

BUILDING OUR COMPETITIVE FOUNDATION: SUPPORTING K-12 STEM EDUCATION

An AIAA Information Paper

ABSTRACT

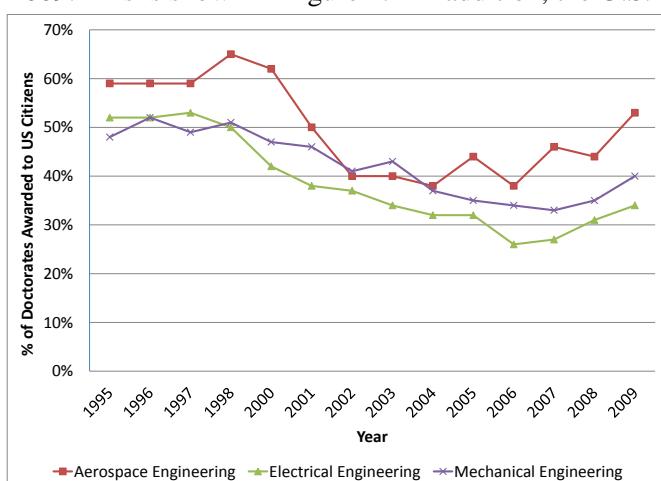
The American Institute of Aeronautics and Astronautics (AIAA) is extremely concerned that the U.S. is falling further behind other nations in the production of engineering graduates. Since professional engineers rely on a firm academic foundation in the “STEM” subjects of Science, Technology, Engineering, and Mathematics, increased national emphasis must be placed on these disciplines. In particular, more attention is needed for the Technology and Engineering (T&E) disciplines, which have not been as well addressed as Science and Mathematics to date. Increased emphasis on T&E education will enable a strong and vibrant supply of engineers in the future who can maintain America’s edge in the global, competitive marketplace.

ISSUE BACKGROUND

The U.S. ranks well behind other countries in the percentage of students earning their first university degree in engineering, as shown in Figure 1.¹ In China, the number of first university degrees awarded in natural sciences and engineering has risen sharply, particularly since 2002. In comparison, those awarded in the United States have remained relatively flat. In the United States, about 4% of all bachelor's degrees are in engineering. In Asia about 17% are in engineering, and in China about one-third are in engineering.

Though improving in recent years, overall the U.S. has also declined in the percentage of doctorate-level engineering

degrees earned in the United States by U.S. citizens and permanent residents, from 47%–59% in 1995 to 34–53% in 2009. This is shown in Figure 2.² In addition, the U.S. ranks behind the European Union and China in PhD degrees awarded in engineering, as shown in Figure 3.³ The EU surpassed the U.S. in 1989, and China surpassed the U.S. in 2003.



engineering increase the likelihood that a high school

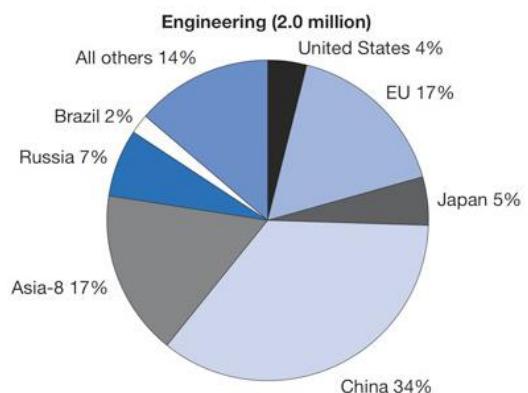


Figure 1: Percentage of 24 year olds in various countries with first university degrees in engineering, relative to all first university degree recipients

Design is a core part of engineering and technology. The design process is a method of discovery, exploration, and problem solving. It teaches integrative knowledge skills, and sharpens teamwork and communications skills. Data show that learning design motivates and excites students about choosing engineering as a career. Students that learn design achieve higher grades, have greater motivation, maintain better attendance, and exhibit less antisocial behavior. A seminal study of FIRST Robotics competition participants, shown in Figure 4,⁴ demonstrates that hands-on experience in technology and

¹ NSF Science and Engineering Indicators 2012, http://www.nsf.gov/statistics/seind12/slides_tn.htm#g3

² NSF/Division of Science Resources Statistics, Survey of Earned Doctorates.

³ NSF Science and Engineering Indicators 2012, <http://www.nsf.gov/statistics/seind12/c2/c2h.htm>

⁴ <http://www.usfirst.org/who/content.aspx?id=46>

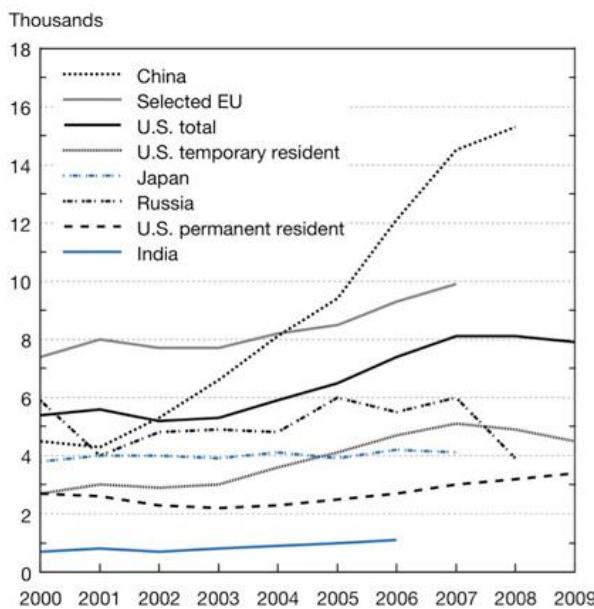


Figure 3: International production of science and engineering doctorates compared with U.S. production

proficiency. Thus, the T&E part of STEM cannot be fully addressed without also improving general science and math education.⁵

Improving science education can begin with implementation of the Next Generation Science Standards to improve the quality of science education throughout the nation. In a poll conducted in February 2012, 87% (+/- 3.5%) of voters surveyed supported these new standards.⁶

student will major in engineering. Alumni of the FIRST Robotics competitions are nearly twice as likely to major in engineering or science, and more than three times as likely to pursue a career in engineering. Learning design and engineering skills and how they are applied in business fosters entrepreneurship, creativity, imagination, and innovation, all critical needs for global competitiveness.

While the T&E components of STEM need particular emphasis, they need to build on a strong basic science and math base. Unfortunately, only 39% of U.S. 4th graders and 33% of U.S. 8th graders performed at or above a level called “proficient” in mathematics (where “proficiency” was considered the ability to exhibit competence with challenging subject matter). Similarly, only 33% of U.S. 4th graders and 30% of U.S. 8th graders performed at or above the proficient level in science. In addition, the U.S. ranked only 18th out of 33 Organization for Economic Cooperation and Development (OECD) countries in a recent OECD study of mathematics proficiency of 15 year olds, and the U.S. ranked only 13th out of 33 OECD countries in science

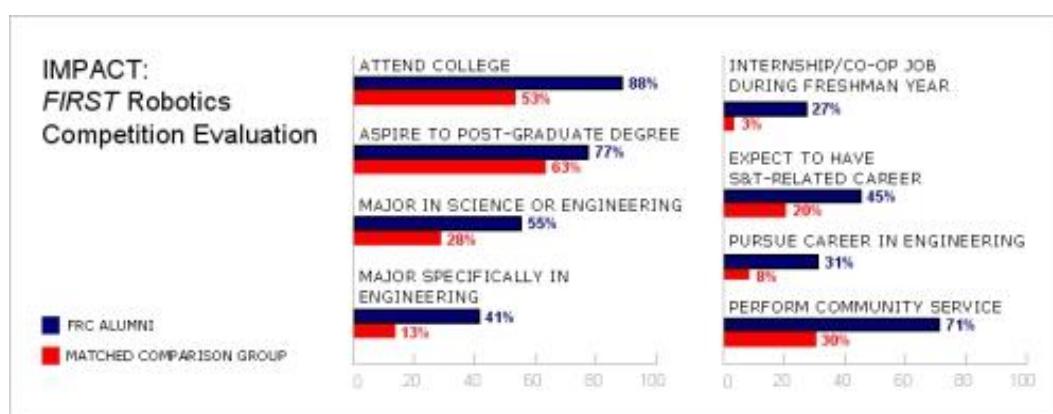


Figure 4: Impact of student participation in FIRST Robotics competitions

⁵ NSF Science and Engineering Indicators 2012, <http://www.nsf.gov/statistics/seind12/c1/c1h.htm>

⁶ On behalf of Achieve Inc., Public Opinion Strategies and Greenberg Quinlan Rosner Research conducted a national survey February 22-26, 2012 of N=800 registered voters.