

Filling the Engineering Gap

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Ask a school head, “What was your major in college?” and, more likely than not, the response will fall under the humanities umbrella. But despite what might be a natural bias towards these disciplines, the past decade has seen an explosion of attention from school leaders on developing and enhancing programmatic offerings in STEM (science, technology, engineering and math). In even the most traditional independent schools, engineering in particular is gaining traction. Why? What is it about engineering that is educationally compelling?

Now more than ever the world needs the skills that engineers bring to the table. For starters, there is a pressing demand to address the fundamental human needs of food, shelter and care on a global scale. Prominent colleges and universities have joined industry in responding to this demand. University of Virginia Provost Tom Katsouleas shared with me that engineering, at its core, is simply about solving humanity’s problems. We need to teach students that this is what engineering is all about in order to attract them to this field and nurture their passion to tackle real-world challenges.

The Missing Engineers

The United States is lagging behind other developed countries in most areas of STEM education. In the most recently reported Program for International Student Assessment, the U.S. ranked 27th in math and 20th in science. And on a national level, while the number of people pursuing STEM careers is increasing, the number of women and underrepresented minorities moving into these fields is not keeping pace, particularly in engineering. The most recent study from the National Science Board reports that women make up only 14.9 percent of engineering professionals, and underrepresented minorities only 10.5 percent.

How can we possibly compete in a global economy that demands these skills if we’re not attracting and engaging the talents of such a significant portion of our population? We have much work to do as a country, but the good news is that vigorous efforts to engage, recruit and retain women and other minorities to be engineers serves not only these underrepresented groups but our nation as a whole.

As an educator of girls, I am influenced by my own experience as a student, which mirrors that of many women. I enjoyed STEM courses

in school and did well. But by my senior year in high school, feeling the pressure of college admission and losing confidence in my ability to handle the highest level math and science classes, I opted out for easier courses. No one advised me otherwise and I didn't seek out a mentor for support to help restore my belief in my own abilities. In college, I again avoided challenging sciences and math and gravitated towards my comfort zone. Distribution requirements had been dropped, so I was allowed to stick with courses in which I felt safe and knew I could succeed.

The National Science Board study tells us that, even in 2016, mine is not an unusual tale for many girls and young women. Educational practice isn't effectively addressing a significant cohort of our population or sufficiently training up the next generation of workers; more change is needed. Because independent schools have the luxury of being driven by values rather than constrained by mandated, standardized curricula, we are seizing the opportunity to foster the process skills at the core of STEM learning. Mastering abilities like problem solving is not only fundamental to engineering, it includes and advances all students.

At Greenwich Academy, as we consider the particular skills that are fostered and promoted in engineering content and coursework, three have emerged as critical to preparing the next generation of thought leaders and practitioners: creativity, resilience and teamwork.

Creativity

While children are naturally curious and creative, formal schooling does not always reinforce these tendencies. Indeed, many school settings place a premium on classroom management and the kind of formulaic thinking that only translates to rote memorization and passive learning. And yet, today's global economy demands creativity and all of its current cousinry—innovation, entrepreneurship and disruptive thinking, among others.

Courses in engineering, science and technology, in particular, have long promoted the values of active, hands-on learning. But this wasn't always valued in elite schools and colleges, which was underscored to me last year when I was visiting select colleges and universities. A professor of mechanical engineering at UC Berkeley said that many STEM disciplines, especially engineering, used to be seen as blue collar. This was not only marginalizing to those who chose these disciplines, but completely ignorant of the creative energy and potential for innovation fostered in these professions. The effect of this narrow-minded approach was that many elite schools and universities simply didn't offer engineering courses.

Thankfully, this has changed. Leading independent schools, colleges, and universities are building engineering and design labs, also called

fabrication labs (FabLabs) or makerspaces, and it is inspiring to see the creativity that is unleashed when students are engaged both intellectually and physically.

Resilience

Learning resilience is particularly important for high achievers. Accustomed to success, high-achieving students can become perfectionistic over time and thus averse to taking risks, for fear of failure. Authentic learning, by contrast, resists the safe, easy and formulaic. A process-based approach, which is foundational to engineering, requires plenty of trial, error and risk and no guarantee of reward. This kind of learning builds resilience.

Robotics programs are fantastic incubators for resiliency. I'm grateful that I've had the opportunity to witness in participants the empowerment that comes from making mistakes—even failing—before recovering, growing, learning and then pivoting in another direction.

I attended my first robotics competition a few years ago and was immediately struck by the sense of purpose and healthy competition that permeated the event. Teams were practicing in various pits, with each pit correlating to a specific task. I asked the captain of our team to describe the objectives of the task at hand. She said, "Basically, we have two minutes for our bot to pick up that ball and bring it over to that hoop and put it in." I responded that their bot looked ready and able to complete the task. She laughed and said, "Yes, but the team we are competing against has already decided that their sole focus will be to derail our bot! In two minutes, 50 things will go wrong and we'll have to figure out how to recover from each one." Poise under pressure and the ability to persevere when things go wrong—resilience personified.

Teamwork

Problem solving is not an isolated effort. Today's employers across all industries are seeking to hire individuals who thrive in the team environment that is part of almost every workplace. Bright individuals with diverse interests and expertise must be able to work together to address issues and challenges at the organizational, national and global level. These kinds of skills are part and parcel of an engineering education.

We see this play out daily in our Engineering and Design Lab, which is used by our Lower, Middle and Upper School students. Lab Director Erin Riley explains that, "Collaboration and teamwork are cornerstones of the engineering and design work practice we are fostering in our lab. Students take on roles of teacher, student and researcher at different points in any given project. The sharing culture we promote advances the ideas that

develop in the lab, and everyone (teachers included!) learns and grows.” The culture that Ms. Riley describes as natural to makerspaces sets up a learning environment that encourages, validates and celebrates all voices and all contributions to the process.

To expose students, particularly girls and other underrepresented groups, to engineering practices from a young age is also to help them develop the confidence to stick with STEM coursework and professions in the future. The next generation of leaders needs the skills that are bred in the bones of engineers—creativity, resilience and teamwork.

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