Women in STEM: Progress, Asymptote, and Equality [1]

Submitted by Marvi Ann Matos [2] on 9 November 2014 - 10:16pm

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In a speech to the United Nations, actress Emma Watson candidly expressed her perspective in regard to feminism, women rights, and gender equality. The speech, which called for action from men, women and the spectrum of genders, presented a realistic and somewhat grim picture of the current status of women's rights around the world. Today, in United States we face very limited progress towards the inclusion of women in fields such as Mathematics, Computer Science, and Engineering. Presented in this article are specific statistics of women with degrees in Science and Engineering that illustrate an asymptote in progress in math-intensive fields. I conclude with ideas to inspire, integrate, and retain more women in Engineering, so that STEM may serve as a passport towards equality.

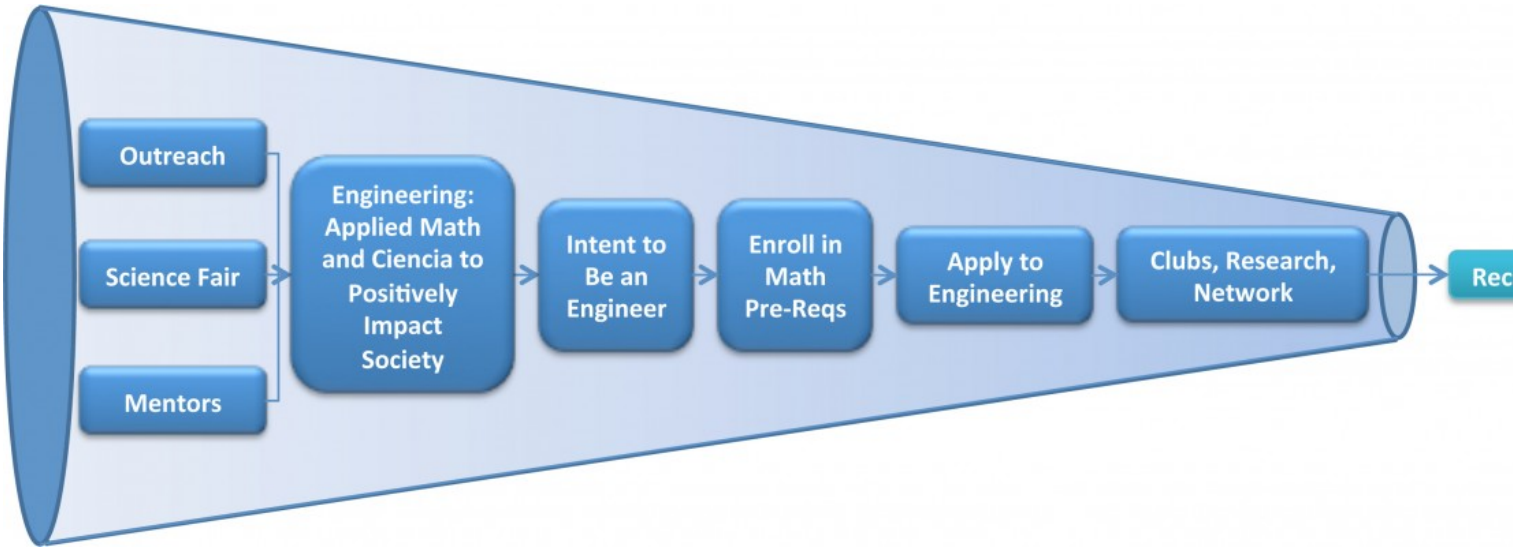
Progress

In 2010, women were earning 57.2% of the bachelor's and 46.8% of the doctoral degrees in all fields. In Science and Engineering (S&E), women earned 50.3% of the bachelor's and 40.9% of the doctoral degrees. Compare these statistics to 1970, when women were awarded 43.3% of the bachelor's and 13.5% of the doctoral degrees in all fields, while in S&E women earned 28.0% of the bachelor's and 9.1% of the doctoral degrees. This is undoubtedly great progress towards inclusion and diversity (1) [3]. Biological and Agricultural Sciences are examples of outstanding progress with, 58.6% of the bachelor's and 51.7% the doctoral degrees awarded to women. Other fields such as Psychology and Veterinary Sciences have even higher percentages (1) [3]. However, in math-intensive fields such as Engineering, Computer Science or Mathematics, progress has been limited. In 2010, women were only awarded 18.5% of bachelor's and 23.1% of doctoral degrees in Engineering (1) [3]. A bigger concern is the fact that progress in the field of engineering has somewhat stagnated since 2000 (2) [4].

Asymptote… and some ideas

In a study published in the *Harvard Educational Review* by Espinosa (2) [4], the author investigates which precollege characteristics and college experiences are predictors for the persistence of all women and women of color in STEM. It was found that women in college leave STEM "in part because of the inability of professors to make science accessible and aligned with their goals of contributing to society". For women of color, the college experience and environment was shown to be contributing factors for their persistence in STEM, more so than their background or high school performance. Among the specific college experiences correlated with retention of women of color are: (a) college community engagement activities, (b) participation in STEM related clubs, (c) co-curricular activities that improve scientific performance, and (d) academic peer relationships (as supposed to strictly social).

In Engineering, a predictor for the retention of women is a clear intention to major in the field prior to college (2) [4]. This goal defines their High School curriculum, focusing more in math and, thus, preparing them for college. For anyone intending to study engineering, it is crucial to understand what Engineering is and what Engineers do while students are still in middle school or high school. To put this in perspective and in chronological order the student: (1) is exposed to the field of engineering via an inspiring teacher, science outreach, mentoring, science fairs, etc., (2) internalizes that engineering is a path to help, serve and impact society via innovation, (3) decides that engineering is a potential career to follow, (4) continues to enroll in all math requirements in middle school and high school to ensure a fair chance to be admitted in an engineering program, (5) applies to college engineering programs, (6) participates clubs, co-curricular activities and sustains healthy work/study peer relationships in preparation for industry or graduate school and (7) graduates as an engineer and is recruited. This is my roadmap for engineering success based on the predictors found by Espinoza. At the beginning of this path, there is always a teacher, or a science fair project, or an outreach activity in which these women are exposed to engineering. This is a call for action, stop waiting passively for serendipitous experiences, spontaneous growth in the number of young women applying for STEM in college and for women to just show up at the job fair. Let's be intentional. STEM outreach and the integration of engineering concepts and courses in middle school and high school curriculums are powerful tools to increase the percentage of women in STEM. More so, connecting Engineering to impact to society is a key message to engage women.

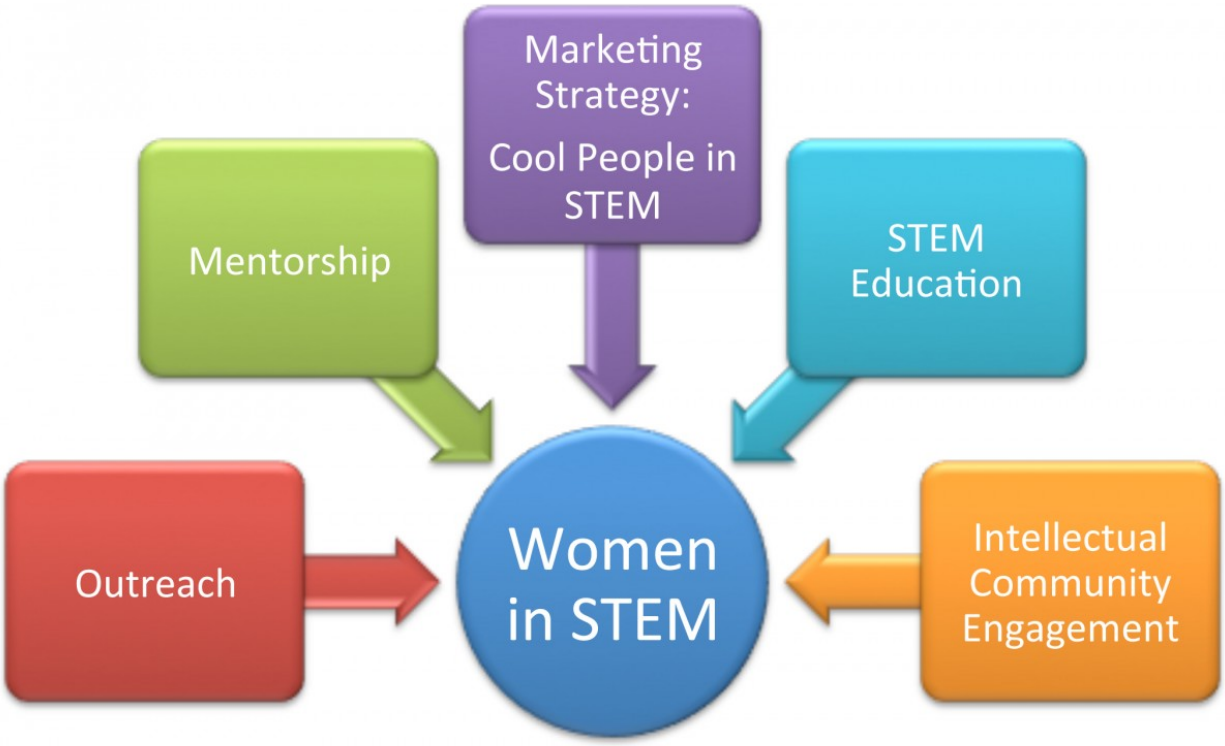


After graduation women retention in STEM fields has proven to be a challenge too. Working conditions vary widely in both industry and academia ranging from accommodating and flexible to hostile and completely incompatible with a family life. Ann Marie Slaughter's article, "Why Women Still Can't Have It All [5]" (3), points out the challenges of women aiming to rise to the top of their organizations. These factors are universal for educated women in the workforce, they include: (a) family commitments unbalanced by gender and based on simple stereotypes of breadwinner vs family caregiver, (b) a lack of control of the work schedule and its incompatibility with schools schedules and (c) the challenge of when to have children, no sequence is optimal. She also presents in the article the significant cultural shifts required for the workplace to fully be an inclusive environment, they include: (a) a focus on quality of work and projects completed rather than number of hours worked, (b) to invest in teleconferencing technologies and to encourage the use of them, (c) to re-evaluate family values and to truly respect and admire a commitment to family life and responsibilities, (d) to understand that work-life balance is not a women issue, "balance would be better for all", and (f) to "enlist men" in the creation and support of these policies.

Challenges in the technical development of women in STEM careers are not so different to the challenges women face when trying to rise to the top. When women have to decide between having children or getting tenure and keeping their family together or professional growth, the careers typically stagnate. The societal expectations of women and men are evolving, but there are still simplistic definitions for the roles of breadwinner and family caregiver. These expectations are a lot of times not compatible with working schedules.

Policy and education programs focused in equal opportunity are required to mitigate the gap of women and minorities pursuing careers in STEM. These programs should offer a window to the real world where positive role models currently working in Industry and Academia can help to construct a dream and can provide the tools to make that dream a reality. Academic institutions, government agencies and industrial partners should continue to join forces and create (a) outreach, science fair and mentoring programs that expose middle school girls and boys to STEM, *always* featuring women in STEM jobs, especially in Engineering, (b) programs related to STEM that integrate women and minorities to the college community (c) pedagogical practices in

middle school, high school and college that ensure broad engagement in STEM, and (d) marketing strategies that leverage social media to present the cool engineer, scientist or mathematician. The latter is my wild card. There is a lot of literature and statistics in the area of marketing to make a product cool and subsequently sell that product. If we want middle school strategies ol, that y.



Women in STEM and the connection to Equality

Finally, I briefly discuss the potential correlation of Women in STEM to Women Rights. I know, far-fetched, but read first. A recent article from Fortune Magazine: "The women who STEM-ed their way to power [6]" presents Fortune's Most Powerful Women in Business [7] and shows how almost all the women at the top majored in "seriously hard sciences". Ginni Rometty, CEO of IBM, is a computer scientist and electrical engineer; Mary Barra, CEO of GM, is an electrical engineer; Indra Nooyi, CEO of PepsiCo, majored in physics, chemistry and math; Ellen Kullman, CEO of DuPont, is a mechanical engineer; Meg Whitman, CEO of Hewlett-Packard, majored in math and science; Marissa Mayer, CEO of Yahoo majored in symbolic systems and has a masters in computer science and Ursula Burns, CEO of Xerox, is a mechanical engineer. These are powerful women, women who are transforming industry and the portrait of leadership, women who can influence and execute change.

When I was a child my grandfather told me: "Your education will be your passport". Our education is not only our passport, but our family's passport to a world requiring discovery, evolution and a bit of revolution. Emma Watson's speech describes the current situation for women rights and calls for action. My hypothesis and plan of action is that with more women in power we will be

able to influence dramatically the political status quo and to positively impact US and Global women's rights. Ann Marie Slaughter wrote: "Only when women wield power in sufficient numbers will we create a society that genuinely works for all women. That will be a society for everyone" (3) [5]. If STEM education is a passport to power, it is only logical that STEM education for women is one powerful passport to equality.

References:

(1) Science and Engineering Degrees: 1966-2010

Detailed Statistical Tables, NSF 12-327, June 2013 NSF Report
http://www.nsf.gov/statistics/nsf13327/pdf/nsf13327.pdf [3]

(2) Espinosa, LL, "Pipelines and Pipeways: Women of Color in Undergraudate STEM Majors and the College Experiences That Contribute to Persistence [4]" Harvard Educational Review, **18-2** :209-241.

(3) Ann Marie Slaughter, "Why Women Still Can't Have it All", The Atlantic, July-August 2012.

http://www.theatlantic.com/magazine/archive/2012/07/why-women-still-cant-have-it-all/309020/ [5]

(4) Leigh Gallagher, "The women who STEM-ed their way to power", Fortune Sept 2014.
http://fortune.com/2014/09/22/women-and-stem/ [6]

Borinqueña emphasizes the contribution of Puerto Rican and Hispanic women in science and technology and provides a space to discuss topics of interest about the empowerment of women. In 'What's up Borinqueña?' we share a variety of experiences and perspectives from different women and men that are committed to advancing equality for women in science. Use #Borinqueña to spread the word. Also, visit our Borinqueña Store [8].

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