

## Opinion

# Mathematicians' Central Role in Educating the STEM Workforce

In the recent report *Engage to Excel*,<sup>1</sup> President Obama's Council of Advisors on Science and Technology (PCAST) identifies mathematics as a bottleneck in undergraduate Science, Technology, Engineering, and Mathematics (STEM) education. Among PCAST's recommendations are ones calling for the development and teaching of college-level mathematics courses "*by faculty from mathematics-intensive disciplines other than mathematics*" and for "a new pathway for producing K-12 mathematics teachers...*in programs in mathematics-intensive fields other than mathematics*."<sup>2</sup> While we are in sharp disagreement with these specific recommendations, we do share PCAST's concern for the state of STEM education. We encourage the mathematics community to focus constructively on the broad view the report sketches. We appeal to the community to amplify its communications with other STEM disciplines, to publicize its teaching innovations, and to redouble its efforts to meet the challenges discussed by PCAST.

We firmly assert that **it is essential that mathematicians be actively engaged in the planning and teaching of the mathematics courses that form the foundation of STEM education.** Mathematicians' understanding of the common mathematical themes that arise in applications across STEM disciplines place them at the center of STEM education. Mathematicians guide students to explore their ideas using skills that apply beyond immediate problems; we facilitate students' efforts to understand the principles and logic that underpin applications.

As a subcommittee of the AMS Committee on Education (CoE), in consultation with the full CoE and the AMS Executive Committee and Board of Trustees, we have prepared a response<sup>3</sup> to the PCAST report. What follows are highlights of that response.

Mathematicians strongly support President Obama's goal of increasing the number of college graduates with STEM training. We promote high-quality undergraduate mathematics education not only to increase

numbers of STEM graduates but also to ensure that these graduates have the education and perspective to succeed in an evolving, increasingly technological world. In active collaboration with our STEM colleagues, we shall continue to explore enhancements to entry-level college mathematics curricula to serve STEM students.

Mathematicians are eager to continue their partnership with other STEM colleagues to adapt mathematics curricula and pedagogy. A solid foundation in mathematics is essential for successful STEM education, for this paves the way for flexibility in a changing workforce environment. We seek to enhance the ability of all STEM students to apply quantitative and critical thinking skills from mathematics to other disciplines.

The mathematics community embraces experimentation in teaching methods, technology that augments learning, and adaptation of curricula. Such efforts need to be carefully assessed, with care taken in defining and interpreting assessment metrics. Mathematicians recognize that there is not just "one problem" to solve, that promoting knowledge of basic mathematics and a facility with its use requires dramatic improvements in precollege mathematics education and encouragement of problem-solving talents. No single pedagogical method will be suitable for every classroom, no one curriculum is appropriate for all students. Success in education is not achieved by simple formulas: there are many different successful ways of teaching mathematics, techniques adapted to the variation in talents of both students and teachers.

We call upon the mathematics community to rise to the challenges set forth in the PCAST report. Consider applying to the National Science Foundation and the Department of Education for grants<sup>4</sup> that support college-level education initiatives. Expand collaborations with STEM colleagues to learn what mathematics their students need and to develop curricula that meet those needs. Send email to [president@ams.org](mailto:president@ams.org) with information about past and existing programs designed to improve college-level mathematics education so that these programs may be listed on the new CoE website, established as an evolving account of efforts to improve college-level mathematics education.<sup>5</sup> Devise new teaching methods that work at individual colleges/universities that might be used to help address the national imperative of training more well-prepared STEM graduates. Disseminate your findings within the mathematical and scientific communities.

Our society requires many more young people who are well trained and confident in their use of quantitative and technological methods. In order to reach as many students as possible, education in entry-level college mathematics must continue to evolve. No easy answers are available, but the mathematical community welcomes the

<sup>1</sup>Available at <http://www.whitehouse.gov/administration/eop/ostp/pcast/docsreports>.

<sup>2</sup>President's Council of Advisors on Science and Technology, *Engage to Excel*, 2012, 30.

<sup>3</sup>Full response available at <http://www.ams.org/policy/govnews/pcast-statement>.

DOI: <http://dx.doi.org/10.1090/noti902>

<sup>4</sup>The AMS has assembled a partial list of grant opportunities at <http://www.ams.org/profession/grant-opportunities>.

<sup>5</sup>See <http://www.ams.org/programs/edu-support/teaching-innovations>.



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## Opinion

challenge of joining with our STEM colleagues to develop new approaches to enhance the learning experiences of the many students who aim for careers requiring a sound STEM education.

—Eric M. Friedlander  
*President of the AMS*  
*University of Southern California*  
ericmf@usc.edu

—Tara S. Holm  
*Chair of the AMS Committee on Education*  
*Cornell University*  
tara.holm@cornell.edu

—John Ewing  
*Math for America*  
jewing@mathforamerica.org

—Rebecca Goldin  
*George Mason University*  
rgoldin@gmu.edu

—William H. Jaco  
*Oklahoma State University*  
jaco@math.okstate.edu

—T. Christine Stevens  
*St. Louis University*  
stevensc@slu.edu

—Abigail Thompson  
*University of California, Davis*  
thompson@math.ucdavis.edu

—David A. Vogan Jr.  
*President-elect of the AMS*  
*Massachusetts Institute of Technology*  
dav@math.mit.edu