THE CHRONICLE
of Higher Education
Diversity in Academe

October 29, 2012

Why STEM Fields Still Don't Draw More Women

Dave Cutler for the Chronicle

There have been many efforts in recent years to draw more women into STEM fields. While women have made gains, they are still far less likely than men to major in such fields, especially engineering and computer science. Why? We asked a group of scholars and experts to respond.

Robin N. Coger
Dean, College of Engineering, and professor of mechanical engineering, North Carolina A&T State University

The Chronicle's audience is undoubtedly aware of the wealth of data available on this issue. Hence my response gives a perspective based on my cumulative experiences over the last 30 years as a female engineering student, a mechanical-engineering educator, and an engineering administrator.

Our university's College of Engineering awards more bachelor-of-science degrees in engineering to African-Americans than any other university in the United States, and is a leading producer of female African-American engineers, according to 2010-11 data from the American Society for Engineering Education.

I have observed that the decision to pursue a STEM major is based on two factors: (1) personal capabilities and preparedness to succeed; and (2) desire to pursue that discipline. I believe that success in attracting more women (or individuals from underrepresented demographic groups) into the STEM fields depends on how well our institutions address both those components.

The quality and rigor of the content of our nation's K-12 and higher-education programs is key to the first factor. Yet to effectively motivate a person to pursue a STEM field, it is important to also nurture the layperson's understanding of STEM occupations, and the relevance of STEM to her own reality. How straightforward is it for a young woman to identify how a specific science, technology, engineering, or math field will position her to "make a difference" post-degree?

Furthermore, the attitudes and customs of current STEM practitioners also play a key role in a newcomer's persistence in a STEM major. As STEM practitioners, we serve as the role models, ambassadors, and gatekeepers of our fields, and as such, potential newcomers assess us when deciding if they want to join the community. Attracting people from underrepresented groups to STEM fields requires the community to welcome and encourage the ideas and diverse perspectives that they can contribute toward solving the global problems before us.

***

Jan Cuny

Program director, National Science Foundation's Computing Education for the 21st Century

The gender gap in computer science is partly rooted in long-held popular misconceptions: that computing is too hard for girls, that it's geeky, that it requires a singleminded 24/7 focus, and—maybe worst of all—that computer science equals programming and so provides little benefit to society. Why would this picture be attractive to girls—especially to girls who want to be creative, to make a difference, to change the world?

These misconceptions are too often confirmed by girls' peers, by cues in the popular media, by a lack of role models that run counter to stereotypes, and even by advice from their parents and guidance counselors. Public schools don't generally help. Most teach just basic IT literacy. Even at the secondary level, most American schools do not offer even one rigorous academic computing course. Girls (and boys, for that matter) are not exposed to the underlying concepts of computation, to the creative aspects of algorithm and software design, or to the transformational effect that computing can have across a wide range of disciplines.

Girls rarely get the encouragement they may need to overcome their hesitancies and try computing. When they do find themselves in a computing course, they are often uncomfortable in the male-dominated climate they encounter. It is not surprising then that only 0.3 percent of girls arrive at college with the intention to major in computer science.

We can change all of this, but the fixes won't be quick or easy. They will require sustained efforts to alter the messages girls receive, to provide them with engaging computer-science-related activities in elementary and middle school, to give them the personal encouragement they may need, and to provide them with access to high-quality courses, through high school and into college, that show them computing's potential to transform our world.

That's a tall order, but there have been successes. Carnegie Mellon University, Georgia Tech, and Harvey Mudd College, to name a few, have changed the cultural climate and had remarkable success in recruiting and retaining female computer-science students.

The National Science Foundation supports many efforts to increase the participation of women in computing, financing programs in middle school through graduate school. Of particular note is the CS 10K program, which is developing rigorous and engaging curricula and, by 2016, training 10,000 teachers to deliver those cutting-edge courses.

***

Maria Klawe

President, Harvey Mudd College, and former dean of engineering and professor of computer science at Princeton University

There have been many efforts over the last three decades to draw more women into STEM fields. While impressive gains have been made in mathematics, statistics, biology, and chemistry, women are still far less likely than men to major in computer science and engineering. In addition, recent studies, like one published last month in *Proceedings of the National Academy of Sciences,* have demonstrated that there is still bias among both male and female scientists against female students.

In America we encourage our young people to follow their passions. If they perceive an academic discipline as uninteresting, they are unlikely to enroll in those courses in college. Women entering college often have little exposure to engineering and computer science, and don't realize they could apply knowledge from these fields in many ways to pursue rewarding careers that benefit society. Programs that introduce female students to the broad range of relevant applications can be very successful in attracting women to STEM careers. At Harvey Mudd College, we have found that broadening our introductory computer-science course from a class framed as learning to program to one framed as computational problem-solving approaches across multiple fields, while still covering the same concepts as the previous version, has sparked enthusiasm among both female and male students.

Even when interested in STEM fields, young women often lose confidence when they take courses with small numbers of female students. Women in introductory computer-science courses are often intimidated by male students who have significant programming experience. Computer-science programs at some universities and colleges, including Harvey Mudd, Carnegie Mellon, MIT, and the University of British Columbia, have succeeded in recruiting and retaining more female students by creating a more encouraging and supportive learning environment.

At Harvey Mudd, we divided our introductory course into two parallel classes, based on prior levels of programming experience. Such minor adjustments have had a large impact on increasing women's confidence. We've also found that providing early research opportunities for female students—as early as the summer after their first year—helps boost confidence as they discover they truly

can do the work of a computer scientist.

Providing female students with access to successful female role models in STEM fields can also be a powerful tool. Each year Harvey Mudd takes a large number of female students to the Grace Hopper conference, the largest conference focusing on women in computer science. When students see successful women working in a wide variety of technology fields and enjoying those fields, they begin to understand who they can become and how STEM can help them get there.

Having a mentor also can increase female interest and success. This month Harvey Mudd and Piazza, an online social-learning network, launched a six-week online mentoring program called WitsOn (Women in Technology Sharing Online) to connect undergraduate students nationwide with female mentors from industry and academe.

To secure continued growth and development, our society desperately needs a larger work force skilled in STEM fields like computer science and engineering. By increasing women's interest, confidence, and sense of belonging in these fields, we will expand technological innovation in new and creative ways.

***

Matt McGann

Director of admissions,Massachusetts Institute of Technology

Each year I have the privilege of reading the applications of thousands of our nation's most promising young women interested in the STEM fields. I am often saddened and occasionally infuriated by the experiences of these extraordinary women, who have faced obstacles, subtle and overt, in their pursuit of science and math education.

There are the stories of the lone girl in the AP physics class, ostracized by her male classmates. The girl on the FIRST Robotics team who is assigned marketing duties when there's nothing she'd like to do more than work on engineering. The counselor who recommends not taking an advanced math class because it would make the student's schedule too rigorous. The science teacher who never seems to call on the girl in the front row.

These problems do not end with high school. Unfortunately, gender discrimination is still a persistent and pernicious problem in higher education as well, as is made frightfully clear in a recent Yale study that showed both male and female science faculty exhibiting gender bias against female job candidates. At MIT, it has not been that long since our 1999 admission of discrimination against female science faculty. This action made international news and promised improved conditions for all women in STEM. Things have improved on campus; I am proud to have helped enroll a student body in which 45 percent of our undergraduates—and 44 percent of our STEM majors—are women. These women perform as well as the men over the course of their undergraduate careers, and they graduate in higher numbers.

While research continues to show societal obstacles for women in STEM, there is evidence of schools with strong, supportive communities for all students. A study released in August, written by Glenn Ellison, an MIT economist, and others does show a large gender gap among high-achieving math students. But it also finds examples of high schools where the gap is significantly narrowed. Those results are echoed in a new report from the Institute of Physics ("It's Different for Girls"), which found that women in

single-sex schools in England pursued physics at much higher rates than those in coeducational schools. Unresolved is what makes the schools in each study so successful. Can we understand these factors and replicate them more widely? By emulating successful educational practices, and eliminating both overt gender discrimination and subtle gender bias, we can make substantial progress in closing the STEM gender gap.

***

Karen D. Purcell

Founder and president of PK Electrical Inc., a Nevada-based electrical-engineering firm, and author of Unlocking Your Brilliance: Smart Strategies for Women to Thrive in Science, Technology, Engineering, and Math (Greenleaf Book Group Press, 2012)

The early lack of exposure can be detrimental to achieving gender balance in the STEM fields. We can also call this lack of enrichment. It begins when we are young and continues throughout our time in high school. Girls generally don't get to experience the level of exposure or encouragement in STEM fields that our male counterparts do. It is often subtle, but it's the first hurdle that confronts and confounds so many women.

Boys, on the other hand, get on their path, and are encouraged to do so, generally earlier than girls. For example, boys are more often given Erector sets and science sets as toys, which sparks an interest in these subjects. And boys are often pushed in school to take the more challenging math and science classes. So the other huge piece to this STEM puzzle is that if we want to attract the best and brightest minds into the fields that will advance us as a people, a country, and a planet, we can no longer look to only half of the population.

Young girls cannot possibly consider opportunities they do not know exist. If girls are not exposed to certain subject and career paths, they are highly unlikely to elect to follow them in college. As a society we have a deeply ingrained bias toward boys in math and science. The bias is so entrenched in our culture that we often don't even recognize it. While the situation has changed substantially in the past 20 or 30 years, there is still a sense that women aren't as good at math, for instance, even though there is almost no evidence to support such a belief.

Educators should be more aware of their thoughts when discussing math or science, so that any ingrained bias doesn't reveal itself. It is important that as a society we confront gender typecasts head-on, long before young people are faced with a decision to declare or choose a major in college. Without making efforts to break the gender stereotypes, we are limiting the potential of our youth, both male and female.

Because of the lack of exposure, some young women discount fields such as engineering and computer science without even knowing what those fields have to offer. They are not given the information, resources, or encouragement to follow such a path. From my personal experience, I was just fortunate to have a high-school physics teacher who suggested I study engineering. I had to ask and determine what engineers do. Providing the necessary resources, exposure, and encouragement would help young women understand that their gender shouldn't determine the career path they choose, and that pursuing a STEM career does not make them less feminine.

Comments