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Boosting School Readiness with Preschool Curricula

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Abstract

Both federal and state governments regulate the quality and curricula of early childhood education programs in hopes of promoting the school readiness of disadvantaged children. We draw on data from the experimental Preschool Curriculum Evaluation Research Initiative Study to provide an aggregated look at the impacts of four types of preschool curricula (literacy-focused, math-focused, whole-child and locally developed) on classroom processes as well as children's academic and socioemotional outcomes. The math curriculum included in the study boosted both classroom math activities and children's math achievement relative to the two whole-child curricula (HighScope and Creative Curriculum) found in most Head Start and pre-K classrooms. Also relative to HighScope and Creative Curriculum, the literacy curricula increased early literacy achievement despite producing no statistically significant differences in classroom activities or teacher-child interactions. Although Creative Curriculum produced much more positive classroom processes than locally developed curricula, it failed to improve either the academic achievement or behavior of preschool children relative to the local curricula. Implications for Head Start and pre-K curricula choice and the utility of widely used classroom rating scales are discussed.

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INTRODUCTION

The math and literacy skills of low-income children are a full year behind those of high-income children at the time of kindergarten entry, and these gaps do not diminish by the time the children reach eighth grade (Duncan & Murnane, 2014). How can policy reduce this disparity? Some of the most encouraging evidence on the role that early childhood education can play comes from two early childhood education programs that operated decades ago—Abecedarian and Perry Preschool (Belfield, Nores, Barnett, & Schweinhart, 2006; Campbell et al., 2008; Reynolds, Temple, Robertson, & Mann, 2001). Yet few of today's public preschool programs generate impacts that can compare in magnitude to those of Abecedarian and Perry (Yoshikawa et al., 2013).

Federal, state, and local policy efforts use two main levers to improve the effectiveness of public preschool program: funding public preschool programs and creating licensing and monitoring systems. Curricula are key feature of public preschool programs—Head Start and state pre-kindergarten (pre-K)—and monitoring initiatives such as Quality Rating and Improvement Systems (QRIS). Research-based preschool curricula can ensure that children are provided opportunities to learn by guiding the nature of instruction and the availability of materials and activities in the classroom.

Based on a belief that young children learn best from engaging in age-appropriate activities that focus on the whole child, federally-funded Head Start programs must utilize "whole-child" curricula. These emphasize child-centered active learning, cultivated by strategically arranging the classroom environment and encouraging children to interact with the available materials, both alone and through group activities in teacher-supported play (Bredekamp, 1997). The most popular whole-child curricula are the Creative Curriculum for Preschool and HighScope (Clifford et al., 2005; Hulsey et al., 2011). Many state-funded pre-K programs utilize these and similar curricula. To date, there exists no rigorous evidence that these curricula are effective in promoting young children's learning.

Prominent alternatives (or supplements) to whole-child curricular approaches target specific skills, typically literacy or numeracy. In contrast to whole-child curricula, these curricula assume that children benefit most from sequenced, explicit instruction intended to promote skills in a specific content area – typically literacy, math, or socio-emotional skills. Consistent with whole-child approaches, most of these academic-skill curricula include both large and small group activities and also provide opportunities for free play and exploration (Bierman, Domitrovich, et al., 2008; Wasik & Hindman, 2011).

Given the wide array of choices available to policymakers, it is important to determine the comparative effectiveness of different types of curricula in promoting school readiness, a task that few studies have attempted. Our analysis uses data from the Preschool Curriculum Evaluation Research Initiative Study (PCER, 2008), a large multi-site random-assignment experimental study focused on a diverse set of preschool curricula, to investigate whether the type of curricula four-year olds experience differentially affects the development of their math, literacy, and socioemotional skills. Our data also provide a look into the black-box of classroom processes targeted by early childhood education quality assessment initiatives, which enables us to assess whether the curricula impact the nature of classroom activities and the warmth of teacher-child interactions.

We find that the math curriculum included in the study is more effective at boosting both classroom math activities and children's math skills than are the "whole-child" curricula most often used in Head Start and pre-K classrooms (Creative Curriculum and HighScope). Although the literacy curricula have no measureable impact on classroom literacy activities, they are more effective than "whole-child" curricula in increasing early literacy skills.

BACKGROUND

Over the past 40 years, evidence of the long-term individual and societal benefits of early childhood programs has shifted U.S. public opinion and policy toward investments in public preschool programs (Barnett, 1995; Warner, 2007). Federal spending on Head Start and the Child Care Development Fund, the federal government's two largest child development programs, totaled $14.7 billion in 2012 (Isaacs, Edelstein, Hahn, Toran, & Steuerle, 2013), with states spending an additional $5.5 billion on programs like universal pre-K (Barnett, Carolan, Squires, & Brown, 2013). In addition to funding programs such as Head Start or state-run pre-K, federal, state and local policy can influence the effectiveness of preschool programs through two main levers: prescribing curricula, and regulating and monitoring classroom processes and quality.

Curricula

Curricula set goals for the knowledge and skills that children should acquire in an educational setting, and support educators' plans for providing the day-to-day learning experiences to cultivate those skills, such as daily lesson plans, materials, and other pedagogical tools (Barnett, 2011; Gilliam & Zigler, 2004; Gormley, 2007; Ritchie & Willer, 2008; Weiland & Yoshikawa, 2013). Most preschool curricula are created by educational researchers and practitioners and then sold to programs by publishers.

Curricula differ across a number of dimensions: philosophies, materials, the role of the teacher, pedagogy or modality (e.g., small or large group setting), classroom design, and child assessment. Preschool programs typically choose their own curriculum, but their choices are often constrained by a pre-approved list developed by state agencies and accrediting bodies (Clifford & Crawford, 2009). Implementing a curriculum can be challenging, and programs often must train and mentor teachers to implement the chosen curriculum faithfully. Nonetheless, curricular guidance and restrictions may be an important and relatively efficient policy lever through which states can influence the quality and effectiveness of their preschool programs. Our focus is on the comparative impacts on children's school readiness of "whole-child" curricula and more targeted, skill-specific curricula.

Whole-Child Curricula

Whole-child (sometimes termed "global") curricula emphasize child-centered active learning, cultivated by strategically arranging the classroom environment (DeVries & Kohlberg, 1987; Piaget, 1976; Weikart & Schweinhart, 1987). Rather than explicitly targeting developmental domains (e.g., math skills), they seek to promote learning by encouraging children to interact independently with the equipment, materials, and other children in the classroom environment. The most famous example of a program based on a whole-child curriculum is the Perry Preschool study, which used a version of the HighScope curriculum that was very similar to the one evaluated here (Belfield et al., 2006; Schweinhart, 2005). Whole-child curricula dominate preschool programs, in part because Head Start program standards require centers to adopt them (Advisory Committee on Head Start Research and Evaluation, 2012). In addition, whole-child curricula reflect the standards for early childhood education put forth by the National Association for the Education of Young Children—the leading professional and accrediting organization for early educators (Copple & Bredekamp, 2009).

We focus our empirical work on the two most common whole-child curricula used by Head Start grantees and other preschool programs, Creative Curriculum and HighScope (Clifford et al., 2005). 46% of the teachers responding to the national Head Start Family and Child Experiences Survey utilized Creative Curriculum; 19% utilized HighScope (Hulsey et al., 2011). Since these two whole-child curricula have a similar focus and approach, in this paper we consider them to be functionally equivalent.

The What Works Clearinghouse (WWC) describes Creative Curriculum as "designed to foster development of the whole child through teacher-led, small and large group activities centered around 11 interest areas (blocks, dramatic play, toys and games, art, library, discovery, sand and water, music and movement, cooking, computers, and outdoors). The curriculum provides teachers with details on child development, classroom organization, teaching strategies, and engaging families in the learning process" (U.S. Department of Education, 2013). Creative Curriculum also allows children a large proportion of free-choice time (Fuligni, Howes, Huang, Hong, & Lara-Cinisomo, 2012).

Virtually no rigorous evaluation studies have estimated the impacts of whole-child curricula on children's school readiness (U.S. Department of Education, 2013). In fact, the WWC concludes that only one study of Creative Curriculum meets minimal standards of empirical rigor. That study is based on the same PCER data we use in the current study, and its site-specific results reveal no statistically or substantively significant differences in children's oral language, print knowledge, phonological processing, or math skills between Creative Curriculum and the locally developed curricula in the control condition. While there is evidence supporting the earliest version of the HighScope curriculum from the 1960s Perry Preschool studies, there exist no methodologically strong evaluations of recent versions of the curriculum.

Content-Specific Curricula

Supporters of skill-specific curricula argue that preschool children benefit most from sequenced, explicit instruction focused on specific academic or socioemotional skills and placed in the context of free play and exploration (Wasik & Hindman, 2011). These curricula often supplement a classroom's regular curriculum (e.g., Creative Curriculum or a teacher or locally developed curriculum). Some random-assignment evaluations of content-specific curricula focusing on language, mathematics, and socio-emotional skills find positive impacts on their targeted sets of skills (Bierman, Domitrovich, et al., 2008; Bierman, Nix, Greenberg, Blair, & Domitrovich, 2008; Clements & Sarama, 2008; Diamond, Barnett, Thomas, & Munro, 2007; Fantuzzo, Gadsden, & McDermott, 2011; Klein, Starkey, Clements, Sarama, & Iyer, 2008; Morris et al., 2014). For example, children who received a literacy-targeted curriculum showed improvements in their literacy and language skills (Justice et al., 2010; Lonigan, Farver, Phillips, & Clancy-Menchetti, 2011). Corresponding gains are also observed in the case of a preschool mathematics curriculum, with children in classrooms implementing this curriculum showing larger gains in their math skills compared with children who received business as usual only (i.e., the regular curriculum) (Clements & Sarama, 2007, 2008).

Locally Developed Curricula

Many states allow early childhood education providers to develop their own lesson plans or curricula rather than purchasing a packaged curriculum. These are designed by local districts or teachers themselves, but may incorporate components of various commercial curricula. While not as common as whole-child curricula in public preschool programs, locally or teacher-developed preschool curricula constitute the business as usual conditions in some of the control classrooms in the data we analyze (see below).

Given the large gaps in achievement and behavior between low- and higher-income children at school entry, coupled with the widespread adoption of global curricula such as Creative Curriculum and HighScope, it is of considerable policy interest to determine whether achievement-focused or locally developed curricula systematically outperform the most commonly used preschool curricula – Creative Curriculum and HighScope – across various domains of school readiness. Our article undertakes such a comparison.

Process Regulation and Monitoring

Regulations typically focus on structural and process features of preschool programs, such as ensuring that classrooms meet minimal health and safety standards, setting teacher educational requirements, and monitoring classroom materials and instruction. In their efforts to regulate program quality, all states with the exception of Missouri have either adopted or are in the process of adopting QRIS, which assign star ratings to childcare providers. QRIS development is also a core objective of the federal Race to the Top Early Learning Challenge grant program (Schaack, Tarrant, Boller, & Tout, 2012; Tout et al., 2010).

Ratings are typically based on observational assessments of classroom processes and basic structural information about the program (e.g., teacher credentials, child-teacher ratios). The most widely used QRIS assessments are the Early Childhood Environmental Rating Scale (ECERS) an omnibus rating of classroom quality that assesses student and teacher interactions and the availability of learning materials for children (Harms, Clifford, & Cryer, 1998), and the CLASS, which focuses more attention on teacher-child instruction (Pianta, La Paro, & Hamre, 2008). Some also use the Arnett Caregiver Interaction Scale (Arnett, 1989) which is designed to assess the teacher's responsiveness to the child (Tout et al., 2010).

Nationwide, the average Head Start and pre-K classroom assessments score in the minimal to good range on the ECERS and CLASS—between three and five on the seven point scales (Clifford et al., 2005; Early et al., 2007; Moiduddin, Aikens, Tarullo, West, & Xue, 2012). The most successful pre-K programs (e.g., Boston, Tulsa) have consistently good classroom quality rating scores (around five) and score higher than average on instructional practices, particularly for techniques that engage students (Phillips, Gormley, & Lowenstein, 2009; Weiland & Yoshikawa, 2013).

QRISs have become widespread despite the paucity of methodologically-strong studies linking either their rated quality characteristics or QRIS scores themselves to children's school readiness (Zellman & Perlman, 2008). Non-experimental studies relating classroom quality ratings to growth in child outcomes over the course of the year suggest that the classroom observational measures must be in the good to high range (5-7) to predict children's academic skill growth, and even then the associations are weak. Several studies indicate that increases in rating scales of one standard deviation (sd) are associated with 0.1 to 0.2 sd increases in early literacy or numeracy (Burchinal, Kainz, & Cai, 2011; Burchinal, Vandergrift, Pianta, & Mashburn, 2010; Burchinal et al., 2015; Burchinal, Zaslow, & Tarullo, 2014; Sabol, Hong, Pianta, & Burchinal, 2013).

In one non-experimental study of simulated QRIS impacts, Sabol and colleagues (2013) find a .3 standard deviation (on average) increase in children's academic school readiness between the very highest- and lowest-rated preschool programs as measured by the CLASS interaction subscale (an observational measure and individual component of QRIS); they find no consistent differences in children's school readiness were found between high- and low-rated programs when all components utilized in several state QRIS systems are averaged together.

Weiland and colleagues (2013) find that observational measures of quality are not associated with children's outcomes in Boston's pre-K program, despite the program's overall effectiveness. A recent meta-analysis concludes that ECERS ratings have neither substantively nor statistically significant associations with children's outcomes (Hofer, Gordon, Lambouths, & Rowe, 2014). All told, evidence suggests that even large improvements in the quality ratings of preschool settings attended by low-income children (which would require substantial investments in money and professional time to achieve) would do little to close the school-readiness gap between children raised in high- and low-income families.

By either prescribing curricula or regulating and monitoring early care settings, state and federal policymakers have the opportunity to influence young children's readiness for school. Our analysis sheds light on which of these policy approaches might best promote school readiness among low-income children.

DATA

We draw on data from the Preschool Curriculum Evaluation Research (PCER) Initiative Study (2008). The PCER study, funded by the Institute of Education Sciences, began in 2003 and provided evaluations of 14 early childhood education curricula. A total of 12 grantees were selected to independently evaluate one or more curricula; all used common measures of child outcomes, classroom processes, and implementation quality. The 14 curricula were evaluated at 18 different research locations, and 2,911 children were included in the evaluation. Each of the grantees independently selected their early childhood education centers, conducted random assignment, and managed their own evaluation with assistance from Mathematica and RTI. The level of random assignment differed across grantees, with the majority of grantees randomly assigning whole preschools to the treatment or business as usual comparison conditions and the rest randomly assigning classrooms within preschool centers to treatment or business as usual curricula. The centers included in the PCER study were public preschools, Head Start programs, and private child care; all primarily served children from low-income families.

The analyses in the PCER final report (2008) provide grantee-specific estimates of the standardized outcome differences between designated and counterfactual curricula. Our study pools data from all grantees that implemented: i) a math or literacy curriculum where the comparison condition was Creative Curriculum or HighScope; ii) a literacy curriculum where the comparison condition was a locally developed curriculum (not enough math sites included a locally developed comparison); or iii) the Creative Curriculum where the comparison condition was a locally developed curriculum. Two PCER grantees included Creative Curriculum as the randomly assigned treatment compared with a locally developed control, which serves as our experimental estimate of the business as usual compared with locally developed curricula.

We included curricula that met our coding criteria, described below. These inclusion criteria led us to drop four grantees and a total of 1,070 children from the study: three grantees were omitted because they evaluated a whole-child curriculum other than Creative Curriculum or HighScope (the Wisconsin, Missouri and three Success For All sites), and the other (New Hampshire) evaluated a literacy enhanced version of Creative Curriculum with Creative Curriculum as the comparison condition. Thus, the whole-child curricula included in our study represent the curricula as they are typically implemented (business as usual) in large-scale preschool programs.

Curricula Categories

We coded each of the treatment curricula in the PCER study into four different categories: literacy, mathematics, whole-child, and locally developed. All literacy curricula focused on a literacy domain, which could have included phonological skills, prewriting skills, or any other early literacy skill. The instructional strategies across the literacy curricula differed greatly. Some provided suggested literacy activities and materials; others had scripted curricula, included technology components, and provided teachers with activities for the entire day. The PCER study included only one math-focused preschool curriculum.

Each of the included PCER curricula and its designated category are available in Table 1. Eight language/literacy curricula were examined that varied in terms of content and focus. One curriculum focused solely on language – the Language-Focused Curriculum, and sought to improve language skills through enhancing the language stimulation techniques used in the classroom. The other seven curricula focused primarily on literacy instruction, but varied in terms of structure and sequence. The least structured literacy curriculum appeared to be Bright Beginnings, which focused on child-centered curriculum units. In the middle are Ladders to Literacy and Doors to Discovery, which provided skill-building activities designed to improve language and basic literacy skills. The remaining four curricula were the most structured; explicitly focusing on sequenced instruction in oral language, phonological and phonemic awareness and letter knowledge. The one math curriculum combined Pre-K Mathematics with software from the DLM Early Childhood Express Math to focus on sequenced instruction in numeracy and geometry.

Our "whole-child" category included HighScope and Creative Curriculum, which share a broad focus on developing children's social and academic skills and promoting health and nutrition. Our final category, "locally developed," included curricula that were developed either by teachers in the classrooms or by the local school district, or were a combination of several of these types of curricula. We lack information on the general content of the locally developed curricula used in some of the PCER study control classrooms. However, our data provide some indication of the classroom processes of locally developed curricula with the classroom outcome models presented in the next section. Table 1 and Figure 1 summarize all of the experimental contrasts and sites included in our study, along with other study information explained below.

Brief descriptions of each curriculum and their respective individual evaluation results are available in the PCER final report (2008).

Fidelity of Implementation

The results of most program evaluations depend on the fidelity of program implementation, which, in our case, means the fidelity with which the treatment and business as usual curricula were implemented. Overall ratings of implementation from observers trained for each of the curricula (experimental and control) were reported in PCER (2008) and are included in Table 1. Fidelity ratings ranged from 0-3, with 0 indicating "Not at all," and 3 indicating

"High." Implementation of most curricula, including the business as usual curricula, was judged medium (with a score in the 2.0-2.5 range), and the differences were small (about 0.15 for the literacy versus whole child and about 0.5 for the math versus whole child). As shown in the Table 1, several of the sites had a pilot study year during which the experimental curriculum was implemented, giving teachers an additional year to familiarize themselves with the content and delivery of the material. Tests to determine whether results differed between the pilot and non-pilot year sites are provided in the "Robustness Checks" section. Treatment sites also received additional training and professional support to implement the curricula, whereas control conditions implemented the curricula as usual.

Classroom Process Measures

We use several classroom-level observational measures assessing the quality of the center-based care setting that were included in the PCER study. Reliability, citations, and additional information for each of the process quality measures we use are available in Appendix Table 1.

The most widely known (and widely used in state QRISs) is the *Early Childhood Environment Rating Scale – Revised* (ECERS-R)(Harms et al., 1998). The ECERS–R is an observational tool used by trained observers who conduct interviews with the staff at the center and observe the classroom during a recommended time period of three hours. Classrooms are observed for safety features, teacher-child interactions, and classroom materials, and program staff are interviewed to assess teacher qualifications, ratio of children to adults, and program characteristics. The 43 items included in the measure are divided into seven subscales: 1) Space and Furnishings, 2) Personal Care Routines, 3) Language-Reasoning, 4) Activities, 5) Interaction, 6) Program Structure, and 7) Parents and Staff. Each item is rated on a scale of 1 – 7, with 1 indicating inadequate quality and 7 excellent quality. Previous factor analyses of these items show that two scales exist – an Interactions scale, which focuses on teacher-child interactions, and a Provisions scale, which contains items related to classroom materials and the safety features of the setting (Pianta et al., 2005). ECERS-R observations were conducted in the fall and spring of the 2003-04 preschool year; the spring measure serves as one of our classroom quality outcomes; the fall score is used as one of the control variables in our impact regressions.

The *Arnett Caregiver Interaction Scale* (Arnett, 1989) was designed to measure the caregivers' positive interactions, warmth, sensitivity, and punishment style. It is also used in some state QRISs. Observers rate interactions between the caregivers and the children on 30 items using a four-point scale (1 = not at all true; 4 = very much true). Our analyses use the total score, which is the average of the 30 items, with the negative items reversed. A higher score indicates a more supportive, positive classroom environment. As with the ECERS-R, Arnett observations were conducted in the fall and spring of the 2003-04 preschool year; the spring measure serves as one of our classroom outcomes, and the fall score is used as a control.

The *Teacher Behavior Rating Scale* (TBRS)(Landry, Crawford, Gunnewig, & Swank, 2002) includes four scales that capture the quantity and quality of math and literacy activities conducted in the classroom. Classrooms were observed and assessed by trained observers on the number of math (5 items) and literacy activities present in the classroom (25 items; 4 categories – book reading, print and letter knowledge, oral language use, and written expression). The four literacy categories were averaged together to form one literacy activity measure for each of the quality and quantity scales. The individual literacy and math activities were rated for quality on a four-point scale (0 = activity not present; 3 = activity high quality), as was the quantity of the activity (0 = activity not present; 3 = activity happened often or many times). We combined the quality and quantity scales for literacy to form a literacy activity composite, and combined the math quality and quantity scales to form a math composite, which became our primary outcome measures. We also control for TBRS observation time to account for variation in time spent observing each classroom. The TBRS was administered only in the spring of 2004.

Because each grantee managed the evaluation of its curriculum comparisons, the time between the fall and spring assessments varies. In the fall, the classroom quality assessments were conducted between 2 and 8 weeks after the start of the preschool year, and in the spring 2-15 weeks before the end of the preschool year. To ensure that these differences do not confound the length of the curricular implementation period with classroom quality assessments, we control for elapsed time between fall and spring assessments in all analyses.

Child Outcomes

Children's academic achievement and socioemotional development were assessed using nationally normed measures that are developmentally appropriate for preschool children and frequently used in developmental research. Children were assessed or rated on each of the academic and socioemotional outcomes in the fall and spring of the 2003-04 preschool year. We focus on aggregated measures of math, literacy, and socioemotional skills. Appendix Tables 2 and 3 present the means, standard deviations, and observation counts for all outcomes and covariates by treatment status for all four curricula comparison groups in Table 1. Observation counts are rounded to the nearest ten in accordance with NCES data policies.

Literacy Outcomes

We draw upon three commonly utilized literacy outcomes. The *Peabody Picture Vocabulary Test* (PPVT)(Dunn & Dunn, 1997) assesses children's vocabulary. It takes approximately 5-10 minutes to complete, is administered by a trained researcher, and requires the child to point to the picture that represents the word spoken to them by the researcher. Words increase in difficulty and scores are standardized for the age of the child. The measure is nationally normed, with a mean of 100 and a standard deviation of 15.

The second and third literacy measures – Letter Word and Spelling – come from the *Woodcock-Johnson III (WJ-III) Tests of Achievement* (Woodcock, McGrew, & Mather, 2001). The *Letter Word* subtest is similar to the PPVT in that it asks children to identify the letter or word spoken to them, and the test gradually increases in difficulty to require the child to read words out of context. The *Spelling* subtest requires children to write and spell words presented to them. Both of these assessments from the WJ-III were administered by trained researchers and each took approximately 10 minutes to administer. As with the PPVT, scores are standardized by the age of the child and nationally normed to have a mean of 100 and a standard deviation of 15. The assessments were standardized for the sample to have a mean of 0 and a standard deviation of 1, and averaged together (alpha=0.66). We then restandardized the composite to have a mean of zero and a standard deviation of 1[1].

Math Outcomes

To measure student mathematics skills, we combine data from two measures into a summary composite. The *Applied Problems* subtest comes from the WJ-III and requires children to solve increasingly difficult math problems. This instrument also assesses basic skills such as

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[1] We also consider both these tests and the math tests discussed below taken one at a time and these results are presented in Appendix Table 5. The advantage of combining them as we do here is that it addresses concerns about

number recognition. Like the literacy measures from the WJ-III, the Applied Problems subtest is standardized for a child's age, and nationally normed to have a mean of 100 and a standard deviation of 15. The assessment takes approximately 10 minutes to administer. The second math assessment, the Child Math Assessment-Abbreviated (CMAA)(Klein & Starkey, 2002) is less well known, and was designed specifically for the PCER study (Preschool Curriculum Evaluation Research Consortium, 2008). It assesses young children's math ability in the domains of numbers, operations, geometry, patterns, and nonstandard measurement. Our analyses use the composite score from the CMAA. To create an overall math outcome composite, both math measures were standardized for the sample to have a mean of zero and a standard deviation of one. The measures were then averaged together (alpha =0.67) and restandardized. We also constructed an academic composite score that combined the math and literacy composites and then restandarized the sum.

Socioemotional Outcomes

Teachers rated children's social skills and behavior problems using the *Social Skills Rating System* (SSRS)(Gresham & Elliott, 1990). The SSRS preschool edition contains 30 items related to social skills and 10 items related to problem behaviors. Each item is rated on a three-point scale (0 = never, 2= very often). The social skills and problem behaviors scales are nationally normed to have a mean of 100 and a standard deviation of 15. To form a social-skills composite score, we standardized (within the sample) both scales to have a mean of zero and a standard deviation of one, reverse coded the problem behaviors scale, averaged the two scores together (alpha = 0.76) and restandardized.

Baseline Controls

To increase the precision of our experimental impacts estimates, we include a host of baseline covariates in all analyses. At baseline the primary caregiver reported on child, personal, and family demographics and background characteristics. Child-level characteristics included gender (1 = female), race (white as the reference category, black, Asian, Hispanic, and other), and age in months. Maternal/Primary caregiver and family characteristics included education level in years, whether working (1 = yes), age in years, annual household income in thousands of dollars, and whether receiving welfare support (1 = yes). Also included in the analyses are children's fall preschool academic and social skills composites, along with classroom measures as appropriate.

ANALYSIS PLAN

We conducted two sets of analyses; the first focuses on classroom outcomes and the second on child outcomes. Both are based on the following regression model:

(1) $O_{icj} = \alpha + \beta_1 T_{icj} + \beta_2 Cov_{icj} + \mu_j + e_{icj}$,

where O_{icj} is the classroom or child outcomes observed for child *i* in classroom *c* in research site *j;* T_{icj} is a dichotomous indicator of assignment to treatment or control curriculum conditions; Cov_{icj} are classroom, child, and family covariates for child *i*, μ_j are research site fixed effects; and e_{icj} is an error term. For each classroom or child outcome, we estimate four versions of equation (1), one for each of the four treatment/control comparisons shown in Figure 1. The results illustrated in Figure 2 represent the magnitude and significance of β_1 for our four primary outcomes (ECERS-R, literacy skills, math skills, and social skills).

All analyses use Ordinary Least Squares regression with standard errors clustered at the classroom level (c) and fixed effects for unit of random assignment (school or research site, denoted by "j" in equation (1)).[2] Including the research site fixed effects produces random-assignment variation in our treatment/control contrasts. In effect, the parameter β_1 in equation (1) provides a meta-analytic average effect size based on all of the treatment/control differences across all of the research sites evaluating a given curriculum contrast. We handled missing data using dummy variables. Variables were created for the baseline academic composites and the covariates indicating whether the value was missing (1 = missing; 0=otherwise), and the missing values on the variables of interest was set to zero.

Classroom Outcome Analyses

Our sample for the classroom outcomes analyses included children in classrooms in one of the curricula comparison sites listed in Table 1 for whom at least one of the classroom observational composite measures (ECERS-R, TBRS Math, TBRS Literacy, Arnett) and one of the academic outcome composite measures at the end of preschool was available. In addition to fixed effects for unit of random assignment, the controls for classroom outcome models

[2] Results are robust to alternative clustering schemes, these results are discussed below.

predicting ECERS-R and Arnett scores in the Spring of 2004 included the corresponding fall score, the difference in days from the start of the preschool year and the baseline observational assessment, a quadratic of this difference, and the time in days between a classroom's fall and spring observational assessments of the ECERS-R and Arnett. The time between assessments accounts for differences in classroom exposure to treatment. As noted above, we include the duration of TBRS observation in minutes in TBRS Math and Literacy models. All child and family covariates were also included in the classroom outcome analyses to account for student composition within a classroom during the observational assessments. Covariates were: baseline academic composite score (fall of preschool year), child gender, race, mother or primary caregiver educational level and age, family income, and indicators for employment, marital status, and whether receiving welfare. Note that only the ECERS-R results are displayed in Figure 2, because it is the most widely used in efforts to regulate child care quality.

Because several of the study sites conducted a pilot study during the 2002-2003 school year, we ran additional models where the baseline measures and the time between assessments were excluded from the analyses. We report the results with the baseline measures below, which is the most conservative test of effect of curricula type on classroom outcomes if the curricula have positive impacts on the classroom outcomes. We also compared effects by whether there was a pilot year, we discuss this below.

Child Outcome Analyses

The sample for our child outcomes analyses consisted of children who had at least one school readiness outcome at the end of preschool and were enrolled in one of the curricula comparison sites listed in Table 1. We used the child and family covariates described above and fixed effects for the unit of random assignment. We also included the baseline academic composite in the literacy, math, and academic composite models as a covariate, adding the baseline social skills composite in the social skills model only. Because the social skills measure was teacher-reported, we did not want to introduce any measurement bias from these assessments into the academic outcome analyses, which were assessed by a trained administrator.

RESULTS

Appendix Tables 2 and 3 present descriptive statistics for the four curriculum comparison samples outlined in Table 1 separately for children in the treatment and control groups. We compared balance in the covariates at baseline between each treatment and control group using a clustered t-test (accounting for experimental site) to assess whether the randomization was successful. P-values from t-tests show that child and family characteristics, including children's baseline school readiness scores, were statistically indistinguishable across literacy vs. whole child or math vs. whole child comparisons. There were also no differences in the classroom observational measures for the curricula comparisons. Baseline differences emerged in the classroom observational measures in the locally developed versus Creative Curriculum experimental comparisons, and the literacy versus locally developed comparison, however. This difference was also noted in PCER by study investigators and may reflect the fact that classroom processes in the Creative Curriculum treatment schools may have changed prior to the time that the baseline measurements were conducted (2008). PCER study investigators used linear projection to test for evidence of an early treatment effect due to variation in children's baseline assessment dates, and for non-equivalence at baseline.

The investigators also note that at the Vanderbilt site (Creative Curriculum compared with locally-developed curricula) there was a possible early treatment effect on an Arnett subscale and non-equivalence at baseline on the ECERS-R total score. In the Texas site (*Let's Begin with the Letter People* and *Doors to Discovery* compared with locally developed curricula) the investigators note non-equivalence at the baseline on an Arnett subscale. In Comparison III, gender, parent's education, and household income were marginally significantly different in univariate t-tests, but were insignificant in a joint test of significance. Our analyses address these issues by controlling for classroom assessment scores at baseline and child and family covariates. Since it is possible that baseline controls may not completely restore equivalence, we regard this comparison as less rigorously causal than the others.

Classroom Outcomes

Table 2 shows impact estimates for classroom outcomes; the ECERS-R impacts are also displayed in Figure 2. All dependent variables were converted into standard deviation units (variables were standardized within the sample), with a mean of zero and standard deviation of one so that the coefficients can be interpreted as effect sizes. Our main results used the four composite classroom measures as the dependent variables. We show the same models using the composite components as dependent variables in Appendix Table 4.

I. Literacy Curricula Compared with Creative/HighScope

There were no statistically significant differences at the end of the preschool year between classrooms using a literacy curriculum and classrooms using the Creative/HighScope curriculum on any of the classroom observational measures.

II. Literacy Curricula Compared with Locally Developed Curricula

Classrooms using a literacy curriculum scored one-half of a standard deviation (sd) higher on the ECERS-R total score, and 0.83 sd higher on the TBRS Literacy activities composite at the end of the preschool year than classrooms using a locally developed curriculum.

III. Math Curricula Compared with Creative/HighScope

Classrooms using a math curriculum scored more than one standard deviation higher on the TBRS Math activities scale than control classrooms using Creative/HighScope at the end of the preschool year. There were no other significant differences between Math treatment and Creative/HighScope classrooms.

IV. Creative Curriculum Compared with Locally Developed Curricula

Classrooms using Creative Curriculum had consistently higher ECERS-R, TBRS Math, TBRS Literacy, and Arnett scores (effect sizes = 0.61 sd, 0.51 sd, 0.71 sd, 0.99 sd, respectively) at the end of the preschool year than classrooms using a locally developed curriculum.

In sum, conventional measures of classroom instruction and interactions were uniformly higher with the whole-child Creative Curriculum than with the assortment of locally developed curricula in the control condition. Further classroom improvements from supplementing or replacing whole-child curricula with skill-focused curricula were more selective.

Child Outcomes

Table 3 show impacts of the various curricula contrasts on children's school readiness outcomes; results for the literacy, math, and social skills composites are also illustrated in Figure 2 in the main document. As with the process measures, outcomes were standardized within the sample (mean of 0, standard deviation of 1) so that coefficients can be interpreted as effect sizes.

Our main results used the four composite child outcome measures as the dependent variables. We show the same models using the composite components as dependent variables in Appendix Table 5.

I. Literacy Curricula Compared with Creative/HighScope

Children in classrooms randomly assigned to a Literacy curriculum had modestly but significantly higher literacy composite scores (0.15 sd) at the end of preschool than did classrooms using Creative/HighScope. There were no other statistically significant differences between children exposed to literacy curricula and Creative/HighScope, although Appendix Table 6 shows significant detrimental impacts of the literacy curricula on one of the two components of the social skills composite.

II. Literacy Curricula Compared with Locally Developed Curricula

Children in classrooms randomly assigned to a literacy curriculum had marginally significantly ($p<.10$) higher math (0.14 sd) and academic composite scores (0.15 sd) at the end of preschool than children who received a locally developed curriculum. The effect size for the literacy composite was similar (0.15 sd), but not statistically significant at conventional levels.

III. Math Curricula Compared with Creative/HighScope

Children in classrooms randomly assigned to the Math curriculum had substantially higher math (0.35 sd) and academic composite scores (0.25 sd) at the end of preschool compared with children who received Creative/HighScope. Children did not have significantly different literacy or social skills composite scores.

IV. Creative Curriculum Compared with Locally Developed Curricula

Despite the consistently positive impacts of the Creative Curriculum on all composite measures of classroom process, there were substantively small and statistically insignificant differences between the school readiness skills of children exposed to Creative Curriculum and locally developed curricula.

Robustness Checks

Classroom Outcomes

One might be concerned that there were too few classrooms to generate unbiased standard errors with clustering and that clustering would instead lead to over-rejection as well as that classroom clustering treats classrooms within site as independent, we repeated the above analyses using bootstrapped standard errors at random assignment site and the wild bootstrap for the literacy versus whole child comparison (Cameron, Gelbach, & Miller, 2008).[3] Wild bootstrap inference lead to conclusions about significance, which were very close to those presented above. We also ran classroom outcome models that omitted the Fall 2003 prescores because some study sites participated in the pilot year (see Table 1), and therefore the Fall 2003 classroom process measure were not a true prescore. The coefficients were generally similar, and for several comparisons, larger than those presented in Table 2.

Pilot Year Interactions

We wanted to test for differences in effects between sites that participated in a pilot implementation year and those that did not. As indicated in Table 1, all sites in comparisons II, III, and IV were pilot sites, so we were only able to test for differences between pilot and non-pilot sites for comparison I (Literacy vs. HighScope and Creative Curriculum). We found no significant differences in the effects of literacy curricula on the classroom or child outcomes by pilot site status.

Pooling HighScope and Creative Curriculum

In the Literacy vs. Creative Curriculum/HighScope comparison, four sites used HighScope and one site used Creative Curriculum. We tested whether removing the Creative Curriculum site from this analysis would alter the results. The coefficients from these analyses were very similar to those presented in Table 3, with the exception of the ECERS-R scores, which increased from 0.25 sd to 0.34 sd and reached statistical significance.

New York Control Group

The Math curriculum was randomly assigned to classrooms at two sites: New York and California. The original PCER study control group for New York consisted of state prekindergarten (pre-K) classrooms using a locally developed curriculum (excluded from above analyses) and Head Start classrooms using Creative Curriculum/HighScope (included). Because

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[3] This also adjusts for the fact that there may be more than one classroom within specific random assignment sites.

our analyses effectively split the New York control group by both curricula and program type, we tested whether different constructions of the Math curriculum control group would affect our results. Appendix Table 6 shows results from the model presented in our main results, a model that excludes all of the New York control group children, and one that excludes the New York Math site entirely. The magnitude and significance of the Math curriculum effect on the math composite is robust to different constructions of the control group, but the statistical significance of the effect on the academic composite is sensitive to changing the control group, most likely because of the small sample size.

Creative Curriculum and HighScope Comparison with the Head Start Impact Study

One concern with the Creative Curriculum/HighScope comparison groups is that they may not be representative of other programs that use these curricula. To address this concern, we compared the ECERS-R and Arnett scores from the Head Start classrooms that used Creative Curriculum or HighScope in the Head Start Impact Study (HSIS) with those of classrooms in the PCER study using these curricula (pooled across all research sites). The overall average ECERS-R score in the PCER sample was 4.21 and 5.22 in the HSIS. On the Arnett the respective PCER and HSIS sample averages were 3.12 and 2.55, respectively. These differences suggest that our impact estimates on classroom quality may be upwardly biased with respect to curricular effects on the ECERS-R, and downwardly biased for the Arnett. The TBRS was not used in other large-scale early childhood studies.

We also compared baseline academic scores for children in the 4 year old cohort in the HSIS to children in the PCER study who received the Creative Curriculum or HighScope curriculum. Scores were compared at the beginning of the preschool year to determine if the samples were similar. Children in the HSIS who received one of the comparison curricula scored very similar to children in the PCER study, with no significant differences in scores (PPVT scores averaged 92.18 in the HSIS and 86.68 in the PCER; WJ Applied Problems means were HSIS: 90.28, PCER: 92.80; WJ Letter Word means were HSIS: 95.12, PCER: 99.82; and WJ Spelling means were HSIS: 92.74, PCER: 94.27).

Child Outcomes

As might be expected, children in our PCER-based analysis sample were not representative of the national distribution of children for which the nationally normed outcome measures (PPVT, Woodcock-Johnson Letter-word, Spelling, and Applied Problems) are calibrated. We used the same comparisons and specifications presented to estimate treatment effects on raw outcome scores and calculated effect sizes by dividing by the standard deviation for the population (15). These coefficients and effect sizes are presented in Appendix Table 7, and are virtually identical to those presented in Table 3. We also estimated the same specifications as our main analyses but excluded the set of child and family control variables, which may be endogenous. The results were very similar to those presented above.

Child Outcomes at Kindergarten

The PCER study included a follow-up data collection of children's outcomes at the end of their kindergarten year, one year after the outcomes we report in Figure 2. Using the same comparisons and specifications presented above, we tested whether curricular effects were sustained until the spring of kindergarten. For composite outcomes, none of the statistically significant content-focused curricular effects shown in Table 3 remained statistically significant at the end of kindergarten. Fadeout is all too common in early childhood program evaluations and points to the need to coordinate curricula and instruction between preschool and early elementary school grade so that preschool intervention gains might be sustained (e.g., Clements, Sarama, Wolfe, & Spitler, 2013)

Training and Professional Development for Curricular Implementation

An alternative explanation for the observed effects is that the professional development and training provided to treatment classrooms are driving our results, and not the curricula per se. The argument here is that treatment classrooms obtained much more intensive implementation than "business as usual" curricula users. If training alone accounted for the differences, we should have seen significant differences in child outcomes in the Creative Curriculum treatment condition compared with the teacher developed control (comparison IV). Training and professional development are important components of any preschool program, but they do not explain the pattern of results we see here.

DISCUSSION

Given the large, persistent, and consequential gaps in literacy and numeracy skills between high- and low-income children when they enter kindergarten, the most important policy goal of publicly supported early childhood education programs should be to boost early achievement skills and promote the socioemotional behaviors that support these skills. Federal, state, and local policy can influence the effectiveness of preschool programs by prescribing curricula, as well as by regulating and monitoring early care settings. Our evidence speaks most directly to curriculum policies.

We find that curricular supplements focused on academic skills are indeed more successful at boosting literacy and math skills than are widely used whole-child curricula. What about the whole-child curricula themselves, which programs like Head Start require their classrooms to use? Our data showed no advantages for Creative Curriculum compared with locally developed curricula in improving academic skills, nor in promoting positive behavior. Here it is important to bear in mind that none of the curricula were implemented with high fidelity under the developer's recommended conditions. On the other hand, the classrooms in the PCER study are likely to reflect a degree of implementation found in many actual classrooms.

Our results, coupled with the absence of other high-quality evaluation evidence demonstrating the effectiveness of the Creative Curriculum, HighScope or any other whole-child curricula lead us to question the policy wisdom of prioritizing either "whole-child" curricula as a whole, or Creative Curriculum and HighScope in particular. While it is conceivable that some kind of "whole-child" curriculum may ultimately be found to be particularly effective at promoting a valued conception of school readiness, there is currently no evidence to support that conclusion. In the absence of such evidence, we conclude that policy efforts should focus more attention on assessing and implementing proven academically focused curricula and move away from the comparatively ineffective whole child approach.

Our findings further suggest that child care quality instruments may be too global to provide useful measurement of children's experiences in those settings related to the acquisition of academic and social skills (Burchinal et al., 2015). State and federal policies have focused on measures of classroom quality, with the assumption that higher classroom quality will lead to larger gains in academic and social skills among young children. As with prior studies, our study finds no consistency between curricular impacts on classroom quality and impacts on children's school readiness. The most striking example is the contrast between classrooms adopting Creative Curriculum and classrooms with an assortment of locally developed curricula. Almost all of our measures of the quality and quantity of academic content, the sensitivity of teacher-pupil interactions, and the global rating scale of classroom quality (the ECERS-R) currently used by most states were significantly more favorable in classrooms that had implemented Creative Curriculum than in classrooms using locally developed curricula. And yet these classroom process advantages failed to translate into better academic or socioemotional outcomes for children.

It is possible that state quality rating systems for early education programs are not targeting the elements of program quality that matter the most for boosting children's school readiness skills. Some evidence suggests that newer classroom quality measures that capture the nature of teacher-child relationships or quality of domain-specific instruction may provide stronger linkages between classroom process and children's outcomes (Burchinal et al., 2010). Nevertheless, these findings provide further evidence that evaluations may need to include assessments of child outcomes as well as classroom quality if the goal of the program is impact children's school readiness skills. Another possibility is to reserve the highest tier of ratings for programs that successfully implement proven academically focused, content-specific curricula. However, our study suggests a more direct approach: encouraging or mandating the use of academically focused curricula to enhance the school readiness of low-income children

A number of considerations suggest caution in drawing strong policy conclusions from our analysis. First, the results are specific to the skill-focused curricula included in the PCER study. In the case of math, only one curriculum was tested, and it is one of the few preschool math curricula to have proved its effectiveness in other random-assignment evaluation studies. Eight different literacy curricula were tested in the PCER study, and, although effects are imprecisely estimated, the PCER evaluation showed that the impacts of those curricula on literacy achievement were quite heterogeneous. Our analyses, which combine these heterogeneous programs into a single category thus provide an estimate of the average effects of these eight literature curricula. Our estimates would likely be larger had we limited the sample to literacy curricula with strong evidence of effectiveness. While the collection of skill-focused curricula used in our analyses outperformed the widely used global curricula in boosting academic skills, future research should focus on specific curricula to aid policy choices in this area. It is also important to note that curricula targeting children's socioemotional skills or executive functioning (e.g., the REDI program or Tools of the Mind) were not included in the PCER study; these should be compared in future research.

A second and enduring feature of most evaluation studies is that their comparisons involve real-world classrooms in which curricula implementation may fall short of what curricula designers judge to be adequate. Implementation assessment scores in the PCER were fairly high, but in many cases, teachers received less training prior to implementing curricula than designers recommend. Teachers in the control conditions did not receive any additional training on their curricula, representing de facto real-world curricular implementation in scaled-up public preschool programs. In the case of HighScope, for example, recommended training lasts four weeks, which was considerably longer than the training times in the PCER study. HighScope also recommends a curriculum implementation protocol that was more sophisticated than the PCER protocol. Of course, there may have been similar problems in the implementation of the academic and even locally developed curricula. The policy infrastructure surrounding curricular requirements would therefore also need to involve on-site assistance and/or extensive training opportunities for child care providers if proven curricula are to be effective at scale.

Integrated Curricular Approaches: Boston's Pre-K Program

Looking beyond individual curricula and quality rating systems, a third policy approach to promoting school readiness is to develop a completely integrated academic and behavioral curriculum and then focus on ensuring that it is implemented in classrooms as faithfully as possible. Classroom "quality" in this case amounts to the fidelity of the implementation of the curriculum. This has been the approach taken over the past decade by Boston Public Schools (Duncan & Murnane, 2014, Chapter 5; Weiland & Yoshikawa, 2013).

System leaders developed a highly-scripted play-based curriculum by combining proven literacy, math and social skills interventions. The academic components focused on concept development, the use of multiple methods and materials to promote children's learning, and a variety of activities to encourage analysis, reasoning, and problem-solving (Weiland and Yoshikawa, forthcoming). Pre-K classrooms were embedded in existing public schools and taught by credentialed teachers who received extensive professional development training and on-going coaching to ensure that they understood the curriculum and were able to implement it effectively in their classrooms.

A regression-discontinuity evaluation of the Boston pre-K system showed much larger impacts on vocabulary, math, and reading (effect sizes ranging from .45 to .62 standard deviations) than the PCER curricula were able to generate, although some of these differences might be attributed to the differences between the regression discontinuity and the RCT evaluations designs (regression discontinuity vs. RCT; Weiland & Yoshikawa, 2013). Interestingly, the evaluation also found smaller, but still noteworthy impacts on working memory and inhibitory control (effect sizes ranging from .21 to .28 standard deviations). Given its all-or-nothing nature, the evaluation could not identify which subset of the many program components were the “active ingredients” leading to the school readiness impacts. It is obviously premature to view integrated curricular approaches to preschool quality as the gold standard approach. The Boston model needs to be evaluated using a strong design that can track impacts on child outcomes during and beyond elementary school. And it needs to be shown to be replicable at scale in other school systems serving predominantly low-income children.

Stepping back, our results from the PCER preschool experiments provide a number of reasons to question the wisdom of current school readiness policies. Our study highlights the importance of curricula as a policy lever to influence the school readiness skills of low-income children, based on good, experimentally-based evidence. We find no such support for policies targeting preschool process quality alone. The entire policy debate would benefit from a stronger culture of telling program evaluations.

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Data used in this article are restricted-use because they contain individually identifiable information that are confidential and protected by law. IES requires a license for their use, which assures that the users of the data abide by the set of laws that provide for the security and privacy

of personal data maintained by the Federal Government to protect the confidentiality of respondents' individually identifiable information. The IES releases restricted-use data only to qualified organizations (universities, research organizations and other government agencies) in the United States. Ph.D. level researchers can apply as a Principal Project Officer through their organization to access these data and replicate our work. The IES received IRB approval through the respective states of each participant in the study.

While we are unable to share the data with other researchers because of our agreement with the IES, we can offer guidance (including sharing of programming code if necessary) to researchers who do receive the data from IES and wish to replicate and/or extend our results.

The authors have no conflicts of interest to report.

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Table 1: Description of curricula comparisons.

Grantee and case range	Site	Treatment Curriculum	Control Curriculum(a)	Project-reported impacts			Pilot Year	Fidelity of Implementation	
				Literacy	Math	Socio-emotional		Treatment	Control
I. Literacy vs. HighScope and Creative Curriculum									
University of North Florida n=250	FL	Early Literacy and Learning Model	Creative Curriculum	ns, ns, ns	ns, ns	ns, ns	X	2.5	Not Provided
Florida State University n=200	FL	Literacy Express	HighScope	ns, ns, ns	ns, ns	ns, ns		2.5	2.0
Florida State University n=200	FL	DLM Early Childhood Express supplemented with Open Court Reading Pre-K	HighScope	+,+,+	+, ns	ns, ns		2.3	2.0
University of California-Berkeley n=290	NJ	Ready Set Leap	HighScope	ns, ns, ns	ns, -	ns, ns		1.9	2.0
University of Virginia n=200	VA	Language Focused	HighScope	ns, ns, ns	ns, ns	ns, ns		2.0	2.0
II. Literacy vs. Locally Developed									
University of Texas Health Science Center at Houston n=200	TX	Doors to Discovery	Locally Developed	ns, ns, ns	ns, ns	ns, ns	X	2.1	1.0
University of Texas Health Science Center at Houston n=200	TX	Let's Begin with the Letter People	Locally Developed	ns, ns, ns	ns, ns	ns, ns	X	1.9	1.0
Vanderbilt University n=210	TN	Bright Beginnings	Locally Developed	ns, ns, ns	ns, ns	ns, ns	X	1.9	2.0
III. Math vs. HighScope and Creative Curriculum									
University of California-Berkeley and SUNY University of Buffalo n=320	CA and NY	Pre-K Mathematics supplemented with DLM Early Childhood Express (Math Software only)	Creative Curriculum or HighScope	ns, ns, ns	ns, +	ns, ns	X	CA (2.7); NY (2.3)	CA (2.0); NY (2.0)
IV. Creative Curriculum vs. Locally Developed									
University of North Carolina at Charlotte n=310	NC and GA	Creative Curriculum	Locally Developed	ns, ns, ns	ns, ns	ns, ns	X	2.1	1.5
Vanderbilt n=210	TN	Creative Curriculum	Locally Developed	ns, ns, ns	ns, ns	ns, ns	X	2.1	2.0

Note to Table 1: "Literacy" outcomes include the PPVT, WJ Letter-Word and WJ Spelling. "Math" outcomes include WJ Applied problems and CMAA. "Socioemotional" outcomes include social skills and problem behaviors."+" indicates beneficial impact with $p<.05$; "-" indicates detrimental impact with $p<.05$; "ns" indicates $p>.05$. Fidelity of implementation was rated on a 4-point scale (0 = Not at all; 3 = High). Ns are rounded to the nearest 10 in accordance with NCES data policies.

Table 2. Experimental curricula comparisons predicting classroom observational measures at the end of preschool

	ECERS total score	TBRS Math	TBRS Literacy	Arnett total score
I. Literacy Curricula Compared with HighScope and Creative Curriculum	0.25+	-0.14	0.07	0.18
	(0.15)	(0.16)	(0.16)	(0.16)
N	890	880	880	890
Classroom N= 100				
II. Literacy Curricula Compared with Locally developed Curricula	0.51*	0.46	0.83*	0.38
	(0.23)	(0.32)	(0.37)	(0.25)
N	460	440	440	440
Classroom N=60				
III. Math Curriculum Compared with HighScope and Creative Curriculum	0.15	1.16*	0.34	0.63
	(0.32)	(0.52)	(0.31)	(0.52)
N	210	200	200	200
Classroom N=30				
IV. Creative Curriculum Compared with Locally developed Curricula	0.61*	0.51*	0.71**	0.99*
	(0.23)	(0.23)	(0.17)	(0.36)
N	350	320	320	330
Classroom N=30				

Note. Standard errors clustered at the classroom level (in parentheses). Fixed effects at the random assignment site level are included in all analyses. Child and family characteristics included in the models were child gender, race, age (months), baseline achievement and social skills; parent/primary caregiver education (years), whether working, age (years), annual household income (thousands), and whether receiving welfare. Classroom observational measures at baseline, time in days from the start of the preschool year and the date of the observational assessment, a quadratic version of this time in days, and the time in days between a classroom's fall and spring observational assessment were also included in all models (Arnett and ECERS). Duration of TBRS observation in minutes was included in TBRS Math and Literacy models. Missing dummy variables were included in the analyses to account for missing data. Outcomes were standardized to have a mean of 0 and standard deviation of 1. Ns are rounded to the nearest 10 in accordance with NCES data policies.
p < .10, *p < .05, **p < .01.

Table 3. Experimental curricula comparisons predicting child school readiness skills at the end of preschool

	Literacy composite	Math composite	Academic composite	Social skills composite
I. Literacy Curricula Compared with HighScope and Creative Curriculum	0.15**	-0.01	0.06	-0.13
	(0.05)	(0.05)	(0.05)	(0.10)
N	890	890	880	860
II. Literacy Curricula Compared with Locally developed Curricula	0.15	0.14+	0.15+	-0.18
	(0.09)	(0.07)	(0.08)	(0.19)
N	480	480	480	440
III. Math Curriculum Compared with HighScope and Creative Curriculum	0.05	0.35**	0.25*	0.14
	(0.10)	(0.11)	(0.11)	(0.17)
N	220	220	220	210
IV. Creative Curriculum Compared with Locally developed Curricula	0.02	0.02	0.02	-0.03
	(0.08)	(0.08)	(0.08)	(0.22)
N	360	360	360	350

Note. Standard errors clustered at the classroom level (in parentheses). Literacy composite included PPVT, WJ Letter Word and WJ Spelling. Math composite included WJ Applied Problems, and CMAA. Academic composite weights the math and literacy composite scores equally. The social skills composite included teacher rated social skills and a reverse-coded teacher rated behavior problems. Models include fixed effects for the unit of random assignment. Child and family characteristics included in the models were child gender, race, age (months), baseline achievement and social skills; parent/primary caregiver education (years), whether working, age (years), annual household income (thousands), and whether receiving welfare. Missing dummy variables were included in the analyses to account for missing data. Outcomes were standardized to have a mean of 0 and standard deviation of 1. Ns are rounded to the nearest 10 in accordance with NCES data policies.
+p < .10, *p < .05, **p < .01.

Appendix Table 1. Description of classroom observational measures.

Name of Measure	Abbreviation	Description of Measure	Items and Rating Scale
Teacher Behavior Rating Scale (Landry, Crawford, Gunnewig, & Swank, 2002)	TBRS	Using the TBRS, trained observers rate the amount and quantity of academic activities present in a classroom. There are two content areas measured by the TBRS - math and literacy.	Quality of the activities were rated from 0-3 (0 = activity not present; 3 = activity high quality). Quantity of activities was similarly rated from 0-3 (0 = activity not present; 3 = activity happened often or many times). Reliability: Math scale, .94; Literacy scale, .87
Early Childhood Environment Rating Scale - Revised (Harms, Clifford, & Cryer, 1998)	ECERS-R	This instrument measures the overall quality of the classroom including structural features (such as the availability of developmental materials in the classroom), and teacher-child interactions (including the use of language in the classroom).	Total score - 43 items; Provisions factor - 12 items; Interaction factor - 11 items. All items were rated by a trained observer on a scale from 1-7 (1 = inadequate quality; 7 = excellent quality. Reliability: Total score, .92; Provisions factor, .89; Interactions factor, .91
Arnett Caregiver Interaction Scale (Arnett, 1989)	Arnett CIS	The Arnett CIS examines the positive interactions, harshness, detachment, and permissiveness between the teacher and children.	Total number of items - 26. Trained observers rated each item from 1-4 (1 = not true at all; 4 = very much true). Reliability: .95

Appendix Table 2. Literacy Curricula Analysis Samples (Comparisons 1 and 2): Descriptive statistics by experimental conditions on child and family background and demographic characteristics, classroom observations, and child school readiness skills

	I. Literacy Curricula Compared With HighScope and Creative Curricula							II.Literacy Curricula Compared With Locally Developed Curricula						
	Literacy Curricula (Treat)			HighScope-Creative Curricula Comparison				Literacy Curricula (Treat)			Locally Developed Curricula			
	N	Mean	SD	N	Mean	SD	P-value	N	Mean	SD	N	Mean	SD	P-value
Covariates at Baseline (Fall 2003)														
Child Gender - Female	550	0.48		340	0.44		0.30	290	0.45	0.50	190	0.48	0.50	0.48
Child Race - Black	550	0.55		340	0.52		0.96	290	0.08	0.27	190	0.10	0.30	0.43
Child Race - Asian	550	0.00		340	0.00		1.00	290	0.01	0.12	190	0.03	0.18	0.27
Child Race - Hispanic	550	0.11		340	0.10		0.54	290	0.28	0.45	190	0.23	0.42	0.92
Child Race - Other	550	0.04		340	0.03		0.60	290	0.05	0.22	190	0.05	0.22	0.67
Child Age (months)	550	54.66	3.78	340	54.82	3.92	0.39	290	54.73	3.74	190	54.93	3.72	0.24
Parent Education (years)	550	12.90	1.59	340	12.53	1.68	0.02	290	13.23	2.06	190	12.92	1.64	0.48
Parent Working	550	0.62		340	0.58		0.31	290	0.51	0.50	190	0.48	0.50	0.58
Parent Age (years)	550	30.95	7.18	340	30.68	6.81	0.69	290	32.71	6.31	190	32.59	6.80	0.58
Annual Household Income (thousands)	550	27.08	17.19	340	26.08	17.87	0.27	290	39.85	27.17	190	32.57	20.82	0.24
Receiving Welfare	550	0.12		340	0.18		0.12	290	0.07	0.26	190	0.08	0.27	0.77
Classroom Observations - Fall 2003														
CIS Arnett Total	550	3.22	0.41	340	3.41	0.33	0.37	280	3.33	0.44	180	3.00	0.58	0.02
ECERS Total	550	4.59	1.17	340	5.02	1.17	0.15	280	3.63	0.65	190	3.14	0.53	0.00
ECERS Provisions	550	4.55	1.42	340	5.15	1.26	0.59	280	3.47	0.69	190	2.97	0.46	0.00
ECERS Interaction	550	5.15	1.36	340	5.57	1.29	0.46	280	4.54	1.23	190	3.60	0.90	0.00
Classroom Observations - Spring 2004														
TBRS Math Quality	550	0.99	0.64	340	1.14	0.66	0.65	260	1.34	0.76	190	0.98	0.50	0.13
TBRS Math Quantity	550	1.11	0.48	340	1.20	0.57	0.87	260	1.33	0.56	190	1.07	0.40	0.15
TBRS Literacy Quality	550	1.58	0.44	340	1.59	0.40	0.86	260	1.75	0.52	190	1.31	0.35	0.01
TBRS Literacy Quantity	550	1.50	0.59	340	1.53	0.55	0.49	260	1.69	0.68	190	1.12	0.45	0.01
CIS Arnett Total	550	3.16	0.47	340	3.17	0.37	0.17	260	3.34	0.49	190	3.09	0.55	0.2
ECERS Total	550	4.36	1.14	340	4.32	0.97	0.16	280	3.99	0.80	190	3.53	0.78	0.06
ECERS Provisions	550	4.37	1.19	340	4.40	1.03	0.57	280	3.92	0.87	190	3.36	0.64	0.01
ECERS Interaction	550	4.89	1.45	340	4.94	1.22	0.09	280	4.95	1.28	190	4.32	1.37	0.12
Child Outcomes - Fall 2003														
PPVT	550	87.81	13.23	340	86.48	14.93	0.04	290	87.89	18.76	190	89.52	19.15	0.39
WJ Letter Word	550	100.78	15.76	340	99.18	15.20	0.30	290	94.85	16.17	190	98.30	15.58	0.42
WJ Spelling	550	94.97	13.85	340	94.61	14.57	0.35	290	90.69	13.16	190	91.81	12.62	0.81
WJ Applied Problems	550	92.44	13.70	340	92.14	13.28	0.61	290	94.79	16.66	190	95.17	16.58	0.94
CMAA Composite	550	0.42	0.25	340	0.43	0.23	0.89	290	0.39	0.25	190	0.42	0.25	0.90
Social Skills (teacher report)	500	100.42	16.10	310	100.69	15.23	0.98	280	101.69	21.15	180	98.55	15.11	0.28
Behavior Problems (teacher report)	530	100.31	13.54	310	100.91	12.74	0.08	280	102.58	15.56	180	99.58	13.12	0.55
Child Outcomes - Spring 2004														
PPVT	550	91.89	13.92	340	90.29	14.84	0.08	290	92.70	16.73	190	94.95	17.50	0.29
WJ Letter Word	540	105.15	13.60	340	102.85	14.07	0.00	290	101.37	14.08	190	105.64	14.26	0.16
WJ Spelling	520	96.95	14.59	320	93.60	14.86	0.00	290	93.97	13.18	190	97.91	12.92	0.13
WJ Applied Problems	540	93.78	13.28	330	91.73	13.74	0.02	290	97.80	16.66	190	99.53	13.73	0.51
CMAA Composite	550	0.58	0.23	340	0.59	0.22	0.96	290	0.59	0.26	190	0.65	0.23	0.26
Social Skills (teacher report)	530	103.91	15.65	320	107.57	15.56	0.13	270	110.74	13.80	170	106.74	14.77	0.09
Behavior Problems (teacher report)	530	101.64	13.59	330	101.22	13.75	0.79	270	99.36	12.71	170	99.73	13.71	0.96
Literacy composite score	550	0.11	0.95	340	-0.10	1.01	0.00	290	-0.07	1.06	190	0.23	1.05	0.14
Math composite score	550	-0.06	0.95	340	-0.11	0.94	0.17	290	0.12	1.19	190	0.34	0.98	0.36
Academic composite score	540	0.01	0.94	340	-0.11	0.97	0.02	290	0.04	1.17	190	0.32	1.02	0.24
Social skills composite score	530	-0.16	0.99	330	-0.00	1.03	0.30	270	0.19	0.91	170	0.02	1.01	0.36

Note. TBRS = Teacher Behavior Rating Scale. TBRS Literacy variables are composites of oral language, book reading, written expression, and print and letter knowledge. Further detail on classroom observational measures is available in Table S2. P-values account for clustering by random assignment site and date of classroom observational assessment (for classroom observation t-tests only). Ns are rounded to the nearest 10 in accordance with NCES data policies.

Appendix Table 3. Math and Creative Curriculum Analysis Samples (Comparisons 3 and 4): Descriptive statistics by experimental conditions on child and family background and demographic characteristics, classroom observations, and child school readiness skills

	III. Math Curriculum Compared With HighScope and Creative Curricula							IV. Creative Curriculum Compared with Locally Developed Curricula						
	Math Curriculum (Treat)			HighScope-Creative Curricula Comparison				Locally Developed Curricula			Creative Curriculum (Treat)			
	N	Mean	SD	N	Mean	SD	P-value	N	Mean	SD	N	Mean	SD	P-value
Covariates at Baseline (Fall 2003)														
Child Gender - Female	110	0.58		110	0.45		0.04	270	0.53		260	0.52		0.62
Child Race - Black	110	0.40		110	0.34		0.58	270	0.51		260	0.54		0.97
Child Race - Asian	110	0.06		110	0.01		0.32	270	0.00		260	0.00		0.33
Child Race - Hispanic	110	0.24		110	0.27		0.77	270	0.08		260	0.09		0.65
Child Race - Other	110	0.05		110	0.15		0.10	270	0.03		260	0.03		0.75
Child Age (months)	110	53.20	3.26	110	52.64	3.31	0.26	270	53.98	3.58	260	54.22	3.63	0.47
Parent Education (years)	110	13.08	1.78	110	12.49	1.81	0.08	270	12.65	1.49	260	12.60	1.60	0.36
Parent Working	110	0.57		110	0.43		0.10	270	0.49		260	0.47		0.52
Parent Age (years)	110	32.94	9.12	110	31.96	7.60	0.42	270	31.86	7.67	260	31.36	7.51	0.04
Annual Household Income (thousands)	110	29.51	17.51	110	24.66	13.80	0.06	270	23.07	14.98	260	21.80	14.47	0.22
Receiving Welfare	110	0.16		110	0.18		0.72	270	0.13		260	0.12		0.54
Classroom Observations - Fall 2003														
CIS Arnett Total	100	3.15	0.37	110	3.18	0.59	0.23	260	2.90	0.66	250	3.07	0.71	0.04
ECERS Total	100	3.48	0.67	110	3.79	0.84	0.26	270	3.40	0.94	260	3.92	1.03	0.03
ECERS Provisions	100	3.50	0.62	110	3.81	0.85	0.34	270	3.36	0.94	260	4.01	1.07	0.04
ECERS Interaction	100	4.04	1.06	110	4.45	1.41	0.27	270	3.97	1.50	260	4.70	1.59	0.01
Classroom Observations - Spring 2004														
TBRS Math Quality	100	1.21	0.94	110	0.73	0.48	0.31	260	1.00	0.71	230	1.18	0.77	0.02
TBRS Math Quantity	100	1.26	0.69	110	0.95	0.33	0.86	260	1.13	0.60	230	1.23	0.63	0.01
TBRS Literacy Quality	100	1.12	0.33	110	1.14	0.39	0.66	260	1.32	0.34	230	1.39	0.40	0.00
TBRS Literacy Quantity	100	1.01	0.35	110	0.93	0.41	0.87	260	1.07	0.40	230	1.27	0.48	0.01
CIS Arnett Total	100	3.06	0.63	110	2.97	0.61	0.92	270	3.10	0.53	240	3.14	0.53	0.01
ECERS Total	110	3.81	0.95	110	3.66	0.87	0.83	270	3.77	0.79	260	3.96	0.78	0.01
ECERS Provisions	110	3.67	1.03	110	3.55	0.74	0.91	270	3.64	0.81	260	3.97	0.89	0.00
ECERS Interaction	110	4.66	1.44	110	4.39	1.40	0.25	270	4.40	1.21	260	4.79	1.30	0.91
Child Outcomes - Fall 2003														
PPVT	110	89.28	12.60	110	92.44	14.29	0.25	270	85.50	15.94	260	85.35	16.01	0.91
WJ Letter Word	110	102.86	17.40	110	101.65	13.92	0.74	270	93.95	16.65	260	95.75	16.44	0.69
WJ Spelling	110	95.30	14.09	110	91.99	12.01	0.27	270	89.73	13.13	260	89.64	12.84	0.86
WJ Applied Problems	110	99.78	12.84	110	96.44	14.34	0.17	270	90.67	15.63	260	91.17	14.73	0.44
CMAA Composite	110	0.44	0.24	110	0.44	0.24	0.97	270	0.31	0.22	260	0.32	0.22	0.73
Social Skills (teacher report)	110	106.06	13.46	110	106.61	15.68	0.86	270	101.29	19.12	260	100.29	16.72	0.98
Behavior Problems (teacher report)	110	96.00	12.10	110	96.75	14.29	0.80	270	101.34	14.89	260	100.97	14.17	0.77
Child Outcomes - Spring 2004														
PPVT	110	94.84	13.02	110	93.67	14.95	0.68	260	88.81	14.98	260	90.13	14.86	0.15
WJ Letter Word	110	101.46	14.15	110	100.80	14.33	0.83	270	99.20	12.83	260	100.00	12.07	0.97
WJ Spelling	110	95.90	13.27	110	92.95	11.99	0.25	270	90.58	13.53	260	91.44	13.02	0.96
WJ Applied Problems	110	98.81	13.43	110	94.69	13.07	0.17	270	92.70	14.73	260	93.36	13.23	0.27
CMAA Composite	110	0.66	0.21	110	0.54	0.21	0.00	270	0.46	0.28	260	0.48	0.27	0.86
Social Skills (teacher report)	110	113.37	12.08	100	108.93	14.77	0.19	260	107.86	13.76	250	107.18	14.27	0.99
Behavior Problems (teacher report)	110	96.15	12.77	100	98.98	13.92	0.40	260	99.30	12.96	250	99.87	13.49	0.89
Literacy composite score	110	0.05	0.96	110	-0.09	0.95	0.49	270	-0.36	1.00	260	-0.27	0.94	0.70
Math composite score	110	0.34	0.89	110	-0.11	0.85	0.02	270	-0.37	1.13	260	-0.32	1.04	0.48
Academic composite score	110	0.24	0.91	110	-0.11	0.88	0.07	270	-0.40	1.08	260	-0.32	0.99	0.55
Social skills composite score	110	0.41	0.91	100	0.13	1.02	0.26	260	0.08	0.91	250	0.03	0.96	0.93

Note. TBRS = Teacher Behavior Rating Scale. TBRS Literacy variables are composites of oral language, book reading, written expression, and print and letter knowledge. Further detail on classroom observational measures is available in Table S2. P-values account for clustering by random assignment site and date of classroom observational assessment (for classroom observation t-tests only). Ns are rounded to the nearest 10 in accordance with NCES data policies.

Appendix Table 4. Experimental curricula comparisons predicting classroom observational measures at the end of preschool, by observational component measure

	ECERS total score	ECERS Provisions	ECERS Interactions	TBRS Math Quality	TBRS Math Quantity	TBRS Literacy Quality	TBRS Literacy Quantity	Arnett total score
I. Literacy Curricula Compared with HighScope and Creative Curriculum	0.25+	0.22	0.16	-0.16	-0.12	0.09	0.05	0.18
	(0.15)	(0.15)	(0.16)	(0.16)	(0.17)	(0.16)	(0.17)	(0.16)
N	890	890	890	890	890	890	890	890
Classroom N= 100								
II. Literacy Curricula Compared with Locally developed Curricula	0.51*	0.53*	0.47+	0.53	0.40	0.79*	0.88*	0.38
	(0.23)	(0.27)	(0.23)	(0.33)	(0.33)	(0.38)	(0.37)	(0.25)
N	210	210	210	200	200	200	200	200
Classroom N=60								
III. Math Curriculum Compared with HighScope and Creative Curriculum	0.15	0.20	0.26	1.24*	1.09+	0.39	0.30	0.63
	(0.32)	(0.26)	(0.40)	(0.51)	(0.53)	(0.28)	(0.35)	(0.52)
N	350	350	350	320	320	320	320	330
Classroom N=30								
IV. Creative Curriculum Compared with Locally developed Curricula	0.61*	0.43+	0.83**	0.51*	0.51+	0.74**	0.67**	0.99*
	(0.23)	(0.22)	(0.24)	(0.21)	(0.27)	(0.17)	(0.21)	(0.36)
	320	320	330	350	350	350	320	320

Note. Standard errors clustered at the classroom level (in parentheses). Fixed effects at the random assignment site level are included in all analyses. Child and family characteristics included in the models were child gender, race, age (months), baseline achievement and social skills; parent/primary caregiver education (years), whether working, age (years), annual household income (thousands), and whether receiving welfare. Classroom observational measures at baseline, time in days from the start of the preschool year and the date of the observational assessment, a quadratic version of this time in days, and the time in days between a classroom's fall and spring observational assessment were also included in all models (Arnett and ECERS). Duration of TBRS observation in minutes was included in TBRS Math and Literacy models. TBRS Math is composite of quantity and quality of math activities, and TBRS Literacy is a composite of literacy (oral language, book reading, written expression, and print and letter knowledge) quantity and quality activities. TBRS = Teacher Behavior Rating Scale. Further detail on classroom observational measures is available in Table S2. Missing dummy variables were included in the analyses to account for missing data. Outcomes were standardized to have a mean of 0 and standard deviation of 1. Ns are rounded to the nearest 10 in accordance with NCES data policies. +$p < .10$, *$p < .05$, **$p < .01$.

Appendix Table 5. Experimental curricula comparisons predicting child school readiness skills at the end of preschool, by outcome component measures

	PPVT	WJ Letter-Word	WJ Spelling	WJ Applied Problems	CMAA	Social Skills	Problem Behaviors
I. Literacy Curricula Compared with HighScope and Creative Curriculum	0.06	0.10	0.18*	0.09	-0.09	-0.25*	-0.00
	(0.04)	(0.06)	(0.07)	(0.06)	(0.06)	(0.10)	(0.10)
N	890	880	830	870	890	850	860
II. Literacy Curricula Compared with Locally developed Curricula	0.06	0.14	0.16+	0.06	0.18**	-0.27	0.18
	(0.08)	(0.11)	(0.08)	(0.09)	(0.07)	(0.19)	(0.19)
N	470	480	480	480	480	440	440
III. Math Curriculum Compared with HighScope and Creative Curriculum	0.16+	-0.09	0.07	0.27*	0.35**	0.29	-0.15
	(0.08)	(0.10)	(0.10)	(0.13)	(0.10)	(0.18)	(0.16)
N	220	220	220	220	220	210	210
IV. Creative Curriculum Compared with Locally developed Curricula	0.12+	-0.04	-0.05	0.10	-0.07	-0.05	0.05
	(0.07)	(0.09)	(0.09)	(0.08)	(0.09)	(0.21)	(0.19)
N	360	360	360	360	360	350	350

Note. Standard errors clustered at the classroom level (in parentheses). Fixed effects at the random assignment site level are included in all analyses. Standard errors are clustered at the classroom level. Models include fixed effects for the unit of random assignment (i.e. grantee, school). Child and family characteristics included in the models were child gender, race, age (months), baseline achievement and social skills; parent/primary caregiver education (years), whether working, age (years), annual household income (thousands), and whether receiving welfare. Missing dummy variables were included in the analyses to account for missing data. Outcomes were standardized to have a mean of 0 and standard deviation of 1. Ns are rounded to the nearest 10 in accordance with NCES data policies.
+p < .10, *p < .05, **p < .01.

Appendix Table 6. Alternate constructions of the math control group in the New York site: effects on outcome composites

		Literacy composite	Math composite	Academic composite	Social skills composite
NY Math treatment group with NY control group that includes Head Start classrooms implementing High/Scope and Creative Curriculum, excluding NY Pre-k control classrooms (Same as second row in Table 4)		0.05 (0.10)	0.35** (0.11)	0.25* (0.11)	0.21 (0.24)
	N	220	220	220	210
NY Math treatment group included, all NY control classrooms excluded		0.11 (0.13)	0.35+ (0.18)	0.27 (0.16)	-0.04 (0.38)
	N	210	210	210	200
Only CA math site		0.06 (0.12)	0.30+ (0.17)	0.23 (0.15)	-0.01 (0.31)
	N	150	150	150	150

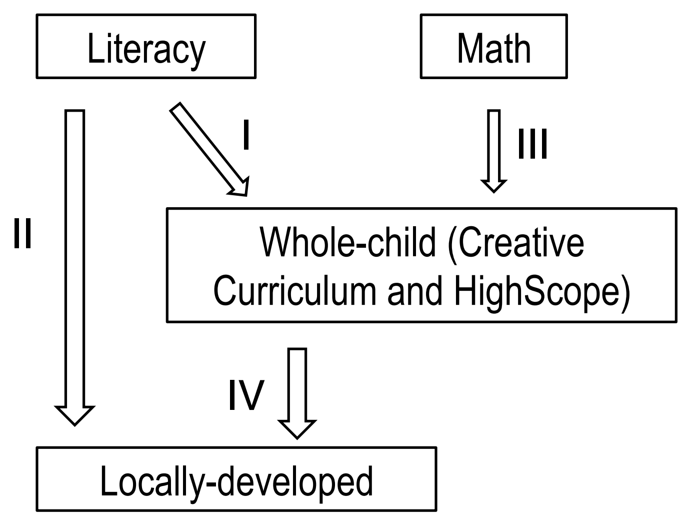
Note. Standard errors clustered at the classroom level (in parentheses). Fixed effects at the random assignment site level are included in all analyses. Reference group is Creative Curriculum or High/Scope. Standard errors are clustered at the classroom level. Literacy composite included PPVT, WJ Letter Word and WJ Spelling. Math composite included WJ Applied Problems, and CMAA. Academic composite weights the math and literacy composites equally. The social skills composite included teacher rated social skills and behavior problems (reverse coded). Models include fixed effects for the unit of random assignment (i.e. grantee, school). Child and family characteristics included in the models were child gender, race, age (months), baseline achievement and social skills; parent/primary caregiver education (years), whether working, age (years), annual household income (thousands), and whether receiving welfare. Missing dummy variables were included in the analyses to account for missing data. Outcomes were standardized to have a mean of 0 and standard deviation of 1. Ns are rounded to the nearest 10 in accordance with NCES data policies.
+p < .10, *p < .05, **p < .01.

Appendix Table 7. Experimental estimates of PCER treatment curricula on raw outcome scores: Effect sizes calculated based on national standard deviation

	PPVT	WJ Letter-Word	WJ Spelling	WJ Applied Problems	CMAA	Social Skills	Problem Behaviors
I. Literacy Curricula Compared with HighScope and Creative Curriculum	0.06	0.10	0.18*	0.09	-0.09	-0.25*	-0.001
	(0.04)	(0.07)	(0.07)	(0.06)	(0.06)	(0.10)	(0.10)
N	890	880	830	870	890	850	860
II. Literacy Curricula Compared with Locally-developed Curricula	0.06	0.14	0.16+	0.06	0.18**	-0.27	0.18
	(0.08)	(0.11)	(0.08)	(0.09)	(0.07)	(0.19)	(0.19)
N	480	480	480	480	480	450	450
III. Math Curriculum Compared with HighScope and Creative Curriculum	0.16+	-0.09	0.07	0.27*	0.35**	0.29	-0.15
	(0.08)	(0.10)	(0.10)	(0.13)	(0.10)	(0.18)	(0.16)
N	220	220	220	220	220	210	210
IV. Creative Curriculum Compared with Locally-developed Curricula	0.12+	-0.04	-0.05	0.10	-0.07	-0.05	0.05
	(0.07)	(0.09)	(0.09)	(0.08)	(0.09)	(0.21)	(0.19)
N	360	360	360	360	360	350	350

Note. Standard errors clustered at the classroom level (in parentheses). Models include fixed effects for the unit of random assignment (i.e. grantee, school). Child and family characteristics included in the models were child gender, race, age (months), baseline achievement and social skills; parent/primary caregiver education (years), whether working, age (years), annual household income (thousands), and whether receiving welfare. Missing dummy variables were included in the analyses to account for missing data. Outcomes were standardized to have a mean of 0 and standard deviation of 1. Ns are rounded to the nearest 10 in accordance with NCES data policies. +$p < .10$, *$p < .05$, **$p < .01$.

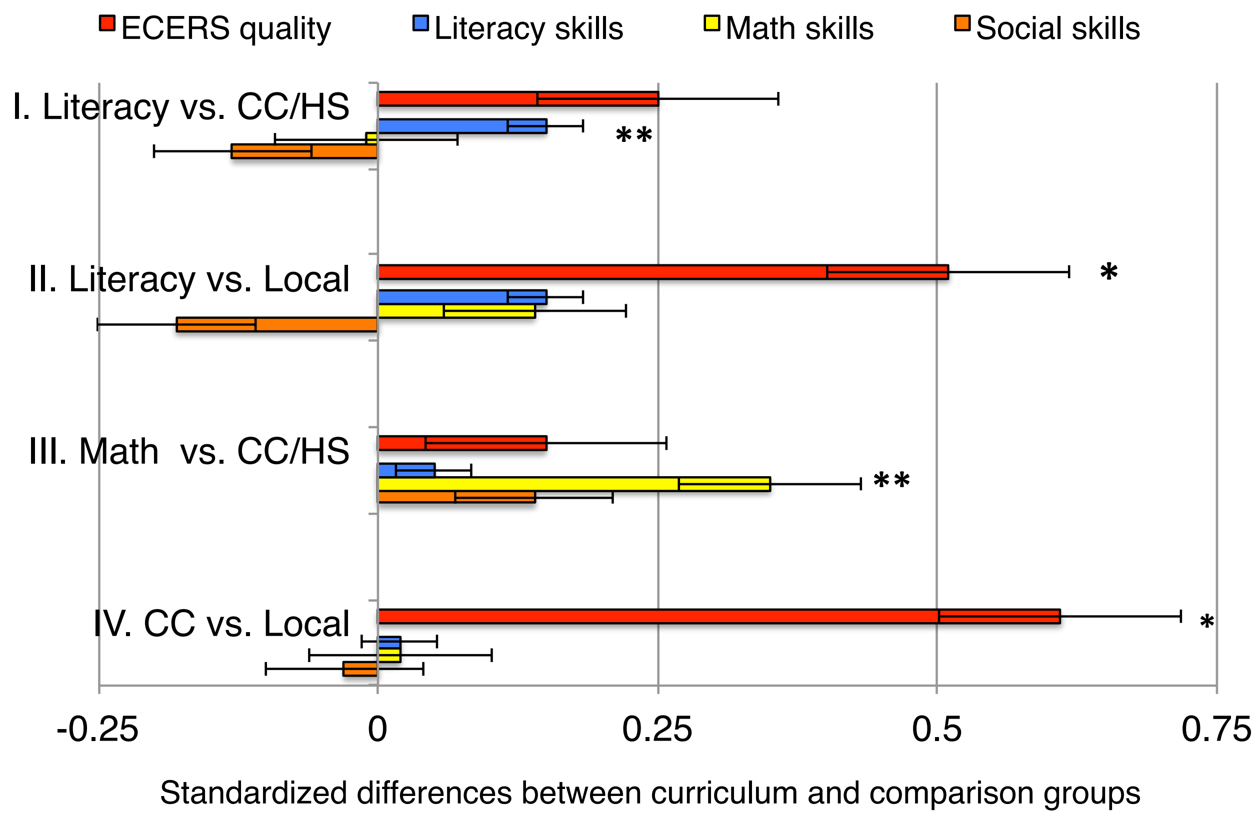
Figure 1: Curricula comparisons in study sample



Note: Comparison IV only involves the Creative Curriculum

Notes: All curricula comparisons are within-site comparisons of randomly assigned treatment-control conditions. Curricula and site-specific information are available in Table 1.

Figure 2: Effects of curricula on children's academic and socioemotional outcomes and classroom process quality



Notes: Bars show estimated impacts of various curricula comparisons on classroom process quality (as measured by the ECERS-R) and child outcomes as measured by composite standardized scores of literacy skills, math skills and socioemotional skills. See SM for details. Contrast I involves comparisons of literacy curricula and two whole-child curricula -- Creative [CC] and HighScope [HS] (N=880). Contrast II involves comparisons of literacy curricula and an assortment of locally developed curricula [Local] (N=480). Contrast III compares the one math curriculum available in the study with Creative and HighScope curricula (N=220). Contrast IV compares the Creative Curriculum with the locally developed curricula control condition (N=360). Standard error bars are shown for each regression-based estimate. *p<.05; **p<.01