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Who Says Math Has to Be Boring?

By THE EDITORIAL BOARD

American students are bored by math, science and engineering. They buy smartphones and tablets by the millions but don't pursue the skills necessary to build them. Engineers and physicists are often portrayed as clueless geeks on television, and despite the high pay and the importance of such jobs to the country's future, the vast majority of high school graduates don't want to go after them.

Nearly 90 percent of high school graduates say they're not interested in a career or a college major involving science, technology, engineering or math, known collectively as STEM, according to a survey of more than a million students who take the ACT test. The number of students who want to pursue engineering or computer science jobs is actually falling, precipitously, at just the moment when the need for those workers is soaring. (Within five years, there will be 2.4 million STEM job openings.)

One of the biggest reasons for that lack of interest is that students have been turned off to the subjects as they move from kindergarten to high school. Many are being taught by teachers who have no particular expertise in the subjects. They are following outdated curriculums and textbooks. They become convinced they're "no good at math," that math and science are only for nerds, and fall behind.

That's because the American system of teaching these subjects is broken. For all the reform campaigns over the years, most schools continue to teach math and science in an off-putting way that appeals only to the most fervent students. The mathematical sequence has changed little since the Sputnik era: arithmetic, pre-algebra, algebra, geometry, trigonometry and, for only 17 percent of students, calculus. Science is generally limited to the familiar trinity of biology, chemistry, physics and, occasionally, earth science.

These pathways, as one report from the National Academy of Education put it, assume that high school students will continue to study science and math in college. But fewer than 13 percent do, usually the most well-prepared and persistent students, who often come from families where encouragement and enrichment are fundamental. The system is alienating and is leaving behind millions of other students, almost all of whom could benefit from real-world

problem solving rather than traditional drills.

Only 11 percent of the jobs in the STEM fields require high-level math, according to Anthony Carnevale, director of the Center on Education and the Workforce at Georgetown University. But the rest still require skills in critical thinking that most high school students aren't getting in the long march to calculus.

Finding ways to make math and science exciting for students who are in the middle of the pack could have a profound effect on their futures, providing them with the skills that will help them get technical jobs in the fields of food science, computer networking or medicine. It would entice many students who are insecure in their own abilities into advanced careers. But it is going to require a fundamentally different approach to teaching these subjects from childhood through high school. Here are a few of the many possible ideas to begin that change.

A More Flexible Curriculum

American students need vastly improved skills in math and science — they ranked 30th among students in 65 nations in math — but they do not all have to be trained to be mathematicians or scientists. While all students need a strong grasp of the fundamentals of critical thinking and problem solving, including algebra and geometry, they should be offered a greater choice between applied skills and the more typical abstract courses.

This is not an endorsement of tracking, the old practice of shunting some students into vocational classes while others are prepped for college. Every graduate should be ready for college (whether for a two- or four-year degree) but should also be exposed to the variety of skills that will be demanded as the country continues its shift to a post-industrial economy. As a study by the Georgetown center notes, very few high schools offer career or technical education; any deviation from a classical math education is viewed with suspicion.

Research has shown that the right mix of career and technical education can reduce dropout rates, and the courses offered don't have to be from the old "industrial arts" ghettos. They should be taught at a challenging level and make students aware of careers that are now being ignored. Take engineering, for example, a field that pays well and needs ever more workers. Most high school students say they have no interest in the subject. That's largely because few of them ever encounter it: Only 3 percent of graduates have taken an engineering course. Only 19 percent of students have taken a computer science course, mostly at the advanced placement level.

The Common Core math standards now being adopted by most states are an important effort to raise learning standards, particularly in primary and middle school, when many students

begin to fall behind. They encourage the use of technology and applied thinking, moving students away from rote memorization. At the high school level, they would introduce all students to useful concepts like real-world modeling. But the standards also assume that all high school students should pursue a high-level math track, studying quadratic equations, transformational geometry and logarithms. The standards need more flexibility to ensure that they do not stand in the way of nontraditional but effective ways to learn, including career-oriented study.

Very Early Exposure to Numbers

Only 18 percent of American adults can calculate how much a carpet will cost if they know the size of the room and the per square yard price of the carpet, according to a federal survey. One in five American adults lack the basic math skills expected of eighth graders, making them unfit for many newly created jobs. In many cases, that's because they weren't exposed to numbers at an early age.

A new study, by researchers at the University of Missouri, showed that the most important factor that predicted math success in middle school and upward was an understanding of what numbers are before entering the first grade. Having "number system knowledge" in kindergarten or earlier — grasping that a numeral represents a quantity, and understanding the relationships among numbers — was a more important factor in math success by seventh grade than intelligence, race or income.

Children of all backgrounds can build a good foundation in math with early exposure to numbers, which should be required in all preschool classes. But less than half of 4-year-olds are enrolled in full-day pre-K programs, and only 70 percent of kindergartners go all day. Although preschool enrollment has increased in recent years, it is still not a high priority in many states and cities, as shown by the cold reception to expansion proposals by President Obama and Mayor-elect Bill de Blasio of New York.

Better Teacher Preparation

The most effective teachers have broad knowledge of their subjects. Too many

preparation. More than half of the 6.7 million students studying physical science, physics and earth science — are learning from teachers who did not major in their subjects. Only 64 percent of those teachers are certified. The number is better for math teachers, as 78 percent are certified, but that still leaves three million math students being taught by uncertified teachers. The problem is significantly worse in low-income communities and in middle schools.

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Some districts give additional instruction to science and math teachers, or team new teachers with more experienced colleagues. But the most important effort is the national campaign to add 100,000 STEM teachers by 2021. The Carnegie Corporation has led a coalition of businesses, universities and other institutions to make it happen at the ground level. The American Museum of Natural History, for example, has pledged to prepare 130 certified science teachers by 2015. The University of Chicago will train 500 new teachers for Chicago's public schools over five years. The campaign now has commitments for more than 37,000 new teachers, but it still has far to go.

Experience in the Real World

A growing number of schools are helping students embrace STEM courses by linking them to potential employers and careers, taking math and science out of textbooks and into their lives. The high school in Brooklyn known as P-Tech, which President Obama recently visited, is a collaboration of the New York City public school system and the City University of New York with IBM. It prepares students for jobs like manufacturing technician and software specialist. Students work with IBM mentors and are encouraged to earn both a diploma and an associate degree after a combined six years in high school and college. Ten more such schools are planned around the state, and last month President Obama announced a promising new grant program to encourage dozens more high schools to offer job-oriented STEM education.

In Seattle, Raisbeck Aviation High School is working with Boeing and other aerospace firms to mentor students in engineering and robotics. Many schools are teaming with software companies to teach programming, including two schools that are very popular in New York City. Though many of these efforts remain untested, they center around a practical and achievable goal: getting students excited about science and mathematics, the first step to improving their performance and helping them discover a career.

This article has been revised to reflect the following correction:

Correction: December 9, 2013

An earlier version of this editorial referred imprecisely to a unit of measurement in a math problem. It is per square yard, not per yard.