Early Childhood Curricula

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Introduction

Early education and care (ECE) programs can improve a broad range of children's short and long-term outcomes and boost family earnings.[1, 2-62]. As with older students, the quality of children's experiences in early education programs varies widely, and young children learn more in higher-quality programs[7, 8]. Curriculum—what and how children learn in a program—is a critical determinant of the quality and effectiveness of a preschool program[9].

Research-validated curricula can be a powerful tool for ensuring high-quality education across all levels, including K-12 [10], especially when supported by proper training and coaching[8, 9]. However, these curricula are not widely implemented, and those that are widely used lack strong evidence of improving child outcomes. The good news is that, among the factors influencing early childhood quality and outcomes,[8] preschool curricula have been one of the most rigorously studied.

In this chapter, we review the evidence on early childhood curricula, with a focus on center-based, publicly funded early education settings for preschoolers (ages 3–5 years). We chose this focus due to research availability; most early childhood curriculum research focuses on this age range and was conducted in public preschool settings. Curricula differ in the domains they cover, as does research across various domains or combinations of domains. About half of preschool curricula are comprehensive or global, meaning they address multiple domains of learning/development; the other half are domain-specific. Among the latter, half focus on literacy and language, with social-emotional development being the second most common. Fewer ECE curricula focus on mathematics, science, engineering, technology or computational thinking, social studies, or the arts[9].

Key Findings Summary

Key finding #1: Policies impact early childhood curriculum choices. For example, almost all public pre-K programs have a curriculum approval process. Just under half provide localities with a list of approved curricula, and these include curricula with little empirical support.

Most states with state-funded Pre-K programs (~90%) have early learning standards, but with wide variation in content and specificity. About 2/3 of states have a curriculum approval process, and 44% provide a list of approved curricula for programs to select from. However, the lists of approved curricula include those with little or no data on effectiveness, as well as curricula for which studies have been conducted but the results do not support their effectiveness, often showing they are outperformed by other options.

Key finding #2: Pre-K curriculum and the instructional approaches they employ vary greatly in key aspects, including time allocated to specific content, overall time use, the balance between child-directed and teacher-directed instruction, and the use (or omission) of a scope and sequence.

Early childhood programs and their curricula differ greatly in their features, with some children learning more in certain programs than in others. Preschool curricula vary in content (emergent,

subject-matter domains, social-emotional only, combinations), organization (e.g., theme, domain content scope and sequences), pacing (curriculum dictates, children's thinking and learning through formative assessment, combination, none), and play (mainly free play, playful with free play, little play). They coalesce into approaches that can be broadly placed along a continuum from child-centered to curriculum-centered. Curricula should be educative, supporting the learning of children and their teachers, and professional development should encompass both training and coaching.

Key finding #3: Pre-K curricula with the strongest track records in improving instructional quality, classroom experiences, and children's early learning target specific skill areas and follow a clear developmental sequence.

Research indicates that some curricula provide a potentially powerful tool to improve the persistently mediocre instructional quality of too many early childhood programs. Using a research-validated curriculum significantly improves instructional quality, classroom experiences, and children's early learning[9]. Domain-specific curricula that follow a specific scope and sequence based on research on children's thinking and learning have a stronger track record in improving targeted child outcomes relative to comprehensive curricula. Children learn more subject-matter content, and sometimes also other content domains and cognitive skills. Some localities have had success combining different domain-specific curricula [5, 11, 12] .

Key finding #4: The most widely used Pre-K curricula lack a strong evidence base.

Comprehensive curricula that purport to cover all domains of learning/development are often recommended and most widely used, despite the greater effectiveness of domain-specific curricula. Curricula may be approved or adopted for several reasons other than benefits for children, including selections based on philosophy, superficial design and features, and commercial interests.

Key finding #5: Existing evidence is somewhat mixed, but suggests that domain-specific curricula have larger impacts on children from marginalized groups and those who enter school with lower skills than their peers. Curriculum effects also vary depending on the outcome measures used to assess effects.

Evidence is somewhat mixed for studies that have tested whether curriculum effects differ by child characteristics, but it suggests that children from marginalized groups and those with lower baseline skills can sometimes benefit more from the curriculum than their peers. Evidence also variation in curriculum effects by outcome domain, with larger effects of curricula on narrower, domain-specific versus broader, domain-general skills.

Key finding #6: When given supports like training and coaching, most ECE teachers implement Pre-K curriculum with good fidelity.

Evidence indicates that a wide range of early educators, based on their training, education, and program setting implement preschool curricula with roughly equal effectiveness when supported. However, research also shows that almost all teachers require professional development, especially in STEM, that is multifaceted, extensive, ongoing, reflective, centered on common practices and challenges, particularly on children's thinking, grounded in specific curriculum materials, and at least partly conducted in the classroom.

Evidence

Key finding #1: Policies impact early childhood curriculum choices. Almost all public pre-K programs have a curriculum approval process, while just under half provide localities with a list of approved curricula.

Most states, around 90%, have early learning standards. However, their expectations and levels of detail differ. For instance, some might specify that preschoolers should learn to count verbally to 10, while others aim for 100. Some standards are clear and specific, while others use general language [13].

In state-funded Pre-K programs (60 in 44 states and Wash., DC), 92% provide criteria for selecting evidence-based curriculum [14]. About 85% require that curricula be aligned with state standards. Further, nearly all states (with exceptions in Missouri and Texas)[15] provide guidance or a curriculum approval process, as well as support for curriculum implementation that might include training and/or technical assistance. However, preschool quality standards remain low in most state-funded programs, and progress has been limited. Some states have recently weakened standards[15]. Just short of half provide a list of approved curricula. Only 22% reported domain-specific curricula on their lists of approved or recommended curricula, and 27% listed only comprehensive curricula.

Of course, the benefits of providing a curriculum approval process and support for a curriculum depend on the efficacy of the curriculum. Often, the list of approved curricula includes those with little or no data regarding effectiveness, as well as curricula for which studies have been conducted but the results do not support their effectiveness and show they are outperformed by other options[8, 9].

Key finding #2: Pre-K curriculum and the instructional approaches they employ vary greatly in key aspects, including time allocated to specific content, overall time use, the balance between child-directed and teacher-directed instruction, and the use (or omission) of a scope and sequence.

Early childhood programs and their curricula vary substantially in effectiveness[16]; some children seem to learn more in certain programs than others[4, 9]. As a result, recent research has focused on examining the specific components that contribute to children's early learning gains in preschool programs[17]. A key factor behind this shift is extensive evidence showing that most public preschool programs are generally mediocre in instructional quality, even though they tend to score in the "good" range for organization, emotional climate, and structural factors[18]. Programs serving children from marginalized groups tend to score lower on various quality metrics compared to those attended by their peers, and they rarely include languages other than English[19].

Preschool curricula are one driver of the variation in early childhood program experiences and effectiveness. Preschool curricula vary widely in their features[4, 9]. For example, they differ in content (emergent, subject-matter domains, social-emotional only, or combinations), organization (e.g., theme, domain content sequences, or none), pacing (curriculum vs. teacher determined, children's thinking and learning via formative assessment, combination, or none), and use of play (mainly free play, playful with free play, or little play). In the rest of this section, we detail common approaches to preschool curriculum,

Broad approaches

Preschool curricula fall along a continuum from child-centered to curriculum-centered[9, 20]. For example, a preschool might place out toys and let children play freely. This represents an extreme form of "emergent" curriculum, with no additional organization, pacing, and mostly free play. Little or no attention is given to content domains, understanding children's conceptual development or assessment, specific vocabulary, or intentional teaching. In more advanced and theoretically grounded emergent, play-based curricula, learning arises from children's play and inquiry. Teachers observe and respond but may not follow domain-based trajectories. Reggio Emilia and Waldorf fall within this broad category.[9].

Moving a bit along the continuum is the popular use of themes, such as "all about me," colors, weather, growing plants, animals, dinosaurs, outer space, holidays, or transportation. For emergent and other approaches to early childhood education, themes can be central. Activities are not pre-ordered but are chosen so that they connect, usually by surface features, to the classroom's theme-based project—such as playing a "pizza game" because the class is making a pizza. The educational rationale is that activities embedded in thematically-based projects are more meaningful and relevant for young children and thus more effective than those in a sequence or progression[21, 22]. Pacing depends on interest in the current theme, and free play is combined with guided inquiry and project-based activities, along with deliberate introduction of book reading and vocabulary related to the theme. Formative assessment of children's development may or may not be a major part, depending on the teacher's content and pedagogical knowledge,[23] because, as with the project approach, there is often insufficient curricular

support. A similar method might involve fewer specific themes but use learning centers (either arranged with children rotating or chosen freely) in content areas like reading, writing, art, math, and science centers. Creative Curriculum and HighScope are similar to this approach.

Another approach is to first determine a developmental progression and then build themes around the content at different times (e.g., weeks), with some emerging from children. An example of this kind of curriculum is Connect4Learning (C4L)[24], which initially determines learning trajectories for all four main domains—literacy and language, social-emotional (SE), science, and math—integrating the domains selectively, and then develops themes and projects (with one unit on museums having the theme chosen by children) suited to what is studied at that moment. See Box 1 for the core tenets of a learning trajectories approach. This is an interdisciplinary approach, distinct from a fully integrated curriculum design, where domains are connected only when it benefits each domain, allowing each to retain its core conceptual and epistemological structures[9, 25]. Pacing is guided by the curriculum's units but adjusted to match children's level of understanding. Intentional teaching, including vocabulary and pedagogical strategies, correlated learning centers, and assessments, is explicitly planned. Guided inquiry, creativity, and child choice and agency are emphasized, especially during the project phase. In addition to Connect4Learning, The Great First Eight and Focus preschool curricula also exhibit many of these characteristics.

Box 1 Learning Trajectories[26]

A learning trajectory is an approach to teaching and guidance for how children typically develop understanding in a specific topic in a domain. Each has three parts:

1. A *learning goal*.
2. A *developmental progression* – the sequence of levels of thinking children naturally pass through on the way toward the goal.
3. *Instructional activities/teaching practices* – for each level in the progression, the tasks, interactions and environment are designed to support children in building new patterns of thinking.

Benefits:

- *Evidence-validated:* Based on research on how children naturally learn and develop.
- *Focus on big ideas*: Revolve around central concepts and skills, ensuring meaningful and coherent learning.
- *Developmentally appropriate*: Instruction is tailored to a child's current thinking with *formative assessment*, making learning more effective and relevant.
- *Supports equity*: By identifying where each child is along the developmental path, teachers can provide the best support and ensure all students succeed.
- *Guides teaching:* Help educators and curriculum designers know not just what to teach, but also how and when, maximizing student growth and achievement.
- *Respects diversity*: Teaching activities are matched to children's backgrounds, linguistic strengths, languages, and ways of learning.
- *Coherence: Align goals, curriculum, assessment, and instruction:* Build coherence within and across teachers, grades, and transitions, reducing fragmentation and misalignment in systems.
- *A tool for policy implementation and teacher professional development.*

A third approach starts with developing a learning trajectory for a specific domain and topic, ensuring that activities can be adapted to fit the class's theme. This is the approach Building Blocks[27] a domain-specific early math curriculum which was based on a similar interdisciplinary approach, but did not specify themes. Instead, math activities were set in a simple context that could easily be modified to match a theme. For example, an empirically-validated math learning game about counting toppings on a pizza can be adapted to a tree with apples, a cookie with chocolate chips, and so on. This illustrates that a domain-specific curriculum that can complement a global curriculum or be combined with other domain-specific curricula. A different variation was the C4L curriculum,[24] which featured a museum theme, including specific content and the suggestion that, given a museum, any content that was a favorite of the teacher or children, or emergent from the children, could be substituted.

A fourth approach downplays themes and child choice, instead focusing on one or more subject-matter domains' content and sequences. These sequences are designed less around children's developmental progress and more based on content-experts' ordering of skills, facts, vocabulary, and concepts. Pacing is set in advance and is usually as fast as possible. Examples include Reading Mastery for language and DISTAR Arithmetic for math. Direct instruction is the primary teaching method, with little or no time allocated to play.

Of course, curricula can include these features to different extents, their content can be more or less accurate, activities more or less effective and motivating, and so forth. Curriculum packages ultimately are just as complex as they are central to children's classroom experiences.

Scope and Sequence

Another key feature for which there is considerable variation in early childhood curricula is scope and sequence[9]. Most domain-specific curricula include scope and sequences in some form or another, which may be a key factor in their effectiveness. At the classroom level, some curricula simply lack these for various domains. Having a scope and sequence may be necessary but not sufficient. Including one does not always lead to greater learning compared to teacher- or locally-developed curriculum approaches[9, 28]. A sequence might exist but may not be (a) a developmental progression finely tuned to guide learning; or (b) aligned with research-validated teaching strategies and activities, like those in successful domain-specific curricula (which define learning trajectories, see in Box 1). For instance, scope and sequences in some global curricula may be helpful but too broad to support formative assessment[29]. Supporting the distinction, curricula that enhance teachers' understanding of the developmental progression and use that understanding to adjust instruction—specifically, using formative assessment correctly—is critical[30-32]. Thus, domain-specific curricula with the strongest track record follow a sequence based on developmental progressions or learning trajectories that align with the science of children's development and learning in the target area[6, 9, 24, 33].

Other aspects

The literature suggests several other aspects that may impact curriculum effectiveness. Although the quality of the evidence varies, these may be significant features for consideration by those selecting or implementing curriculum. These include: (a) an emphasis on formative assessment, (b) providing scaffolding for inclusive peer interactions, and (c) including supports for Children With Disabilities (CWD) and Multi-Lingual Learners (MLL)[9]. On the latter, acquiring two or more languages in early childhood is advantageous, not a weakness; and robust proficiency in the home language, coupled with English language skills, seems to be the most effective groundwork for success in both early and later stages of schooling[9]. Further, all young children benefit from early learning opportunities that support emergent bilingualism; therefore, early education goals can be strengthened by immediately including bilingualism as an explicit goal for multilingual learners and eventually expanding to all children[9].

Educative curricula

Effective curricula help teachers develop knowledge across all developmental domains. Without understanding the goals and big ideas of each domain and how they develop, teachers may find it difficult to recognize their early signs in children's daily activities, play, and other expressions[34, 35].

Consequently, educators might struggle to build on children's prior knowledge and to effectively implement an approach centered on asset-based learning trajectories. Due to limited preservice and in-service training for many preschool teachers, another important feature may be educative curricula, supporting both children's and teachers' learning[36]. This is especially crucial in STEM, and even in language and literacy, many practices do not align with research[9].

Furthermore, the teacher's role in implementing different types of curricula must be considered when designing the educational components of a curriculum[9]. At one end, teachers using an emergent curriculum have significant responsibilities and are expected to develop nearly all aspects of the curriculum, while also ensuring children meet important learning goals. At the other end, teachers' expertise might be undervalued, and adaptations for individual differences could be limited if administrators do not some teacher autonomy in deviatimg from the script or adapting the curriculum to be responsive to children's needs.

Research provides insights into what kind of professional development and supports are most beneficial for teachers[9, 17, 31, 37, 38]. Key messages relevant here are that basing professional development on specific curriculum materials is most effective, as is a focus on the components of earning trajectories, including the goal (teachers' content knowledge), developmental progressions (understanding how children think and learn), and instruction (pedagogical content knowledge)[23, 38]. Also, successful curriculum studies have included training and coaching focused on curriculum implementation (and not only on general best teaching practices), that is, features that have supported fidelity of implementation (see Key Finding #6 for more on teachers)[11, 17].

Key finding #3: Pre-K curricula with the strongest track records in improving instructional quality, classroom experiences, and children's early learning target specific skill areas and follow a clear developmental sequence.

Using a research-validated curriculum significantly improves instructional quality, classroom experiences, and children's early learning[9]. Available research shows that domain-specific curricula that follow a specific scope and sequence have a stronger track record in improving targeted child outcomes relative to global curricula[4, 6, 28, 39]. This pattern holds true across the domain addressed[3, 9, 40, 41] and sometimes also for other content and overall cognitive areas. For example, literacy-focused curricula improve children's literacy competencies compared to those using a global or other (including no specific) curriculum.[42]. In rigorous randomized trials, the Building Blocks math curriculum had positive impacts not just on children's math skills, but also on their executive functioning and language skills[43, 44]. These effects are especially strong when curricula are supported by regular in-classroom mentoring from an expert instructor (see Key Finding #5)[4, 6].

Research on the impacts of curriculum on classroom processes helps give insight into this pattern. For example, a study using five different large-scale datasets showed that average classroom scores in literacy, mathematics, and quality of teacher-child and peer interactions for HighScope and Creative Curriculum (i.e., two widely used global curricula) varied just as much as those using no published curriculum[30]. Further, in studies that compare domain-specific and global curricula, there are few differences in general interactions in the classroom. However, there are notable differences in content of instruction, especially for math. In studies of math curriculum that have improved children's math learning more than global curricula, math-specific curricula have also led to increased time on and quality of math-specific learning in preschool classrooms[28, 39].

Studies on the efficacy of global versus domain-specific curricula are consistent across several outcomes beyond achieving competencies in the targeted content domains. For instance, teachers' emotional support and classroom organization show inconsistent associations with academic competencies, whereas targeted domain-specific activities are consistently linked to positive outcomes[45]. Some localities have had success combining multiple-domain specific curricula[9, 11, 46, 47]. Boston Public Schools, for instance, implemented two research-validated curricula – one in language and literacy, and another in math - supported by coaching and training[44]. In rural Pennsylvania, researchers implemented literacy and social emotional-focused domain-specific curriculum in Head Start classrooms[11]. Both localities showed strong impacts on children's targeted and related but non-

targeted skills. For Boston, research found long-term (middle school) improvements on math test scores, suspension rates, and Algebra I enrollment and passing rates.[5]

Of course, implementation matters greatly for improving children's learning. Even the best curriculum will not achieve intended effects if it is only weakly implemented. Strong implementation is a key missing piece of the puzzle to improve education[48]. Further, valid measures of fidelity are required to understand implementation[49]. These measures must capture the facets of implementation that are requisite for providing high-quality educational experiences to children, and malleable. Also, fidelity instruments must go beyond simple compliance fidelity (are teachers following a script or pacing guide) to include fidelity to the vision of the curriculum[50]. The latter, for example, might include curricular compaction (skipping a lesson or unit that children already have mastered) or supplementation and adapting activities to the cultures, languages, interests, and individual needs of their children. Understanding curriculum effects fully requires data on implementation levels and quality.

Key finding #4: The most widely used Pre-K curricula lack a strong evidence base.

There are many preschool curricula; the National Academies report[9] identified over 200 referenced in publications or other publicly available resources. About half (n = 88) of the preschool curricula that NASEM identified are comprehensive or global, addressing four to eight domains of learning/child development, most frequently literacy/language, mathematics, science, social-emotional development, and the arts.

However, only a few curricula are widely used. A nationally representative survey found that 41% of state Pre-K programs and 73% of Head Start programs used global curriculum; 25% of state Pre-K programs and 20% of Head Start programs used other published curricula; and the remaining share – 34% of state Pre-K programs and 7% of Head Start programs – used a self-created curriculum or no curriculum[51]. The single most dominant curriculum was Creative Curriculum, a global curriculum, used in 32% of state Pre-K programs and 55% of Head Start programs. Another more recent 2024 nationally representative survey of school-based Pre-K programs (including Head Start programs located in schools) similarly found 67% used global curricula, with Creative Curriculum the most prevalent choice[52]. Interestingly, about half of programs had added on at least one domain-specific curriculum, with the most popular add-on being Heggerty, a phonemic awareness curriculum that takes only ~10 minutes per day to implement. Few programs that used global curriculum had layered on domain-specific curriculum in domains other than literacy. For math, only 9% had done so and for social emotional learning, it was 14%.

More effective preschool curricula are rarely used due to several barriers and challenges. First, the relative effectiveness of curricula is not widely known or appreciated. Instead, curricula may be approved or adopted for several reasons other than benefits for children and teachers. For example, they are often purchased based on history ("we've always used…"), political influences, state or local review process that privilege particular curriculum types, and superficial design and features, rather than the latest research on how children learn and how well they promote student achievement[53, 54]. Second, the Head Start Early Learning Outcomes Framework requires learning experiences in language, literacy, social-emotional development, mathematics, science, social studies, creative arts, and physical development, which may contribute to the enduring popularity of global curricula[9].

Additionally, publishing is a commercial enterprise in which a few companies control the majority of sales. Large publishers of preschool curricula have a significant influence on curriculum uptake[54, 55], including commercially motivated political influence, such as lobbyists. Publishers often do not incorporate the latest teaching methods and subject-matter content because they believe that teachers do not want a curriculum that requires them to change their practices. This has been a key contributor to the widespread use of global curricula that, compared with domain-specific curricula, have been found to have smaller gains in domain-targeted academic[51]. Finally, the difficulty of implementation is also a factor in curriculum choices (see finding #6 below).

Policy levers to shift curriculum choices include allocating additional public funding to incentivize

programs to use evidence-based curricula; providing quality improvement supports and resources to address equity and inclusion gaps; and providing technical assistance and targeted funding to support ongoing professional development related to incorporating evidence-based curricula[9].

Key finding #5: Existing evidence is somewhat mixed, but suggests that domain-specific curricula have larger impacts on children from marginalized groups and those who enter school with lower skills than their peers. Curriculum effects also vary depending on the outcome measures used to assess effects.

Heterogeneity of preschool curriculum effects for student subgroups has been less commonly studied, in part due to sample size requirements. Overall, the studies that we do have suggest that some domain-specific curricula have larger effects on children from less advantaged and marginalized backgrounds. Multiple studies, for example, have shown larger impacts of math curriculum on children with lower skills at the beginning of the preschool year,[41, 42, 56] as well as for Black and Latino children compared to White children trials (Clements et al., 2011; Clements et al., 2012; Dumas et al., 2019;[44]. For social emotional curriculum, there is similar evidence of larger gains for children with lower initial skills,[57] though another study found larger gains for children with higher skills[58]. And for children who speak a home language other than English, studies of language- and literacy-focused curriculum have had larger impacts on their oral language outcomes than global curriculum[59]. This evidence is not universal; other studies have found no differences by factors like family income, gender, race/ethnicity, disability, or home language vs. peers[44, 49, 60].

Findings also differ by the outcome measure used. For child-level outcomes, there tend to be larger effects of curriculum (and of any kind of preschool) on measures of narrower, domain-specific than broader, domain-general skills[44, 61]. For example, a widely replicated finding is larger impacts on letter-naming or letter-knowledge effects than vocabulary. This makes sense, given that there are only 26 letters but essentially no limit on vocabulary to be learned. And even within domain, the assessment used can matter (i.e., a vocabulary assessment of a small number of words explicitly taught in a curriculum would almost certainly show larger impacts than a measure of the child's overall vocabulary).

Finally, children attend preschool in a variety of settings that can include family child care homes, community-based preschool classrooms, for-profit preschools, faith-based schools, charter schools, and traditional public schools. Further, all but two states with state-funded Pre-K programs uses a mixed-delivery system, allowing public dollars to be used to fund any of these program types, depending on state rules and regulations[15]. Most commonly, curriculum studies have been conducted in just a few of these types, largely in community-based preschool classrooms (including nonprofit private programs and Head Start) and in traditional public schools. The evidence shows that programs in each of the settings can implement curricula at least moderately well[6] . Interestingly, there is evidence of differences in impacts before curriculum implementation, as well as differences in child impacts after implementation[9]. For example, a randomized trial of a preschool math curriculum in New York City found that at baseline, CBOs spent less time on math instruction and had lower-quality math instruction than public school programs. Ultimately, implementing the math curriculum increased time on math in both settings. There were impacts on children's math skills in public school only, versus impacts on their vocabulary in executive function in CBOs only[62].

Key finding #6: When given supports like training and coaching, most ECE teachers implement Pre-K curriculum with good fidelity.

Early childhood teachers are very diverse in their prior education and training, much more so than their K-12 counterparts (Chaudry et al., 2021; see Markowitz and Bassok AEFP workforce chapter). Some complete formal teacher preparation programs, hold a BA or higher, complete teaching apprenticeships, and complete state certification requirements. Others instead may hold an associate's degree and learn primarily on the job. Accordingly, the degree to which successful preschool curriculum implementation depend on teacher characteristics is an important question for policy and practice.

Fortunately, research shows that a wide range of teachers, when given supports like training and

coaching, can implement curriculum at least moderately well. For example, a study of a domain-specific language and literacy curriculum in Head Start and public pre-K in rural Appalachia included teachers with an associates degree or less, a bachelor's degree, or a masters degree found high rates of implementation fidelity, with little variation by teacher education[63] . Similarly, a study of a vocabulary and language curriculum found that teachers' education levels did not predict their implementation levels[64] . A study in community-based centers that combined social emotional, language, and literacy curriculum found no variation in implementation by teacher education or experience. However, implementation quality (but not adherence) was higher for teachers with higher-quality teaching practices at baseline, for those who were more receptive to the curriculum, and those with higher classroom resources[65] Higher fidelity in multiple studies across math, language, literacy, and multiple domains in preschool has been shown to predict larger child gains[49, 66].

For child impacts, as reviewed in NASEM[9], very few studies have been able to test whether effects of curriculum on children's learning and on classroom quality vary by teacher education and training. This is for two reasons. The first is that teacher characteristics do not tend to vary much in a given setting/study. The second is that even when there is some variation, as there can be in Head Start settings for instance, studies often lack statistical power.

With that important limitation in mind, looking across the studies that we do have, domain-specific curricula has shown positive impacts on classroom processes and child learning both in settings where teachers have both lower educational levels[67] and relatively higher educational levels[44]. A randomized trial of HighScope, a commonly used comprehensive curriculum with domain-specific supplements, found positive impacts on classroom processes but not on child learning. Most teachers in that study held a BA[68]. Interestingly, several randomized trials in the U.S. and in Santiago, Chile have found that training and in-classroom coaching for preschool teachers that is not tied to a specific curriculum has not improved children's learning[69] .

Notably, research also indicates that almost all teachers need professional development, especially in STEM, that is multifaceted; extensive; ongoing; reflective; focused on common actions and problems of practice, particularly children's thinking; grounded in specific curriculum materials; and at least partly situated in the classroom[49]. Further, curriculum materials alone, even those designed to be educational and supportive of teacher implementation, may not be enough to change teaching practices for some educators[38, 46].

Areas for Future Research

The NASEM report[9] described multiple unanswered questions regarding the effects of early childhood curricula. As NASEM committee members, we unsurprisingly agree with those conclusions. For example, we have almost no research on curricula for 0-3 year olds. We also know too little about the benefits of culturally responsive curricula, or even how any curriculum could or should be responsive. There are fewer studies on the effects of curricula in some important early education settings, such as family childcare, for-profit, charter schools, or faith-based schools. Likewise, there are few studies on effects of curriculum on multilingual learners' growth in both home language and English language development[9].

We also need research on a broader range of child outcomes. For example, while there is evidence on subject-matter content, we know little about other vital processes and constructs, such as creativity, curiosity, problem solving, collaboration, confidence, and healthy racial and subject-matter identities. These outcomes are becoming increasingly important in the present century[70]. In addition, there is intriguing evidence that some domain-specific curricula, such as in the math domain, have positive effects on language and executive function, but the consistency, replicability, and reasons for such effects have not been determined [43, 71].

We also need to learn more about the implementation and effects of other commonly used instructional approaches in preschool, such as the project approach[21] Cycle of Inquiry[34] and the Reggio Emilia approach[34, 35, 72]. These are not so much curricula as methods for organizing and engaging children with

curriculum content, often incorporated into other curricula[24].

The project approach aims to involve children over a long period of time in investigations within the social and cultural contexts of their lived experiences. Research shows that although it is difficult to implement, it can be effective when teachers possess content knowledge themselves[73] and have the potential to serve children from low-income families[74].

The Reggio Emilia approach is not a curriculum, nor is it a model. It involves collaborative project work among small groups of children and co-construction of knowledge and understanding between teachers and children[72]. One evaluation in the country of Colombia reported large effects on preschoolers' learning of math, language, literacy, executive function, and health, though the counterfactual in the preschool year was unclear, and there were some baseline differences between the groups[75]. An evaluation in Italy found benefits on a broad range of outcomes - including social-emotional skills, high school graduation, obesity, and employment - for children who attended centers that used the Reggio approach when compared to staying home with a family member, but not when compared to other early childhood programs[76]

Montessori is another popular model around the world for which rigorous research has lagged. A recent randomized study showed that Montessori implemented in public schools had no impacts on children's learning and development at age three or four compared to a counterfactual in which control group studies mostly attended other preschool programs[77] However, the treatment group had significantly higher reading, short-term memory, theory of mind, and executive function scores at the end of kindergarten. Interestingly, about half of treatment children stayed in a Montessori program in kindergarten. This study raises important questions about the timing of impact and the roll of kindergarten settings. More such studies are needed.

Finally, there is one randomized trial in 42 Head Start centers that found that a coding-readiness curriculum improved children's computational thinking skills and teacher ratings of children's math skills[78]. This is a novel, promising approach that deserves further research.

References

1. Carr RC, Watts TW, Jenkins JM, et al. The long-term effect of North Carolina pre-kindergarten is larger in school districts with lower rates of growth in academic achievement (EdWorkingPaper: 21-494). . October 2024. Suggested citation: Carr, Robert C., Tyler Watts, Jade M. Jenkins, Yu Bai, Ellen S. Peisner-Feinberg, Clara G. Muschkin, Helen F.
Ladd, and Kenneth A. Dodge. (2024). The Long-Term Effect of North Carolina Pre-Kindergarten is Larger in School Districts with
Lower Rates of Growth in Academic Achievement. : Annenberg Institute at Brown University; Cascio E. Early Childhood Education in the United States: What, when, where, who, how, and why. SSRN Electronic Journal 2021. DOI: 10.2139/ssrn.3834162; Johnson AD, Partika A, Martin A, et al. Public preschool predicts stronger third-grade academic skills. AERA Open 2024; 10. DOI: 10.1177/23328584231223477; Gibbs CR. Broader benefits of ECE. In: Harris D (ed) Live Handbook of Education Policy Research. Association for Education Finance and Policy (AEFP), 2025; List JA and Uchida H. Here today, gone tomorrow? Toward an understanding of fade-out in early childhood education programs (Working paper 33027). October 2024. National Bureau of Economic Research; Suna HE and Ozer M. Medium- and long-term outcomes of early childhood education: experiences from Turkish large-scale assessments. Humanities and Social Sciences Communications 2024; 11: 853. DOI: 10.1057/s41599-024-03241-9; Yang H. The effects of Wisconsin's universal prekindergarten program on third-grade academic achievement. American Educational Research Journal 2024: 00028312241275967. DOI: 10.3102/00028312241275967; Yoshikawa H, Weiland C and Brooks-Gunn J. When does preschool matter? The Future of Children 2016; 26: 21–35.
2. Humphries JE, Neilson C, Ye X, et al. Parents' earnings and the returns to universal pre-kindergarten (No. w33038). 2024. National Bureau of Economic Research.
3. Mattera S, Jacob R, Morris-Perez P, et al. The impact of Making PreK Count on short and longer-term outcomes 2025.
4. Phillips DA, Lipsey MW, Dodge KA, et al. Puzzling it out: The current state of scientific knowledge on pre-kindergarten effects. The current state of scientific knowledge on pre-kindergarten effects 2017: 19–30.
5. Weiland C, Wu T, Unterman R, et al. Impacts of oversubscribed Boston Pre-K programs through middle school. 2025.
6. Yoshikawa H, Weiland C, Brooks-Gunn J, et al. Investing in our future: The evidence base on preschool education. 2013. Washington, DC: Society for Research in Child Development.
7. Weiland C, Moffett L, Rosada PG, et al. Learning experiences vary across young children in the same classroom: Evidence from the individualizing student instruction measure in the Boston Public Schools. Early Childhood Research Quarterly 2023; 63: 313–326. DOI: 10.1016/j.ecresq.2022.11.008.
8. Weiland C and Guerrero-Rosada P. Early care and education quality. LiveHandbook. Charlottesville, VA: Association for Education Finance and Policy (AEFP), 2024.
9. National Academies of Sciences, Engineering, and Medicine. A new vision for high-quality preschool curriculum. Washington, DC: The National Academies Press, 2024.
10. Steiner D. Curriculum policy. Live Handbook of Education Policy Research. Association for Education Finance and Policy (AEFP), 2025.
11. Bierman KL, Domitrovich CE, Nix RL, et al. Promoting academic and social-emotional school readiness: The Head Start REDI Program. Child Development 2008; 79: 1802–1817. DOI: 10.1111/j.1467-8624.2008.01227.x.
12. McCormick MP, MacDowell C, Weiland C, et al. Instructional alignment is associated with PreK persistence: Evidence from the Boston Public Schools. Early Childhood Research Quarterly 2024; 67: 89–100. DOI: https://doi.org/10.1016/j.ecresq.2023.11.008.
13. Scott-Little C, Kagan SL, Reid JL, et al. Early mathematics standards in the United States: Understanding their content. Los Altos, CA: Heising-Simons Foundation, 2011.
14. Friedman-Krauss A and Weisenfeld GG. The state of preschool curricula in state-funded preschool. New Brunswick, NJ: National Institute for Early Education Research, 2025.
15. Friedman-Krauss AH, Barnett WS, Hodges KS, et al. The state of preschool 2024: State preschool yearbook. New Brunswick, NJ: National Institute for Early Education Research, 2025.
16. Cabell SQ, DeCoster J, LoCasale- Crouch J, et al. Variation in the effectiveness of instructional interactions across preschool classroom settings and learning activities. Early Childhood Research Quarterly 2013; 28: 820–830.
17. Weiland C, McCormick M, Mattera S, et al. Preschool curricula and professional development features for getting to high-quality implementation at scale: A comparative review across five trials. AERA Open 2018; 4. DOI: 10.1177/2332858418757735.
18. Burchinal MR. Measuring early care and education quality. Child Development Perspectives 2017; 12: 3–9. DOI: 10.1111/cdep.12260; Weiland C and Rosada PG. WIdely used measures of pre-k classroom quality: What we know, gaps in the field, and promising new directions. May 2022. New York, NY: MDRC.
19. Latham S, Corcoran SP, Sattin-Bajaj C, et al. Racial disparities in pre-K quality: Evidence from New York City's universal pre-K program. Educational Researcher 2021; 50: 607–617. DOI: 10.3102/0013189x211028214; Valentino R. Will public pre-K really close achievement gaps? Gaps in prekindergarten quality between students and across states. American Educational Research Journal 2018; 55: 79–116.
20. Sarama J and Clements DH. Playing to know the world mathematically. Educational Studies in Mathematics 2025. DOI: 10.1007/s10649-025-10446-5.
21. Helm JH and Katz LG. Young investigators: The project approach in the early years. 3rd ed. New York, NY: Teachers College Press, 2016; Katz LG, Chard SC and Kogan Y. Engaging children's minds: The project approach. 3rd ed. 2014.
22. Tullis P. The death of preschool. Scientific American Mind 2011; 22: 36–41.
23. Shulman LS. Those who understand: Knowledge growth in teaching. Educational Researcher 1986; 15: 4–14.
24. Sarama J, Brenneman K, Clements DH, et al. Interdisciplinary teaching across multiple domains: The C4L (Connect4Learning) Curriculum. In: Bailey LB (ed) Implementing a standards-based curriculum in the early childhood classroom. New York, NY: Routledge, 2017, pp.1–53.
25. National Academies of Sciences, Engineering, and Medicine. Science and engineering in preschool through elementary grades: The brilliance of children and the strengths of educators. Washington, DC: The National Academies Press, 2022.
26. Clements DH and Sarama J. Systematic review of learning trajectories in early mathematics. ZDM – Mathematics Education 2025; 57 637–650. DOI: 10.1007/s11858-024-01644-1; Clements DH and Sarama J. Learning and teaching early math: The learning trajectories approach. 4th ed. New York, NY: Routledge, in press.
27. Sarama J and Clements DH. The Building Blocks and TRIAD projects. In: Sztajn P and Wilson PH (eds) Learning trajectories for teachers: Designing effective professional development for math instruction. New York, NY: Teachers College Press, 2019, pp.104–131.
28. Jenkins JM, Duncan GJ, Auger A, et al. Boosting school readiness: Should preschool teachers target skills or the whole child? Economic of Education Review 2018; 65: 107–125. DOI: 10.1016/j.econedurev.2018.05.001.

29. Clements DH and Sarama J. A framework of scientific methods for developing classroom-based practices, pedagogies, programs, and policies. In: Saracho ON (ed) Research methods for studying young children. Charlotte, NC: Information Age, 2025.

30. Jenkins JM, Whitaker AA, Nguyen T, et al. Distinctions without a difference? Preschool curricula and children's development. Journal of Research on Educational Effectiveness 2019; 12: 514–549. 20190809. DOI: 10.1080/19345747.2019.1631420.

31. Jiang H, Justice LM, Lin T-J, et al. Peer experiences in the preschool classroom: Contribution to children's academic development. Journal of Applied Developmental Psychology 2023; 86. DOI: 10.1016/j.appdev.2023.101542.

32. Maskos K, Schulz A, Oeksuez SS, et al. Formative assessment in mathematics education: A systematic review. ZDM – Mathematics Education 2025. DOI: 10.1007/s11858-025-01696-x; Sarama J, Clements DH and Spitler ME. Evidence of teacher change after participating in TRIAD's learning trajectories-based professional development and after implementing learning trajectory-based mathematics. Mathematics Teacher Education and Development 2017; 19: 58–75; Shepard LA and Pellegrino JW. Classroom assessment principles to support learning and avoid the harms of testing. Educational Measurement: Issues and Practice 2018; 37: 52–57. DOI: 10.1111/emip.12195.

33. Weiland C and Yoshikawa H. The effects of large-scale economic change and policies on children's developmental contexts and developmental outcomes. Child Development Perspectives 2012; 6: 342–350. DOI: 10.1111/j.1750-8606.2011.00222.x.

34. Broderick JT and Hong SB. From children's interests to children's thinking: Using a cycle of inquiry to plan curriculum. Washington, DC: National Association for the Education of Young Children, 2020.

35. Edwards C, Gandini L and Forman GE. The hundred languages of children: The Reggio Emilia experience in transformation. 3rd ed. Westport, CT: Praeger, 2012.

36. Drake C, Land TJ and Tyminski AM. Using educative curriculum materials to support the development of prospective teachers' knowledge. Educational Researcher 2014; 43: 154–162. DOI: 10.3102/0013189X14528039.

37. Beyer CJ and Davis EA. Using educative curriculum materials to support preservice elementary teachers' curricular planning: A comparison between two different forms of support. Curriculum Inquiry 2015; 39: 679–703. DOI: 10.1111/j.1467-873X.2009.00464.x; Broderick JT, Sareh N and Aggrey PM-B. Teaching preschool teachers to converse productively with children: A single case design. Early Childhood Education Journal 2022; 51: 165–178. DOI: 10.1007/s10643-021-01284-0; Clements DH and Conference Working Group. Part one: Major themes and recommendations. In: Clements DH, Sarama J and DiBiase A-M (eds) Engaging young children in mathematics: Standards for early childhood mathematics education. Mahwah, NJ: Erlbaum, 2004, pp.1–72; Davis EA, Palincsar AS, Smith PS, et al. Educative curriculum materials: Uptake, impact, and implications for research and design. Educational Researcher 2017; 46: 293–304. DOI: 10.3102/0013189x17727502; Hamre BK, Partee A and Mulcahy C. Enhancing the Impact of Professional Development in the Context of Preschool Expansion. AERA Open 2017; 3: 2332858417733686. DOI: 10.1177/2332858417733686; Hill HC and Papay JP. Dispelling the myths: What the research says about teacher professional learning. Epub ahead of print Feb. 15; Hill HC, Mancenido Z and Loeb S. Effectiveness research for teacher education. Educational Researcher 2024; 53: 370–377. DOI: 10.3102/0013189X241260393.

38. Lynch K, Hill HC, Gonzalez KE, et al. Strengthening the research base that informs STEM instructional improvement efforts: A meta-analysis. Educational Evaluation and Policy Analysis 2019; 41: 260–293. DOI: 10.3102/0162373719849044.

39. Clements DH, Sarama J, Layzer C, et al. Implementation of a scale-up model in early childhood: Long-term impacts on mathematics achievement. Journal for Research in Mathematics Education 2023; 54: 64–88. DOI: 10.5951/jresematheduc-2020-0245; Mattera S, Jacob R and Morris P. Strengthening children's math skills with enhanced instruction: The impacts of Making Pre-K Count and High 5s on kindergarten outcomes. 2018. MDRC; Wakabayashi T, Andrade-Adaniya F, Schweinhart LJ, et al. The impact of a supplementary preschool mathematics curriculum on children's early mathematics learning. Early Childhood Research Quarterly 2020; 53: 329–342. DOI: 10.1016/j.ecresq.2020.04.002.

40. Clements DH, Sarama J, Wolfe CB, et al. Longitudinal evaluation of a scale-up model for teaching mathematics with trajectories and technologies: Persistence of effects in the third year. American Educational Research Journal 2013; 50: 812 – 850. DOI: 10.3102/0002831212469270.

41. Mattera SK, Jacob R, MacDowell C, et al. Long-term effects of enhanced early childhood math instruction: The impacts of Making Pre-K Count and High 5s on third-grade outcomes. 2021. New York, NY: MDRC.

42. Shea ZM, Piasta SB, Shen Y, et al. Is use of literacy-focused curricula associated with children's literacy gains and are associations moderated by risk status, receipt of intervention, or preschool setting? Education Sciences 15. DOI: 10.3390/educsci15101368.

43. Clements DH, Sarama J, Layzer C, et al. Effects on mathematics and executive function of a mathematics and play intervention versus mathematics alone. Journal for Research in Mathematics Education 2020; 51: 301–333. DOI: 10.5951/jresemtheduc-2019-0069; Sarama J, Lange A, Clements DH, et al. The impacts of an early mathematics curriculum on emerging literacy and language. Early Childhood Research Quarterly 2012; 27: 489–502. DOI: 10.1016/j.ecresq.2011.12.002.

44. Weiland C and Yoshikawa H. Impacts of a prekindergarten program on children's mathematics, language, literacy, executive function, and emotional skills. Child Development 2013; 84: 2112–2130. DOI: 10.1111/cdev.12099.

45. Rademacher A, Bäker N, von Düring U, et al. The effects of early childhood education and care quality on academic competences in early primary school: A systematic review and meta-analysis. European Journal of Psychology of Education 2025; 40: 110. DOI: 10.1007/s10212-025-01005-w.

46. Lonigan CJ, Phillips BM, Clancy JL, et al. Impacts of a comprehensive school readiness curriculum for preschool children at risk for educational difficulties. Child Development 2015; 86: 1773–1793. DOI: https://doi.org/10.1111/cdev.12460.

47. Weiland C and Yoshikawa H. Impacts of BPS K1 on children's early numeracy, language, literacy, executive functioning, and emotional development. In: Education HGSo, (ed.). School Committe, Boston Public Schools. Boston, MA2012.

48. Borman GD, Hewes GM, Overman LT, et al. Comprehensive school reform and achievement: A meta-analysis. Review of Educational Research 2003; 73: 125–230. DOI: 10.3102/00346543073002125.

49. Sarama J, Clements DH, Starkey P, et al. Scaling up the implementation of a pre-kindergarten mathematics curriculum: Teaching for understanding with trajectories and technologies. Journal of Research on Educational Effectiveness 2008; 1: 89–119. DOI: 10.1080/19345740801941332.

50. Sarama J and Clements DH. Research and curricula. In: Leatham KR (ed) Designing, conducting, and publishing quality research in mathematics education Research in mathematics education. Cham, Switzerland: Springer, 2019, pp.61–83.

51. Jenkins JM and Duncan GJ. Do pre-kindergarten curricula matter? In: Phillips DA, Dodge K and Pre-Kindergarten Task Force (eds) The current state of scientific knowledge on pre-kindergarten effects. Washington, D.C.: Brookings Institution and Duke University, 2017.

52. Shapiro A, Steiner ED, Woo A, et al. Instructional resources in public school–based pre-l. 2025. Santa Monica, CA RAND Corporation.

53. Jobrack B. Tyranny of the textbook: An insider exposes how educational materials undermine reforms. Lanham, Maryland: Rowman & Littlefield Publishers, 2011.

54. Peters L, Nagasawa M, Calderon MM, et al. What happened to the creative in the Creative Curriculum? Global Education Review 2025; 12: 4–22.

55. Duncan RG and Gotwals AW. A tale of two progressions: On the benefits of careful comparisons. Science Education 2015. DOI: 10.1002/sce.21167; School Readiness Consulting (SRC). Side by side: A playbook on centering and promoting equity in early education. 2022. Silver Spring, MD: Author.

56. Watts TW, Duncan GJ, Clements DH, et al. What is the long-run impact of learning mathematics during preschool? Child Development 2018; 89: 539–555. DOI: 10.1111/cdev.12713.

57. Finlon KJ, Izard CE, Seidenfeld A, et al. Emotion-based preventive intervention: Effectively promoting emotion knowledge and adaptive behavior among at-risk preschoolers. Development and Psychopathology 2015; 27: 1353–1365. 2015/01/09. DOI: 10.1017/S0954579414001461; Flook L, Goldberg SB, Pinger L, et al. Promoting prosocial behavior and self-regulatory skills in preschool children through a mindfulness-based kindness curriculum. Developmental psychology 2015; 51: 44–51. DOI: 10.1037/a0038256.

58. Shea ZM and Jenkins JM. Examining heterogeneity in the impacts of socio-emotional curricula in preschool: A quantile treatment effect approach. Frontiers in Psychology 2021; 12: 624320. DOI: 10.3389/fpsyg.2021.624320.

59. Kaiser A, Dickinson D, Roberts M, et al. The effects of two language-focused preschool curricula on children's achievement through first grade. Society for Research on Educational Effectiveness. Washington, D.C.,: SREE, 2011; Wilson SJ, Dickinson DK and Rowe DW. Impact of an Early Reading First program on the language and literacy achievement of children from diverse language backgrounds. Early Childhood Research Quarterly 2013; 28: 578–592. DOI: 10.1016/j.ecresq.2013.03.006.

60. Clements DH and Sarama J. Experimental evaluation of the effects of a research-based preschool mathematics curriculum. American Educational Research Journal 2008; 45: 443–494. DOI: 10.3102/0002831207312908; Dumas DG, McNeish D, Sarama J, et al. Preschool mathematics intervention can significantly improve student learning trajectories through elementary school. AERA Open 2019; 5: 1–5. DOI: 10.1177/2332858419879446; McCarthy B. Learning with PBS KIDS: A study of family engagement and early mathematics achievement. WestEd, 2015; Nesbitt KT and Farran DC. Effects of prekindergarten curricula: Tools of the Mind as a case study. Monographs of the Society for Research in Child Development 2021; 86. DOI: 10.1111/mono.12425.

61. Goodrich JM, Lonigan CJ and Farver JAM. Impacts of a literacy-focused preschool curriculum on the early literacy skills of language-minority children. Early childhood research quarterly 2017; 40: 13–24; Gormley W, Gayer T, Phillips D, et al. The effects of universal pre-K on cognitive development. Developmental Psychology 2005; 41: 872–884; Wong VC, Cook TD, Barnett WS, et al. An effectiveness-based evaluation of five state pre-kindergarten programs. Journal of Policy Analysis and Management 2008; 27: 122–154.

62. McCormick MP, Mattera SK, Maier MF, et al. Different settings, different patterns of impacts: Effects of a Pre-K math intervention in a mixed-delivery system. Early Childhood Research Quarterly 2022; 58: 136–154.

63. Piasta SB, Logan JAR, Pelatti CY, et al. Professional development for early childhood educators: Efforts to improve math and science learning opportunities in early childhood classrooms. Journal of Educational Psychology 2015; 107: 407–422. DOI: 10.1037/a0037621.

64. Phillips BM, Ingrole SA, Burris PW, et al. Investigating predictors of fidelity of implementation for a preschool vocabulary and language curriculum. Research in Young Children's Literacy and Language Development. Routledge, 2019, pp.244–255.

65. Hunter J, Hunter R, Tupouniua J, et al. Bringing the home into school: learning and connecting through mathematics education during the time of a pandemic. Educational Studies in Mathematics 2022; 111: 207–224.

66. Hamre BK, Justice LM, Pianta RC, et al. Implementation fidelity of MyTeachingPartner literacy and language activities: Association with preschoolers' language and literacy growth. Early Childhood Research Quarterly 2010; 25: 329–347. DOI: http://doi.org/10.1016/j.ecresq.2009.07.002; Maier MF, McCormick MP, Xia S, et al. Content-rich instruction and cognitive demand in prek: Using systematic observations to predict child gains. Early Childhood Research Quarterly 2022; 60: 96–109. DOI: 10.1016/j.ecresq.2021.12.010.

67. Bierman KL, Nix RL, Greenberg MT, et al. Executive functions and school readiness intervention: Impact, moderation, and mediation in the Head Start REDI program. Development and Psychopathology 2008; 20: 821–843. DOI: 10.1017/S0954579408000394; Morris PA, Mattera SK, Castells N, et al. Impact findings from the Head Start CARES Demonstration: National evaluation of three approaches to improving preschoolers' social and emotional competence (OPRE Report 2014-44). Washington, DC: Office of Planning, Research and Evaluation, Administration for Children and Families, U.S. Department of Health and Human Services, 2014.

68. Howard SJ, Neilsen-Hewett C, de Rosnay M, et al. Validity, reliability and viability of pre-school educators' use of early years toolbox early numeracy. Australasian Journal of Early Childhood 2021; 0: 1–15. DOI: 10.1177/18369391211061188.

69. Pianta R, Hamre B, Downer J, et al. Early childhood professional development: Coaching and coursework effects on indicators of children's school readiness. Early Education and Development 2017; 28: 956–975; Piasta SB, Justice LM, O'Connell AA, et al. Effectiveness of large-scale, state-sponsored language and literacy professional development on early childhood educator outcomes. Journal of Research on Educational Effectiveness 2017; 10: 354–378; Yoshikawa H, Leyva D, Snow CE, et al. Experimental impacts of a teacher professional development program in Chile on preschool classroom quality and child outcomes. Developmental Psychology 2015; 51: 309–322. DOI: 10.1037/a0038785.

70. Hirsh-Pasek K, Hadani HS, Blinkoff E, et al. A new path to education reform: Playful learning promotes 21st century skills in school and beyond. Policy Brief 2020: 1–25; McCoy DC and Sabol TJ. Overcoming the streetlight effect: Shining light on the foundations of learning and development in early childhood. American Psychologist 2025; 80: 135. DOI: 10.1037/amp0001432.

71. Jiao X, Traverso L and Gai X. Examining the effectiveness of group games in enhancing inhibitory control in preschoolers. Early Education and Development 2021; 32: 741–763. DOI: 10.1080/10409289.2020.1802972; McCormick MP, Mattera SK, Maier MF, et al. Different settings, different patterns of impacts: Effects of a Pre-K math intervention in a mixed-delivery system. Early Childhood Research Quarterly 2021; 58: 136–154. DOI: 10.1016/j.ecresq.2021.08.005.

72. Rinaldi C. In dialogue with Reggio Emilia: Listening, researching and learning. 2nd ed. New York, NY: Routledge, 2021.

73. National Academies of Sciences, Engineering, and Medicine. How people learn II: Learners, contexts, and cultures. Washington, DC: The National Academies Press, 2018.

74. Halvorsen A-L, Duke NK, Brugar KA, et al. Narrowing the achievement gap in second-grade social studies and content area literacy: The promise of a project-based approach. Theory & Research in Social Education 2012; 40: 198–229. DOI: 10.1080/00933104.2012.705954.

75. Bernal R, Giannola M and Nores M. The effects of a project and play-based early education program on medium term developmental trajectories of young children in a low-income setting. New Brunswick, NJ: National Institute for Early Education Research & Bogotá, Colombia:
Universidad de Los Andes, 2022.

76. Biroli P, Del Boca D, Heckman JJ, et al. Evaluation of the Reggio approach to early education. Research in Economics 2018; 72: 1–32.

77. Lillard AS, Loeb D, Berg J, et al. A national randomized controlled trial of the impact of public Montessori preschool at the end of kindergarten. Proceedings of the National Academy of Sciences 2025; 122: e2506130122.

78. Doss C, Pane JF and Jones V. Teaching computational thinking to children in Head Start Classrooms: Results from a randomized controlled trial.