

How to fix the STEM education 'crisis'

Experts weigh in on teacher qualification, cultural perceptions, and systemic solutions for improving U.S. math and science instruction

By Meris Stansbury, Associate Editor

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According to experts ranging from White House advisors to leading education organizations, the state of math and science instruction in the United States is in crisis--and only a major overhaul of the U.S. education system will get the nation back on track. In a Nov. 12 webinar, experts discussed several potential ways to bring out these necessary reforms, from changing the perception of math and science to implementing common national standards.

The webinar, titled "America's Math and Science Crisis: How to Fix It," was hosted by the Hechinger Institute on Education and the Media at Columbia University Teachers College. The event started with a list of statistics that suggested the skills of American students in science, technology, engineering, and mathematics (STEM) are declining in relation to students from other industrialized nations.

For instance, recent results from the Program for International Student Assessment (PISA) suggested the top-performing U.S. high school students were bested by students from at least 20 other nations in math and science.

Presenters also discussed a [story from the *New York Daily News*](#) that was published on the same day as the webinar, reporting that freshman students at the City University of New York could not solve basic algebra problems involving fractions and decimals.

"It's a problem that [exists] all across the country," said presenter Steve Robinson, a member of the White House Domestic Policy Counsel for the U.S. Department of Education (ED) and special advisor to Education Secretary Arne Duncan. "You read about these things all the time."

According to Robinson, the solution to the STEM education crisis revolves around ED's four major areas of school reform: improved standards and assessments (and specifically, promoting common national standards), effective teachers and school leaders, the use of robust data systems to inform instruction, and targeting chronically low-performing schools.

Although there are many funding sources to help encourage high-quality education, Robinson cited the federal Race to the Top Fund, "which I think could specifically help STEM fields," he said.

The fund, which will distribute nearly \$5 billion to states that adopt ED's reform goals, is now open for applications. (See ["\\$5 billion 'Race to the Top' begins."](#)) However, there is a "Competitive Preference Priority" that says the fund will give preference to states that focus on STEM education by providing rigorous standards, partnering with national and local STEM organizations, and encouraging underrepresented groups to enter the STEM fields.

Michele Cahill, vice president for national programs and director of urban education at the Carnegie Corporation of New York, a philanthropic organization dedicated to education research and knowledge "diffusion," said it's not just about advancing STEM-capable kids into the STEM fields, but making sure that students who are not even moderately proficient in math and science can at least become college-ready in those subjects.

"It's about making sure the entire country is at a proficient

level--and then, of course, making sure a larger number of those students then go on to become advanced in those fields," said Cahill.

Only by aligning school system design with standards and assessments, as well as with effective teaching and human capital management, can students learn STEM subjects in broad, deep ways that will lead to academic success, Cahill said.

"Right now, maybe there are good standards and assessments, but only little focus on good teaching. Or maybe there's good teaching, but no school administrative support. Everything needs to be stacked and aligned to produce good results," she said.

The Carnegie Corporation is advancing the recommendations of its Institute for Advanced Study, which aims to transform education in the United States so that every student reaches higher levels of mathematics and science learning.

Its report, titled "[The Opportunity Equation: Transforming Mathematics and Science Education for Citizenship and the Global Economy](#)," focuses on three recommendations to improve STEM education:

1. Establish common standards for the nation in math and science--standards that are fewer, clearer, and more advanced--along with high-quality assessments that will demonstrate proficiency effectively.
2. Improve the practice of math and science teaching and the methods for recruiting and preparing teachers and for managing the nation's teaching talent.
3. Redesign schools and districts to deliver high-quality, equitable math and science learning.

The report also details examples of promising practices,

resources, and opportunities for action.

Tom Luce, CEO of the National Math and Science Initiative (NMSI), said there are already some best-practice programs in place that states should look to for inspiration.

For example, the Advanced Placement Training and Incentive Program (APTIP) is an approach that reportedly increases teacher effectiveness and student achievement in rigorous math and science courses through training, teacher and student support, vertical teaming, open enrollment, and incentives. The program has been shown to increase the number of students taking and passing AP math, science, and English exams, and it expands access to traditionally underrepresented students, said Luce.

In 2007, nonprofit organizations from 28 states applied to replicate [APTIP](#). NMSI selected nonprofit partners in six states for five-year funding and program management support. NMSI is now replicating APTIP in Alabama, Arkansas, Connecticut, Kentucky, Massachusetts, and Virginia.

Implementation began during the 2008-09 school year and will expand to include a new group of public high schools each year over the five-year grant period. In 2008-09, NMSI affiliates implemented APTIP in 67 public high schools. This fall, they will be implementing the program in 142 public high schools.

NMSI trained 478 AP teachers in curriculum development, pedagogy, and content in the following subjects: biology, calculus, chemistry, computer science, English language, English literature, environmental science, physics, and statistics. The program resulted in a 51-percent increase in AP exams passed in math, science, and English, and there was a 134-percent increase in the number of AP math, science, and English exams taken for African-American and

Hispanic students. There was a 71-percent increase in AP exams passed by African-American and Hispanic students in math, science, and English, and a 55-percent increase in AP exams passed by female students in these subjects.

Luce also promoted the [UTeach program](#), which started at the University of Texas at Austin in 1997 as a new way to prepare high school science, math, and computer science teachers. According to its organizers, the program's strength lies in its collaboration between the Colleges of Natural Sciences and Education.

"UTeach has proven to be so effective that it is now being replicated at universities across the U.S.," said Luce. "Fourteen universities now have UTeach, and 40 more are on the waiting list to replicate this program. It really works."

He continued, "What it really comes down to, especially with UTeach, is that you can't teach what you don't know, and this is a large problem, especially with teachers in lower grade levels." (Read the PDF report: ["Knowing Mathematics for Teaching: Who Knows Mathematics Well Enough to Teach Third Grade, and How Can We Decide."](#))

Luce also says the STEM crisis needs to be made more public and more people, especially parents, need to realize that an ignorance of math and science concepts is not practical in a 21st-century society.

"Even car mechanics need to have some STEM skills these days," he explained. "I hear all the time people bragging about not being able to balance their checkbooks. You would never hear people bragging about not being able to read. We need a culture shift--we need to let people know it's not OK anymore to lack skills in STEM. Our country, our economy, depends on that."

Luce said students need to be made more aware of what is required to do certain tasks, saying, for instance, that "if

kids want to design video games, they need to know that they will have to be proficient in STEM to do that."

All the presenters agreed that beyond more capable teachers, common national standards, and a major cultural shift, STEM concepts also should be integrated into all school subjects, and not just taught separately. This will help students become more aware that math is not just for statisticians, for example, but is used in many different fields.

The presenters also acknowledged that top-performing STEM countries, according to the latest PISA results, have best practices the United States can learn from, although it will take major systemic change on a massive scale to accomplish this--something the presenters said will happen only if there is a sense of urgency at all levels: federal, state, and local.

Links:

[The Hechinger Institute](#)

[U.S. Department of Education](#)

[National Math and Science Initiative](#)

[The Carnegie Corporation](#)

*Note to readers: Don't forget to visit the **Igniting and Sustaining STEM Education** resource center. As the workplace changes and becomes increasingly global, today's students must be educated with a 21st-century mindset. Science, technology, engineering, and math (STEM) skills are no longer just "good skills" to have; they are increasingly vital to a 21st-century education—and students should begin cultivating these skills as early as possible. Go to: [Igniting and Sustaining STEM Education](#)*

