STEM and Early Childhood—When Skills Take Root

Pennsylvania businesses and the military warn of STEM workforce skills gap; urge greater access to pre-k

MISSION: READINESS

ReadyNation

Acknowledgements

Mission: Readiness is the nonpartisan national security organization of more than 600 retired generals and admirals calling for smart investments in the upcoming generation of American children. **ReadyNation** is the nation's preeminent business leader organization, whose more than 1,400 members work to strengthen business through effective policies for children and youth. Both organizations operate under the umbrella of the non-profit Council For A Strong America.

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Summary

Nearly two-thirds of Pennsylvania 8th graders aren't proficient in math and science, and more than a quarter of students entering the PA State System of Higher Education require remedial education in math and English. As a result, employers—both in the private sector and the military—are struggling to find the STEM (science, technology, engineering and math) skilled workforce they need. That's why business and military leaders in Pennsylvania are calling on policymakers to invest more in high-quality early education where STEM skills take root.

Importance of STEM

STEM occupations in sectors like healthcare and computer science will drive our economy—growing by as much as 20 to 37 percent nationwide.[2] Moreover, STEM jobs are typically higher paying than jobs in many other fields, with some boasting salaries more than double the median salary for all workers.[3] And this salary boost holds despite the fact that many STEM jobs do not require four-year college degrees.[4]

An adequate STEM workforce is also critical to our increasingly technology-focused military. For example, the US Army operates 16 laboratories and research centers employing more than 16,000 world-class scientists and engineers who "develop leading-edge technologies and advanced capabilities that give our soldiers…the decisive advantage."[5]

To better fulfill current STEM workforce needs and build a pipeline for the future, businesses and the military, as well as higher and K-12 education, are engaging in strategic partnerships to both retrain current employees and remediate / bolster STEM (and other) skills among our students. These efforts include working with middle and high schools, technical schools, colleges and universities to offer enrichment opportunities, competitions, apprenticeships and scholarships.[7]

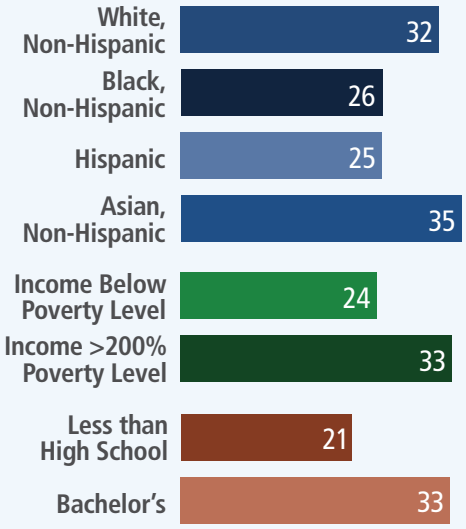
"More than half of PA employers (52 percent) reported having difficulty hiring people with adequate skills, training or education. This is especially true of the technical / skilled trade jobs."

– Pennsylvania Chamber of Business and Industry[1]

FIGURE 1:

Achievement Gaps in Math Start Early and Are Highly Dependent on Social Factors

Math scores for children coming from disadvantaged homes were significantly lower than their peers when entering kindergarten for the first time in 2010.



Note: Scores range from 0-75. Skills assessed include counting, geometry, identification of patterns, and identification of shapes.

Source: U.S. Department of Education, Early Childhood Longitudinal Study math assessment, 2010-2011.

STEM and Early Childhood

A growing body of research, however, suggests that developing STEM proficiency starts much earlier than high school, middle school or even elementary school. According to the Wall Street Journal, "Evidence is mounting about the importance of teaching math in preschool and kindergarten...if children don't have good instruction and effective teachers in early grades, they are more likely to struggle later when they face more complicated concepts."[8]

1. The math achievement gap starts early, even before kindergarten

The first three to five years of life are a unique period of growth for a child's brain. Every second, young children's brains develop 700 synapses, the neural connections that support learning and skills.[9] Disadvantaged children can already be 18 months behind their peers when they start kindergarten.[10] This gap is as pronounced for math skills as for literacy abilities.[11] U.S. Department of Education data show that math scores for kindergarteners were already higher for children: who were white or Asian (rather than African-American or Hispanic); whose families had higher incomes; and whose parents were more highly educated (figure 1).[12] By college age, African-American or Hispanic children, as well as children from low-income families, are much more likely to receive remedial instruction in math and other subjects.[13]

2. High-quality early education teaches real math and science

Young children can learn more STEM content than we may realize. Good early learning curricula capitalize on the natural curiosity and exploration of young children and can build an understanding of math and science concepts[14]. Children should experience this content through enjoyable, play-based activities appropriate for their age. The Pennsylvania Learning Standards for Early Childhood Pre-Kindergarten include topics and content that help lay this foundation for STEM abilities[15]

3. Early math affects later abilities

While it is a long road from pre-k to Ph.D., a growing body of research shows that early exposure to math is linked to later abilities in not only math but other subjects. For example:

- "Preschool children's knowledge of mathematics predicts their later school success into elementary and even high school. Further, it predicts later reading achievement even better than early reading skills."[16]
- Likewise, "[K]indergarten skills in math significantly predicted second grade math, reading, and general achievement."[17]
- "Early math concepts, such as knowledge of numbers and ordinality [sequences like 1, 2, 3], were the most powerful predictors of later learning,"[18] and "school-entry reading and math skills are almost always statistically significant predictors of later reading and math achievement...[and] rudimentary math skills appear to matter the most."[19]
- Children with "persistent" problems in math at ages 6, 8 and 10 were 13 percentage points less likely to graduate from high school and 29 percentage points less likely to attend college.[20]

4. Early learning builds the behavioral traits that STEM employees need

The development of children's brains not only supports cognitive abilities, but social and emotional skills such as focusing, persevering and working well with others. These are important for all employees, including those in the STEM field. "[M]ore than smarts is required for success in life," concluded Prof. James Heckman, the 2000 Nobel Laureate in economics. "[T]he empirical literature shows high economic returns for remedial investments in young disadvantaged children...[that affect] a range of cognitive and non-cognitive skills, schooling achievement, job performance, and social behaviors, long after the interventions ended."[21]

"A workforce with robust science, technology, engineering and mathematics capabilities is critical to the success of the U. S. military mission."

– Lieutenant General Thomas P. Bostick, Commanding General and Chief of Engineers, U. S. Army Corps of Engineers[6]

Quick Facts
PA's STEM Skills Gap

170,000+
positions will not be filled with qualified in-state employees who have the educational credentials their employers seek.[23]

52%
of employers have difficulty hiring people with adequate skills, training or education.[24]

56%
of employers expect the recruiting problem to continue to get worse.[25]

$188.9 million+
per year on retraining employees.[26]

72%
of 17- to 24-year-olds are not eligible for military service due to poor education, poor health/fitness and/or criminal activity or substance abuse.[28]

2/3
of 8th graders are not proficient in math and science.[29]

28%
of students entering state system universities enrolled in remedial courses The rate for low-income students is 40%.[30]

$153 million
per year spent on remedial education at colleges and universities.[31]

Pre-K in PA

Access to high-quality pre-k is an important part of nurturing a STEM skilled workforce. Unfortunately, far too few of Pennsylvania's young learners have access to publicly funded high-quality pre-k. Among the approximately 175,000 Pennsylvania 3- and 4-year-olds at greatest risk of academic failure due to living in lower-income households, nearly 70 percent—or about 120,000 children—lack access to programs like PA Pre-K Counts and Head Start each year.[22] This lack of access represents missed opportunities for these children and contributes to the STEM skills gap.

In order to bridge this gap, Pennsylvania business and military leaders support expanded access to high-quality pre-k for all at-risk children and more middle-income families. As a step towards this goal, Pennsylvania should enact a state budget that grows funding for PA Pre-K Counts and Head Start Supplemental by $90 million in fiscal year 2016-17 to provide access to an additional 7,400 children.

If America does not produce enough young people who can meet the STEM needs of both the private sector and the military, both our economy and our national security could suffer. Pennsylvania policymakers can help build the STEM pipeline for the future by investing in broader access to high-quality pre-k today.

Endnotes

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