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Evolution of the
**Modern
Woman and
Her Absence**
from **STEM**

**DEVELOPING THE 21ST
CENTURY WORKFORCE**

Dr. Kimberley Gordon, University of
Arkansas – Fort Smith



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Introduction/ Summary

While career opportunities in Science Technology Engineering and Math (STEM) fields continue to increase, females entering STEM fields of study are being outpaced. This paper chronicles the challenges faced by young females as they develop self-efficacy. Job growth projections and wage information is used to support the argument that educators should buoy females in STEM programs. This paper provides suggestions for closing the gender gap in STEM learning communities.

Background/ Problems

By the time a child enters kindergarten, she can recite numerous fairy tales and Bible stories, ethnic parables and historical accounts. She can recount the story of Eve whose absence of discipline resulted in banishment from the Garden of Eden. The child can tell of Pandora who disobeyed her father Zeus, opened a forbidden box, and unleashed upon the world pestilent plagues and much suffering. It is true that children's literature does little to counter those early stereotypes but rather perpetuates the perception of the naiveté of the female character.

As time passes, the female student learns via civics courses of the harshness of Colonial America, a time when women were not considered citizens and forbidden from owning property. She learns that in the U.S. women earned the right to vote in 1920 after a period of great struggle lead by suffragists like Susan B. Anthony and Elizabeth Cady Pinkston. This female student learns formal education was reserved for boys and all but a few girls whose family's wealth or status afforded such luxury as education. This female student discovers the great academe edifice Harvard, established in 1840, didn't admit female students until 1972.

As she looks beyond academe to our nation's institute of government, this female scholar discerns the U.S. has only twice offered females on the presidential ticket and both times as the president's understudy. She may be surprised to find the U.S. trails other nations significantly in this regard. Sri Lanka was the first country to elect a female head of state with Sirimavo Bandaranaike to the post of Prime Minister in 1960. Countries in which women have held the highest elected position include Argentina, Australia, Brazil, Canada, Chile, Germany, India, Pakistan, United Kingdom, South Korea and Ukraine. The Inter-Parliamentary Union (2013) reported that in democratic countries around the globe women comprise 20.8 percent of national parliaments in democratic countries. Female representation in the U.S. Congress is currently 18.2 percent (Rutgers, 2013).

What lesson therefore is imprinted upon this female student and others like her? Is it that collectively girls are weak and impulsive? Is it that girls haven't the discipline or intellectual capacity for discovery and invention? Is it that girls can lead nations just not the United States? How do these revelations impact the self-efficacy of these female students and her peers?

As reported in the Chronicle of Higher Education (Coger, Cuny, Klawe, McGann, & Purcell, 2012), Jan Cuny, Program Director with the National Science Foundation (NSF), draws attention to the many stereotypical excuses that have been the underpinnings for many years. According to Cuny, reasons for the absence of females within STEM include the notion that girls can't do computations, aren't geeky enough, that individuals with a propensity towards STEM are one-dimensional, or that careers in things such as computer science are of little service to society. Girls who manage to navigate all the aforementioned concerns are still left to challenge by their peers, the media, and a dearth of role models. In particular, Cuny says the lack of academic programs such as basic IT mean those girls who do make it through K-12 with an interest in STEM fail to connect that interest in a long-term career plan as was evidenced by a mere 0.3 percent choosing computer science as their major. Cuny suggests educators address the problem first in elementary school with an increasingly challenging progression through computer science programs as the students advance through the K-12 experience.

Does it matter? In spite of the rhetorical question (because it does matter), the answer is ensconced in complicated riddles such as current and anticipated needs of the U.S. workforce, the number of female students as compared to male students in STEM studies and actionable plans to close the existing gap.

The shortage of STEM graduates entering the workforce continues to worry human resource professionals. According to the Society for Human Resource Management (SHRM) (2013), 68 percent of respondents said a top trend for 2013 and beyond is the ongoing lack of science, technology, engineering and math (STEM) graduates and that the void will have a significant impact on the U.S. workplace over the next five years. SHRM research (2012) offered that 88% of human resource professionals cite engineers as the most difficult high-skilled workers to find. Other research shows that high-skilled workers are often the hardest to find.

For a narrow window of time, women in the U.S. had in their collective grasp the more lucrative STEM careers. During World War II, millions of men left their jobs to join the war. The exodus created a workplace void subsequently filled by roughly 18 million women, women such as Rosie Bonavitas (the woman behind Rosie the Riveter). The American woman learned that she was intelligent and could learn new skills, technical skills. She was independent and capable of balancing work and home lives. When the war ended and the men returned home, women were displaced in vast numbers back to the domestic lives they'd held just a few years earlier. Betty Friedan reported in her 1963 bestseller *The Feminine Mystique* how women experienced depression and associated ills when they were consigned to their devalued domestic status following the war.

In 1963 with around 25 million women in the workforce (Fortman, Lyles and Shiu, 2013) – or roughly one-third of women – working outside the home, Congress passed the Equal Pay Act which required employers to compensate women at the same rate as men doing the same work for the same company. The 1960's were marked by demands for civil rights and gave rise to the Equal Rights Movement by women. Though adopted in 1972 by Congress, the amendment unfortunately was never ratified by the states (National Archives, 2013). Perhaps this is an activity which if undertaken would redirect attention to the path of the modern female and her valued role in the social order.

Great strides have been made since the mid 20th century. According to the NSF, workers in the fields of science and engineering grew at an annual rate of 5.9 percent and increased from around 182,000 in 1950 to 5.4 million in 2009. The growth rate is substantially higher than 1.2 percent of growth for the total workforce during the same period. The median age, however, indicates that scientists and engineers are advancing in age with the median age shifting from 37 in 1993 to 41 in 2008. STEM practitioners who were now over 50 years of age moved from 18% in 1993 to 27% in 2008.

In early 2012, the President's Council of Advisors on Science and Technology (PCAST) issued a report addressing the need for more STEM graduates. The report declared that for the United States to maintain its role as the preeminent leader in STEM fields and continue to enjoy the economic, social and national-security rewards of such status, the current rate of STEM practitioners must be increased by nearly one

million over the next decades. The report cites the current rates of STEM completers must be increased by 33% to reach the threshold of a million more STEM practitioners.

In May, 2013, the U.S. House of Representatives introduced the Supplying Knowledge Based Immigrants and Lifting Levels of Stem Visas Act (SKILLS Visa Act) to close the gap between supply and demand of STEM graduates and practitioners. If passed, the bill will raise the H-1B visa cap for temporary high-skilled workers to 155,000, up from 65,000 (US House of Representatives, 2013). Additionally the SKILLS Visa Act will authorize as many as 55,000 green cards to foreign graduates of U.S. doctoral programs in STEM fields while it raises the fees that host employers must pay.

Reducing barriers to entry and supporting women through the educational cycle has an additional enticement for employers. Those who are federal contractors are required to comply with Executive Order 11246 requiring affirmative action in employment practices (USDOL, 2013). The decades-old challenge for human resource managers is to recruit, retain and promote women into areas in which they are underutilized. An unintended consequence of the shortage of female STEM graduates is the ongoing disparate impact that occurs when the pipeline itself isn't flush with candidates. Thus the underutilization is perpetuated. Part of the equation for attracting females to STEM, therefore, is connecting STEM careers with financial stability.

While females comprise roughly half the labor force, participation in STEM-related jobs occurs at a rate of one in four (Costello, 2012). This poses a more significant challenge for maintaining a 25 percent participation rate when considering the report suggests that by 2018 STEM fields will have expanded by 30 percent over the previous ten years (Costello, 2012). The proof is in the pudding, so the saying goes. Female STEM students who persist through their programs can expect a

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significant elevation in monetary status once employed. The report provides that in 2009, earnings for women in non-STEM fields were reported at median annual income of \$35,633 (Costello, 2012). Median incomes for women in STEM fields were considerably higher with female engineering technicians and female electrical engineers earning of \$41,091 and \$71,944, respectively (Costello, 2012).



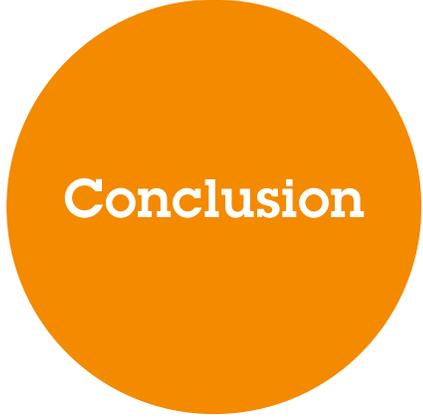
Solution

To close the gender gap in STEM, these recommendations are offered.

- Genuine collaboration with K-12 to create and support interest in STEM fields. The University of Texas - El Paso instituted a bridge program and experienced an increase of nearly 50% in STEM graduation rates earning the nation's top producer of Latino/Latina STEM graduates. The same approach can be applied to support females in STEM (Gates and Mirkin, 2012).
- Genuine collaboration between community colleges and university systems to attract non-traditional students and to bolster rigor in STEM coursework at the community college level to prepare said students for the higher level coursework in a university setting.
- Strong leaders in academic arenas who will appoint individuals to roles solely geared at recruiting and retaining the target group (females). The University of Maryland - Baltimore County, for example, targeted STEM recruiting and retention of African Americans to the extent over a seven-year period 51 percent of the targeted students went on to graduate studies in STEM fields (Gates and Mirkin, 2012)..
- Mentoring of girls to encourage their interest in STEM should begin early in the formal education system. While many non-profit organizations provide mentoring, it's clearly not enough to let the responsibility of mentoring reside in that domain.
- Modeling through departmental partnerships with STEM practitioners.
- Promotion of STEM successes by women through events such as the Ada Lovelade Day or an extended celebration of Pi Day.

This last recommendation confirms to female students that women have participated in STEM and succeeded. For example, in 1871 Margaret Knight became the first woman awarded a U.S. patent for her box-folding machine invention; she earned 87 patents in total. In 1872 Josephine Cochran invented the dishwasher. In 1903 Mary Anderson created the windshield wiper to free herself from leaning out the

car door to clear the field of vision on the windshield. DuPont chemist Stephanie Kwolek in 1966 created poly-paraphenylene terephthalamide (aka Kevlar). Yes, women have been STEM contributors for a long time. These women and their contributions dispel the distorted childhood impressions with which this paper began.



Conclusion

This paper chronicles the evolution of women as societal contributors and features a number of females whose STEM contributions can be praised as revolutionary. This paper makes the business case for a robust recruiting and retention program citing evidence from a variety of reputable sources. This paper provides action steps that should be instituted (all or in part) by STEM colleges. Finally, this paper raises the awareness of the critical absence of women in STEM and the call for action to close the gap.

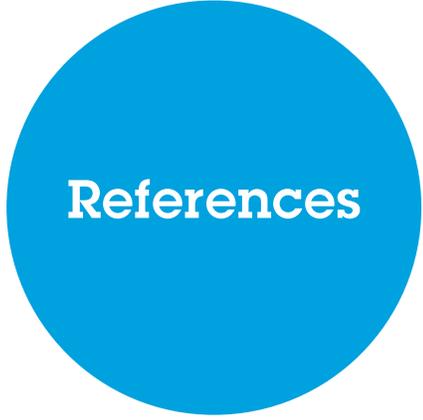
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**Author
information**

Dr. Kimberley Gordon, University of Arkansas – Fort Smith (479) 788.7782
kim.gordon@uafs.edu