



Math and Science in Preschool: Policies and Practice

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Improving mathematics and science learning is of great concern to educators and policymakers. Because early experiences affect later education outcomes, providing young children with research-based mathematics and science learning opportunities is likely to pay off with increased achievement, literacy, and work skills in these critical areas. This report addresses the development of mathematics and science understanding in preschool children, reviews the current knowledge base on educational practices in these domains, identifies areas that require further study, and outlines recommendations for early education policy in mathematics and science.



Preschool Policy Facts

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What We Know:

- Young children have foundational competence in mathematics and science *before* they begin formal schooling.
- Children are motivated to explore mathematical and scientific concepts they encounter in their everyday interactions with the world.
- Comprehensive curricula are strengthening their offerings, and subject-specific programs are emerging. Almost every state has developed mathematics and science learning expectations or standards for preschoolers.
- Despite the existence of learning standards and increased curricular attention to mathematics and science, they tend not to be emphasized by teacher preparation or in-service professional development programs and evidence suggests that preschool educators tend not to support mathematics and science learning.
- In general, little is known about effective teaching of mathematics in preschool and even less is known about science.

Policy Recommendations:

- Mathematics and science should be treated as essential components of a comprehensive, high-quality preschool program, not as extras.
- Policymakers must be certain that curricula, learning standards, and teaching expectations for early mathematics and science are research based and must outline expectations that are attainable and appropriate for preschool learners.
- Early education policies should define mathematics as more than counting and number, and science should be treated as more than learning lists of facts.
- Pre-service and in-service educators need improved preparation to understand math and science content and to provide experiences integrating this content into their teaching practice.
- Appropriate accountability systems that focus on the classroom, the teacher, and the child must be built to support high-quality early mathematics and science education.
- Mathematics and science learning should be integrated with each other and with other content domains.

Young children demonstrate a natural interest in exploring everyday math and science concepts. These early explorations and engagement in associated thinking processes serve as foundations for learning as children continue toward more formal understandings.

Early Math Competence

Preschool children are capable of learning how to “tag” objects individually with only one number in the counting sequence. Preschoolers learn about spatial relationships and geometric shapes by moving through classroom and outdoor spaces and by manipulating toys such as puzzles. They also demonstrate emerging awareness of measurement when they begin to notice differences in the height, weight, and length of objects. Children as young as 3 or 4 years old begin to think algebraically by manipulating pattern blocks or arranging objects according to a rule. Children’s propensity to collect and sort items by their attributes is a key component of the ability to represent, analyze, and interpret mathematical data.

Early Science Competence

Children enter kindergarten with a great deal of knowledge about the natural world, including understandings of cause and effect; differences between animate and inanimate objects; ways in which people’s beliefs, goals, and desires affect behavior; and substances and their properties. Preschool children can think abstractly about various scientific concepts and possess dispositions and thinking skills that support later, more sophisticated, scientific reasoning. Older preschoolers are able to interpret simple data patterns and show some understanding of how different patterns support different conclusions.

Connections Among Literacy, Mathematics and Science

Opportunities to explore math and

science concepts matter because they support *language and literacy* development, independent of any effect on later math and science achievement. Science and math experiences support vocabulary development by exposing children to a variety of new words in meaningful contexts. Conversations about objects that are not present or events in the past or future support the development of abstract reasoning and are related to literacy skills. Science journals provide opportunities for children to practice emerging printing and spelling abilities. When teachers transcribe children’s observations, predictions, and explanations on their journal entries or on charts, they illustrate the links between spoken and written language.

Critical Issues

1. Early Learning Standards

Experts in early mathematics agree that standards should be research based and should focus on big ideas, such as number and operations, geometry and spatial relations, and algebraic thinking/problem solving. At the K-8 level, science educators and policymakers are calling for learning expectations that focus on the big ideas of science; this is also a reasonable goal for preschool expectations.

2. Curriculum and Classroom Practices: More Than Calendars and Daily Weather

A quality curriculum provides experiences in mathematics that encourage thinking and reasoning about numbers and support investigations into size, quantity, properties of objects, patterns, space, and measurement. In high-quality preschool programs, mathematical thinking and reasoning are encouraged as children engage in activities such as counting, measuring, constructing with blocks, and manipulating geometric shapes. Similarly, a quality preschool supports children as they learn key content and practices

of science by providing opportunities to observe, explore, experiment with, question, and discuss a range of scientific phenomena.

3. Accountability and Assessment

Performance-based assessment tools have been developed that rely on systematic teacher observation and documentation of children’s development and learning. Although there is reasonable concern that assessments can narrow what teachers teach, well-designed, comprehensive assessment tools for math and science can support and expand learning activities.

4. Teacher Preparation and Professional Development

Many preschool teachers consider mathematics and science difficult to teach, which is not surprising because teachers traditionally have not been prepared to support children’s learning in these areas. Preservice preparation programs should provide opportunities for integrating mathematics and science into teaching practice. In-service professional development should move beyond one-day workshops and into approaches that allow teachers to explore deeply the content and pedagogy of math and science.

5. Home-School Connection

Like many preschool teachers, parents report trying to help their children learn math but feel less capable to support early math than they do literacy. Many recommendations to improve early math and science teaching apply equally to the home environment. Parents will be able to provide better learning supports if they understand the importance of early math and science, are given examples of the ways preschoolers learn math and science, and are provided with practical strategies to leverage and increase children’s natural interest in these areas.