of (1) early literacy content, and demonstrate skill in (2) planning, (3) implementing the coaching cycle, and (4) influencing teacher behavior. Within each of these components are specific competencies. These competencies support the components, which in turn define what coaches need to know and be able to do.

Professional development for the literacy coaches begins with an intensive five-day summer institute designed to develop knowledge of literacy as well as coaching skills and strategies with the guidance of *ELLM* consultants. Weekly coaching seminars build on the summer institute and further develop coaching expertise. In these seminars the coaches share successes and concerns, become more familiar with literacy research, and identify and seek to solve barriers to implementation. *ELLM* consultants provide individual technical assistance to coaches in implementing and assessing the effectiveness of site-based activities. Consultants visit sites, observe coaches, provide support, assist in solving implementation problems, and develop the coach's capacity and confidence to promote change in instruction.

The *ELLM* Coaching Cycle

The *ELLM* coaching cycle addresses effective teaching skills and behaviors for each of the literacy components. The cycle begins with the coach modeling a lesson and ends with the teacher assimilating critical behaviors into daily practice. Each cycle is designed to increase the effectiveness of teacher instruction. Modeling and practice are conducted in both whole- and small-group settings.

During the first phase of the cycle, the coach models the lesson, demonstrating desired instructional behaviors as the teacher observes and conducts a written analysis of the critical behaviors taught during the lesson. A feedback and reflection conference follows the lesson. The coach and teacher meet to discuss the effectiveness of the lesson and plan for the next coaching cycle. In this cycle, the teacher implements the lesson and the coach observes the teacher and conducts a written analysis of the critical behaviors of the teacher's instruction. A feedback and reflection conference follows. The coach and teacher assess the effectiveness of the lesson and plan for the next coaching cycle, which may be conducted by the coach or the teacher. As the cycle continues, additional modeling by the coach and practice by the teacher are provided. Critical behaviors taught during the lesson are specified in advance and analyzed during delivery. This analysis is the focus of the feedback and reflection conference. Again, feedback and reflection occur to determine the effectiveness of the lesson and answer three questions: What worked? What needs to be added? What needs to be extended? As additional help is needed, additional support is provided through abbreviated coaching sessions, teacher observations, or instructional materials.

Research Design and Methodology

In July 2002 *ELLM* became part of a three-year longitudinal study through a *Preschool Curriculum Evaluation Research* (PCER) grant from the U.S. Department of Education Institute of Education Services. Participation in the grant program meant that the efficacy of *ELLM* was tested using randomized clinical trials in multiple settings. *ELLM* researchers longitudinally followed children, their teachers, and their parents for three years. This paper reports the year-one study, which was designed to determine whether participation in *ELLM* resulted in higher

posttest emergent literacy achievement scores for 4-year-old children from low-income neighborhoods than participation in the locally accepted curricula without the *ELLM* intervention.

Sample Description

Preschool children in three geographical locations representing differing degrees of urbanicity within a single southeastern state participated in the study. One location was thinly populated and part of a Metropolitan Statistical Area (MSA) whose principal city had a population of approximately 36,000 in the 2000 census. The second location was intermediately populated and part of an MSA whose principal city had a population of approximately 1,100,000. The third location was heavily populated and part of a Principal Metropolitan Statistical Area (PMSA) whose principal city had a population of approximately 2,253,000. Low-performing elementary schools housing at least one early intervention pre-kindergarten class were identified in each of the three locations and randomly assigned to either *ELLM* or wait-list control status. Additionally, two Head Start and two subsidized sites were randomly selected in the neighborhood of each elementary school. One class from each site was randomly selected to participate. Demographic profiles of the three locations are provided in Table 1.

Table 1

Demographic Profiles of ELLM Field Test Locations

Location	Population	# of Classes	# of Children	% White	% Black	% Hispanic/ Latino
MSA A	36,000	10	93	53	36	1
MSA B	1,100,000	10	93	1	98	1
PMSA	2,253,000	28	280	2	73	12

Within the classes, the *ELLM* literacy curriculum was used in combination with the existing comprehensive curricula. The prevalent comprehensive curricula used in both *ELLM* and wait-list control classes were *Creative Curriculum*, *High/Scope*, and *High Reach*. Children who were four years old on or before September 1 of the school year were assessed.

A self-reported teacher survey included demographic information about the classroom teachers, including their ages, ethnicity, number of years of experience with young children, number of years in their present positions, and their levels of education. The age range of the *ELLM* and wait-list control teachers was similar, with the average age of both groups about 45 years. Sixty-three percent of the teachers were Black, but there were more White and Hispanic teachers among the control teachers than the *ELLM* teachers. The typical teacher in both groups reported about 14 years' experience working with young children. Most of the teachers in both groups had less than three and a half years' experience in their current position. Sixty-seven percent of the control teachers and about 40% of the *ELLM* teachers had at least a two-year associate's degree. Overall, the control teachers had a higher level of education than the *ELLM* teachers. Four teachers in each group had master's degrees.

Study Measures

Data were collected on the children's ability to recognize the 52 upper- and lowercase letters of the alphabet, and their early literacy abilities were measured by the *Test of Early Reading Ability-Third Edition, Form A*. The TERA-3 is composed of three scales measuring unique but related early literacy skills. According to the *TERA-3 Examiner's Manual* (Reid, Hresko, & Hammill, 2000), the Alphabet scale measures graphophonic knowledge, the Conventions of Print scale measures knowledge of conventions of English print, and the

Meaning scale measures ability to comprehend meaning of print. The Reading Quotient score is the unweighted sum of the three scales. Items within each scale are arranged by difficulty, and each scale has a stopping mechanism and a method for determining the correct basal. However, all children began testing with the first item in each scale, and the correct basal and scores were determined using a computer program. Published validity and reliability information presented in the *TERA-3 Examiner's Manual* indicates Cronbach's Alpha coefficients of internal consistency for 4-year-old children for the Reading Quotient and the Alphabet, Conventions, and Meaning subtests are .97, .94, .88, and .94 respectively. Alpha coefficients for the 5-year-old children were comparable. TERA-3 Reading Quotient scores are reported as norm-referenced, standardized scores with a mean of 100 and a standard deviation of 15. The TERA-3 scale scores are reported as norm-referenced, standardized scores with a mean of 10 and a standard deviation of three. Because the scores represent the ranking of scores relative to a national normative population, a change in scores represents a change in ranking relative to a normative population.

The Alphabet Letter Recognition Inventory (ALRI) is a locally developed inventory of children's ability to recognize the upper- and lowercase letters of the alphabet. Trained assessors presented uppercase letter flashcards, arranged in a fixed non-alphabetic order, to each child. The child was asked to name the letter. Following presentation of the uppercase letters, lowercase letter flashcards were presented in a similar fashion. The children's responses were recorded on scannable forms and computer scored.

Though data were collected in the study about teachers, families, and children, the children's results were the focus of this study.

Results

Attrition occurred at both the site and child levels. One wait-list control and one *ELLM* classroom in the PMSA were withdrawn from the study and are not included in Table 1. In the 48 remaining classrooms, child-level attrition occurred, and 21% of the remaining children with pretest scores were unavailable for posttesting. Comparison of the TERA-3 mean pretest scores of children with both pretest and posttest scores to those of the children with only pretest scores provided no evidence of systematic attrition.

Verification of the Randomized Design

Pretest data were collected during October and November 2002, and posttest data were collected during May 2003. Mean scores for the *ELLM* and the wait-list control groups are reported in Table 2.

Table 2

Summary Statistics of TERA-3 Scores of ELLM and Wait-List Control Children with Complete Scores

	Time	ELLM (n=222) Mean Scores	W-L Control (n=244) Mean Scores
TERA-3 Reading Quotient	Pretest	84.62	84.73
	Posttest	91.81	88.76
TERA-3 Alphabet	Pretest	7.80	7.98
	Posttest	9.92	9.29
TERA-3 Conventions of Print	Pretest	7.16	7.33
	Posttest	7.72	7.48
TERA-3 Meaning	Pretest	7.86	7.57
	Posttest	8.55	7.98
ALRI	Pretest	15.55	17.97
	Posttest	33.58	31.64

The TERA-3 mean pretest scores for the children in the *ELLM* classrooms and those of the children in wait-list control classrooms with complete data were compared to verify the

randomization of the design. No statistically significant differences in the mean pretest scores of the children were found.

Hierarchical Linear Model Analysis of Year 1 Treatment Effects

Examination of the TERA-3 and ALRI posttest scores indicated that those of the *ELLM* children were higher than those of the wait-list control children on all measures. Hierarchical linear modeling (HLM) was used to test the statistical significance of these observed differences because children experienced *ELLM* together in classes rather than in one-on-one settings (Raudenbush & Bryk, 2001). HLM allows this shared learning to be modeled in data analyses. Modeling was done using SAS Release 9.1 and the Proc Mixed procedure. Child-level variables included in the analyses were the TERA-3 pretest standardized scores, the ALRI pretest scores, the child's age in months on September 1, 2002, and gender. All continuous variables were grand-mean centered. Class-level variables included in the analyses were class assignment as *ELLM* or wait-list control, urbanicity, and educational attainment of the teacher (coded as either having completed a bachelor's degree or not). The child-level and classroom-level models are described in Figure 1. Results of the analysis are reported in Table 3 and Table 4.

Figure 1 *Child- and Class-Level HLM Models*

Child-Level Model:

$$Y_{ij} = \beta_{0j} + \beta_{1j} \left(\text{Pretest}_{ij} - \overline{\text{Pretest}_{..}} \right) + \beta_{2j} \left(\text{ALRI Pretest}_{ij} - \overline{\text{ALRI Pretest}_{..}} \right) + \beta_{3j} \left(\text{Age}_{ij} - \overline{\text{Age}_{..}} \right) + \beta_{4j} \left(\text{Gender}_{ij} \right) + r_{ij}$$

Class-Level Model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} \left(\text{Status}_j \right) + \gamma_{02} \left(\text{Area}_j \right) + \gamma_{03} \left(\text{Education}_j \right) + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + u_{1j}$$

where

Y_{ij} is the TERA-3 posttest score of the i^{th} child in the j^{th} class and for

$i = 1, L$, 466 children and $j = 1, L$, 48 classes (and $i = 1, L$, 118 children and $j = 1, L$, 45 classes for the most at-risk children).

β_{0j} is the intercept for class j .

β_{1j} is the fixed or random slope of the child-level pretest effect for class j .

Table 3

HLM ANCOVA Models of TERA-3 Scores Using TERA-3 and ALRI Pretests, Age, Area, Gender, and Teacher's Level of Education as Covariates

		TERA-3 Literacy Outcomes											
	<i>Fixed Effects</i>	Reading Quotient			Alphabet			Conventions of Print			Meaning		
		<i>Effect</i>	<i>SE</i>	<i>t</i>	<i>Effect</i>	<i>SE</i>	<i>t</i>	<i>Effect</i>	<i>SE</i>	<i>t</i>	<i>Effect</i>	<i>SE</i>	<i>t</i>
Child	Intercept	91.60	1.25	73.2**	10.02	0.32	31.7**	7.64	0.22	35.6**	8.30	0.21	40.3**
	TERA-3	0.44	0.05	8.4**	0.18	0.07	2.8**	0.31	0.06	5.5**	0.26	0.04	6.0**
	Pretest												
	ALRI	0.28	0.04	7.4**	0.11	0.01	9.3**	0.04	0.01	6.6**	0.03	0.01	5.7**
	Pretest												
	Gender	2.16	0.85	2.6*	0.54	0.23	2.4*	0.40	0.18	2.2*	0.24	0.16	1.6
Class	Age	-1.01	0.12	-8.6**	-0.19	0.03	-5.8**	-0.19	0.02	-7.6**	-0.15	0.02	-7.1**
	ELLM/Con	3.80	1.19	3.2**	0.98	0.30	3.3**	0.40	0.20	2.2*	0.58	0.19	3.1**
	Area	-	-	NS F	-	-	NS F	-	-	S F	-	-	S F
	Education	-2.06	1.28	-1.6	-0.41	0.32	-1.3	-0.47	0.22	-2.2**	-0.17	0.21	-0.8
	<i>Random Effects</i>	<i>Estimate</i>			<i>Estimate</i>			<i>Estimate</i>			<i>Estimate</i>		
	Child	78.557			4.255			3.657			2.633		
	Variance												
	Class	7.332			0.120			0.086			0.191		
	Variance												
	Slope	-						0.003			0.026		
	Variance												
		<i>Estimate</i>			<i>Estimate</i>			<i>Estimate</i>			<i>Estimate</i>		
		<i>Effect Size</i>											
		0.28			0.28			0.17			0.29		

Note: + $p < .10$; * $p < .05$; ** $p < .01$

NS F is a non-significant F test; S F is a significant F test; $\alpha = .05$

N=466 scores nested in 48 classes

Table 4

HLM ANCOVA Models of ALRI Scores Using ALRI Pretests, Age, Area, Gender, and Teacher's Level of Education as Covariates

		ALRI		
	Fixed Effects	Effect	SE	t
Child	Intercept	34.08	1.99	17.2**
	ALRI Pretest	0.69	0.03	20.0**
	Gender	3.05	1.06	2.9**
	Age	0.41	0.14	2.8**
Class	ELLM/Con	4.41	1.91	2.3*
	Area	-	-	NS F
	Education	-0.84	2.07	-0.4
<i>Random Effects</i>		<i>Estimate</i>		
Child Variance		120.80		
Class Variance		2.84		
<i>Effect Size</i>		0.25		

Note: + p<.10; * p<.05; ** p<.01

NS F is a non-significant F test; S F is a significant F test; $\alpha=.05$

N=459 scores nested in 48 classes

The child-level variables were statistically significant predictors in all of the analyses except for the child's gender in the Analysis of the Meaning scale. In all cases, older children scored at lower posttest levels than younger children, and, where gender was significant, boys achieved at lower levels than girls. These findings were the same for children in the *ELLM* and wait-list control classrooms. At the class level, only assignment to *ELLM* or wait-list control classes was a statistically significant predictor in all analyses. The educational attainment of the classroom teacher was a statistically significant predictor only in the analysis of the Conventions of Print scale, and for this analysis, children who were taught by bachelor-degreed teachers achieved at higher levels in both the *ELLM* and wait-list control classrooms.

Analyses indicated that *ELLM* was more effective than traditional approaches in raising the emergent literacy achievement of children. As measured by all TERA-3 scales, the children experiencing the *ELLM* literacy curriculum and instruction support system achieved higher adjusted mean posttest levels of emergent literacy skills than children in the wait-list control classrooms. With the exception of the differences in the TERA-3 Conventions of Print scale adjusted mean posttest scores, resulting effect sizes were 25 percent of a standard deviation or larger. Cohen (1988) classified effect sizes of 20 to 50 percent of a standard deviation as small, differences between 50 and 79 percent as medium, and differences of 80 percent or higher as large.

These results using the PCER complementary data support historic evaluations which had demonstrated that the ranking of the scores of *ELLM* children improved in comparison to the ranking of the TERA-3 normative population over the academic year.

Discussion

Apart from the primary findings of the study, exploratory analysis of the data indicated issues that merit further consideration. First, the results are consistent with the common assertion that alphabet knowledge is fundamental to early literacy. Table 5 shows the ALRI pretest scores and the Reading Quotation posttest scores for *ELLM* and wait-list control children in the bottom, middle two, and top quartiles of the score distribution. Children in the bottom quartile demonstrated substantially lower initial alphabet recognition than children in the other quartiles. For example, children at the bottom quartile in the *ELLM* classrooms recognized 7.8 letters on average at the time of the pretest, and children at the bottom quartile in the wait-list control classrooms recognized only 11.2 letters. By contrast, children at the top quartile in the *ELLM* classrooms recognized 36.6 letters at the time of the pretest, children at the top quartile in the wait-list control classrooms recognized 42.3. This supports the need to focus on alphabet recognition as a primary component of early literacy development.

Table 5

Letter Recognition as a Predictor of Early Literacy

<u>Quartile</u>	<u>Test</u>	<u>ELLM</u>		<u>Control</u>	
		<u>Mean</u>	<u>Percent</u>	<u>Mean</u>	<u>Percent</u>
Bottom	RQ (Posttest)	79.9	46.8	79.7	57.8
	ALRI (Pretest)	7.8		11.2	
Second & Third	RQ (Posttest)	98.8	42.8	98.6	36.1
	ALRI (Pretest)	18.9		24.8	
Top	RQ (Posttest)	116.7	10.4	116.9	6.1
	ALRI (Pretest)	36.6		42.3	

Note: RQ is the TERA-3 Reading Quotient Score.

A second issue warranting further research concerns describing the children whose achievement scores are most likely to place them in the bottom quartile of early literacy measures. Table 6 summarizes the results from this study for the Reading Quotient measure.

Table 6

TERA-3 Reading Quotient Quartiles by Gender and Age

Quartile	% Older than 55 Month On September 1, 2002	% Boys
Bottom	54	58
Second & Third	38	45
Top	13	29

As indicated in the table, older children and boys were overrepresented among the lowest-performing children. This suggests that boys and older children warrant special consideration in efforts to address deficiencies in early learning. Targeted curriculum materials and instructional techniques most effective with boys and older children, in conjunction with additional learning opportunities, may be appropriate strategies for addressing the needs of the children whose achievement is the lowest.

The third issue concerns the educational background of the teachers. *ELLM* was developed in part to support early childhood teachers who lack credentials and baccalaureate degrees and experienced teachers with credentials and degrees whose preparation may not have included extensive focus on early literacy. The HLM analysis (see Tables 3 and 4) indicated education of the teacher was a predictor of student achievement only on the Conventions of Print measure. However, examination of the gains of children from pretest to posttest in *ELLM* and control classrooms indicated that children taught by *ELLM* teachers lacking four-year degrees had gains consistently higher than children in the wait-list control classrooms, regardless of whether the control classes were taught by teachers with or lacking a four-year degree. (See Table 7.) In fact, the gain scores for students taught by *ELLM* non-degreed teachers were higher than those of the children taught by the *ELLM* degreed teachers on two of the five measures. This

suggests that *ELLM* is successful in addressing the preparation deficiencies of early childhood and child care educators, though the issue merits further study.

Table 7

Children's Gains on All Measures and Teacher Degree Status

		ELLM				Control			
		Less Than 4-Year Degreed		At Least 4-Year Degreed		Less Than 4-Year Degreed		At Least 4-Year Degreed	
Test	Time	Mean	Difference	Mean	Difference	Mean	Difference	Mean	Difference
RQ	Fall	84.58		84.68		85.67		83.61	
	Spring	90.68	6.10	93.47	8.79	89.11	3.44	88.34	4.73
ALP	Fall	7.59		8.10		8.13		7.80	
	Spring	9.44	1.85	10.62	2.52	9.42	1.29	9.14	1.34
CONV	Fall	7.39		6.82		7.37		7.27	
	Spring	7.62	0.23	7.87	1.05	7.48	0.11	7.48	0.21
MEAN	Fall	7.82		7.93		7.81		7.28	
	Spring	8.60	0.78	8.47	0.54	8.00	0.19	7.95	0.67
ALRI	Fall	13.71		18.23		19.77		15.83	
	Spring	31.95	18.24	35.92	17.69	32.23	12.46	30.92	15.09

Note: RQ, ALP, CONV, and MEAN are the TERA-3 Reading Quotient, Alphabet, Conventions of Print, and Meaning scale scores, respectively.

Limitations of the study also need to be acknowledged. *ELLM* is a coherent system for addressing early literacy for children living in low-income neighborhoods. It was developed with five interconnected facets. Particular attention was paid to the design of the curriculum and the instructional support system in this paper, but we did not in this study test claims about which of the five facets, if any, is more important for supporting the development of early literacy in children. Generalizations from the study are also limited by the sample composition, the location of the study at three sites within a single state, and the fact that wait-list control classrooms were not absent attention to early literacy during this time period. Both *ELLM* and wait-list control classrooms used comprehensive curricula that included the elements of early literacy to some

degree. We could only test whether *ELLM* added value to what was already present. This study included no measures of curriculum implementation in either the *ELLM* or control classrooms.

Additional research should address, in particular, the degree to which coaching is effective as an element of early literacy program design. Research from the elementary and secondary levels of education is compelling, but comparable research has not been done in early childhood education. Moreover, we need to fine tune what we know about the coaching process. If coaching is effective, as we think it is, what aspects of coaching are essential? How should coaches be prepared for their roles and responsibilities? How long should coaching last? How intense should it be? How should coaching roles change as teachers develop more proficiency? These and other similar questions need to be addressed.

The study did establish the feasibility of using true experimental designs in field tests of early literacy models. The results from this study confirmed the results of earlier, less rigorous studies. Whether the costs of clinical field trials in real dollars and human resources are balanced by the confidence we can place in the results is an unanswered question.

Educational and Scientific Importance

As evidence grows that it is possible to improve the quality of early learning services for children from low-income neighborhoods and assure development of the knowledge and skills children need to be successful learners, we must begin to think about bringing these changes in practice to scale. Just as we have developed models for building and sustaining the physical infrastructure for communities, we must develop infrastructure models to develop learning cultures that begin before children enter formal schooling. Possibilities include strengthening early care and learning providers (private, public, and not-for-profit), leveraging community

resources through partnerships and linkages, inventing new organizational structures and delivery systems, and fostering more supportive public policy agenda.

Several policy issues are relevant. The first is whether high quality in early care and learning programs is a strong value for families, educators, and policy-makers. A second and related issue is how the increased costs of high quality will be supported. Many of the benefits associated with high-quality care and learning programs are future-oriented, but the costs of improving quality are immediate. A third policy issue involves access and equity. Current improvement efforts often focus attention on centers with children in subsidized care. The subsidized child care program was designed to encourage parents to move from welfare and enter the workforce. It is an adult-focused incentive program, not a child-focused early learning program. These two conflicting goals raise questions about how we will address the needs of children from low-income families who are not actively in the workforce or who are on waiting lists for subsidized early care and learning services.

Improving the early literacy of at-risk children holds great promise as a reform strategy for closing the achievement gap between children from lower-income neighborhoods and their peers from more affluent areas. This study, using a randomized field trial design carried out through a partnership between researchers and practitioners, builds credible evidence of effectiveness. Furthermore, the study demonstrates ways in which rigorous research methodology can be successfully paired with practitioners' needs to use data for instructional improvements. The study provides results that answer questions related to changes in student performance, guide the strengthening of instructional efforts and strategies, and provide insights for additional research.

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Appendix A: What is the Early Literacy and Learning Model (ELLM)?

