Early Education for All

A campaign of Strategies for Children

High-Quality Early Learning Promotes Success in Science and Math

Today's economy increasingly requires science and math skills. However, far too many Massachusetts students struggle with these subjects. On the National Assessment of Educational Progress (NAEP) in 2013, 42% of our 4th grade students and 45% of our 8th grade students scored below proficient in math.[1] 56% of our 8th graders score below proficient in science.[2] After graduating high school, many students with low math skills are required to take remedial math courses in college, particularly at community colleges. Data from the Department of Higher Education show that a high percentage of students who take remedial courses do not go on to complete credit-bearing college-level math,[3] a sign that math ability is a barrier to college completion.

The foundation for developing math and science skills and children's enthusiasm for these subjects begins in early childhood. There are many ways that Massachusetts is leading the way in best practice at both the policy and programmatic level.

> "Investing to ensure a pipeline of workers skilled in STEM competencies is a workforce issue, an economic-development issue, and a business imperative. And the best way to ensure return on these investments is to start fostering these skills in young children."
> - JD Chesloff, executive director, Massachusetts Business Roundtable. Commentary in Education Week, March 6, 2013

Early childhood development is connected to STEM learning

- Neuroscience research shows that critical aspects of brain architecture are shaped by experiences in the first few years of life. It is important to take advantage of these early stages to help develop children's learning capacities.[4]
- The brain is particularly receptive to learning math and logic between the ages of 1 and 4.[5]
- Inquiry and exploration are foundations for math and science and are also the foundations of early learning.[6]

Early math ability predicts later outcomes

- Achievement gaps in children's math ability (by race, poverty status, parent education level) have been clearly documented upon kindergarten entry.[8]
- Research demonstrates that early math knowledge is a powerful predictor of later learning. Early math skills also strongly predict later reading achievement.[9]
- Early math ability can also impact future educational attainment. Research has shown persistently low-achieving math students at ages 6, 8, and 10 are 13 percentage points less likely to graduate from high school and 29 percentage points less likely to attend college than higher achieving peers.[10]

High-quality early education improves math and science achievement

- Low-income children who attended high-quality early education programs on average outperformed those who did not on mathematics tests throughout childhood and young adulthood.[11]
- In Georgia and Oklahoma, states with two of the nation's largest state-funded pre-kindergarten programs, children who attend pre-kindergarten demonstrate better kindergarten-preparedness in reading, math and social skills.[12] [13]
- New Jersey's high-quality Abbott Preschool program has shown significant effects on children's science and math outcomes through fourth grade and fifth grade, respectively (science test only administered in 4th grade). Effects are strongest for children who experienced two years of preschool, and are the equivalent of closing 20-40% of the achievement gap between white and minority students.[14]

How math and science exploration takes place at an early age

Young children are naturally inquisitive learners who ask an average of 76 questions per hour. Young children are also natural scientists—they make sense of the world around them by making predictions, checking them, and using evidence to make inductions and deductions.[7]

Children learn about **science** through play. They blow soap bubbles, for instance, add a block that causes a tower to collapse or refract light through a prism.

Children learn to solve **math** problems as they design and test solutions through the construction of block towers, piecing together puzzles and even dividing up a snack among friends.

High-quality early learning environments provide children a structure in which to build upon their natural inclination to explore.

Business, education and policy leaders recognize the critical link between early education and STEM for children's success in school, college and career

- Leaders in business, science and technology support high-quality early education. Among them are Verizon Communications, Inc., Staples, Inc., PNC Bank, Associated Industries of Massachusetts, the Massachusetts Business Roundtable, the National Association of Manufacturers and the American Chemical Society.[15]
- Massachusetts Governor Deval Patrick's STEM Advisory Council set goals for improving students' STEM achievement in the commonwealth. Its recommendations include increasing the number of educators trained in STEM subjects in pre-kindergarten through grade 12.[16]

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Massachusetts early learning standards and curriculum integrate STEM

- In 2011, Massachusetts updated its curriculum standards for math to incorporate the adopted Common Core State Standards, and began providing professional development to educators on the implementation of the standards. The Massachusetts Curriculum Frameworks for Mathematics Grades Pre-Kindergarten to 12, defines the knowledge and skills that children should develop in the year prior to kindergarten (i.e., older four- and younger five-year olds).[17]
- To complement these and other existing early childhood standards, Pre-k Science Technology and Engineering Standards (STE) have been drafted by The Department of Early Education and Care and the Aspire Institute at Wheelock College, with feedback from the public.[18] The STE standards identify learning outcomes for students and focus on three domains, practices of science and technology, cross-cutting concepts, and disciplinary core ideas. The standards were adopted in October 2013 and are available on EEC's website: http://www.mass.gov/edu/docs/eec/2013/20131009-pk-sci-tech-standards.pdf.
- In the fiscal year 2014 state budget, $250,000 was appropriated to develop innovative preschool curriculum with a STEM focus. Five grants were awarded to providers and community partners statewide, including the Heritage Museum and Gardens in Sandwich, MA which enrolled 40 students in a new STEM preschool located at the museum.[19] Curricular materials are archived online and available for use by educators: http://www.mass.edu/stem/initiatives/otherstateearlycurricula.asp

Room for improvement: investments in professional development

- A recent study shows that myths persist in the early childhood field about how young children learn math concepts. These include the myths that children are too young to learn math, that they should only learn math using simple shapes and numbers, or that literacy is more important than math. In fact, research shows that young children are capable of learning broad, complex and sophisticated math concepts such as geometry, measurement, data analysis and problem solving.[20]
- In January, 2014, the National Science Teachers Association issued a position statement on early childhood science education. Based on current research on young children's capacity for inquiry, exploration, and focus, the NSTA makes detailed recommendations for educators, professional development providers, and policymakers to ensure higher quality science-based experiences for preschool-age children.[21]
- Massachusetts should continue to invest in early childhood educator professional development, in STEM subjects as well as early literacy and social/emotional development. This includes continued state budget support for the Early Childhood Educator Scholarship for educators to pursue and complete AA and BA degrees. Supports like tutoring and study groups are also needed at the college and university level to help early educators complete math requirements, and adequate courses and professional development should be available for educators to learn strategies to better integrate STEM into their teaching practice.

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