Shattering the Glass Flask: A Women's Battle Against Sexism in STEM

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Abstract: The growth of women in STEM fields has always been a force to be reckoned with. Men have tried to show through countless opportunities that they preside in all fields and have created barriers, such as the female pay gap, to display their dominance and preserve their confidence. Around 27% of women have the confidence to pursue a career in STEM and by breaking down the barriers of sexism, hopefully that number will increase exponentially.

1.0 Introduction: Less than 30% of women work in the fields of science, technology, engineering, and mathematics (STEM) in the globe, even though women make up almost half of the global population (Parks 2023). They publish in the Proceedings of the National Academy of Sciences of the United States of America at a rate comparable to males, and their research has about the same effect (Parks 2023). The representation of women in STEM varies by field. In biological areas, women predominate over males (Parks 2023). But in the fields of engineering, computer science, and physics, men predominate over women (Parks 2023) (**Figure 1**). STEM education and employment have historically been viewed as being exclusively for men. Moreover, sexual harassment, unconscious prejudice, and systemic discrimination can put an early stop to women's STEM careers (Parks 2023).

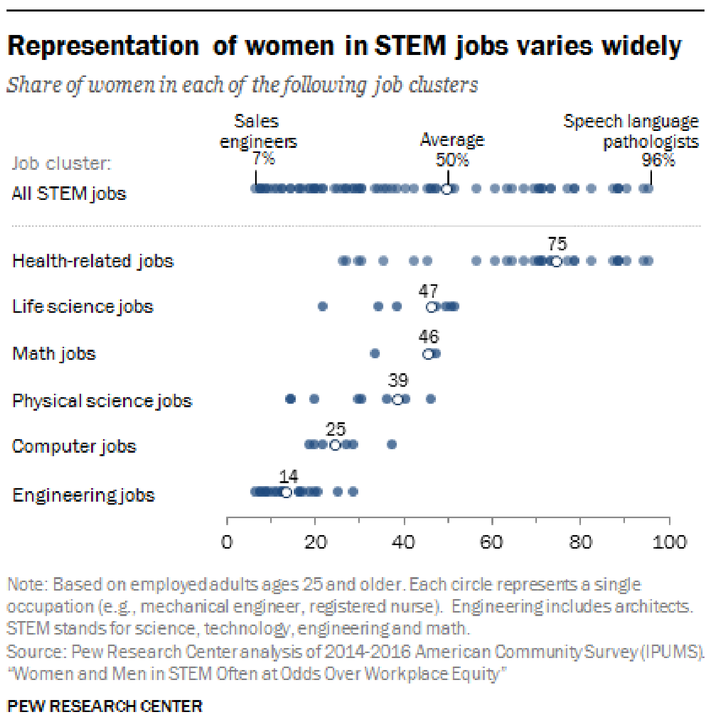

Figure 1 Graph displaying women in different fields of STEM.

https://www.pewresearch.org/social-trends/2018/01/09/women-and-men-in-stem-often-at-odds-over-workplace-equity/

1.1 Discrimination in the Field: The underrepresentation of women in STEM fields—science, technology, engineering, and mathematics—has garnered a lot of attention lately, but progress toward gender equality in these areas is lethargic (Casad et al., 2021). Even more concerning, these gender differences get worse when one looks at how many women are represented in academic STEM departments (**Figure 1**). The proportion of women in STEM faculty roles has not changed significantly, despite an increase in the number of women obtaining postgraduate degrees in recent years (Casad et al., 2021). Negative and widespread gender stereotypes, which may encourage hiring discrimination and limit possibilities for women's professional progression, are one reason for the lack of progress toward gender equity (Casad et al., 2021).

Women in STEM fields are also less likely to have access to social capital, such as support networks, which might hinder their chances of obtaining tenure and learning about grant funding sources (Casad et al., 2021). In addition, female STEM faculty members may feel that the academic atmosphere is hostile and intimidating, and they may experience unpleasant conflicts at work, including discrimination and sexual harassment (Casad et al., 2021). Even the mere existence of gender-biased indicators (such as "geeky" décor) in physically male-oriented areas might contribute to a feeling of exclusion from STEM fields (Casad et al., 2021).

2.0 Background on Sexism in STEM It is possible to pinpoint the root cause of the gender gap in STEM fields as early as middle school (Swaford & Anderson, 2020). In mathematics, boys have historically scored better than girls, but in recent decades, the gender gap has closed and the inequalities are now insignificant (Hyde, Lindberg, Linn, Ellis, & Williams, 2008). According to the U.S. Department of Education's National Center for Education Statistics (NCES), 2007 report, females are now obtaining somewhat higher grades in math and science, nevertheless, boys are currently gaining credits at an equal rate (Swaford & Anderson, 2020).

Once students enter university, the gender disparity widens even further. Among entering freshmen, males outnumbered women by 29% to 15% in the pursuit of STEM degrees, despite the fact that women make up the majority of college students (National Science Foundation, 2009). While women made up 40% of full-time STEM faculty in degree-granting institutions in 2005, they made up fewer than 25% of faculty in the physical sciences (18%), computer and information sciences (22%), mathematics (19%), engineering (12%), and other fields (Swaford & Anderson, 2020).

2.1 Experiencing Imposter Syndrome From a cultural standpoint, women in higher education encounter several obstacles to becoming leaders (Laux 2018). A lack of gender parity in professor ranks suggests hurdles to opportunity structures since access to higher education is a major factor in class mobility and achieving enhanced professional positions (Cama, Jorge, & Andrades, 2016). Research demonstrates that norms, organizational structures, and values work against women's development in the academic workforce (Beauregard, 2012; Giesler, Kaminski, & Berkley, 2007).

Gender stereotypes in the workplace usually result in gender expectations for women to participate in more organizational citizenship activities, which are demonstrated by actions like helping coworkers, volunteering, serving on committees, and fostering interpersonal relationships (Beauregard, 2012). According to some (Dlamini & Adams, 2014; O'Meara, 2015), the male-dominated field of academia harbors patriarchal attitudes and ideologies that elevate men to leadership positions and a status of recognition over women while ignoring the abilities and merits of women (Laux 2018). This creates yet another obstacle to women's upward mobility in higher education.

In addition to these external obstacles to professional development, women face internal constraints that also lead to their underrepresentation in senior leadership positions in academia (Cama et al., 2016). Due to feelings and perceptions of being undervalued, overlooked, overworked, and the subjects of unequal treatment in a management climate that can be alienating in the academic setting, academic women's identities are frequently compromised, challenged, and made vulnerable (Vergauwe, Wille, Feys, DeFruyt, & Anseel, 2015). This research investigates the experiences of female academic staff members with impostor syndrome and working in higher education, particularly concerning their quest for tenure and promotion (Laux 2018).

2.2 Anxiety among Women in STEM A model of the variables influencing career decisions is called social cognitive career theory, or SCCT. Adding occupational interest, career decisions, perseverance, and performance tasks to Bandura's (1986) SCT, Lent et al. (1994) built on it (Lapan, Shaughnesy, & Boggs, 1996). People's choices of majors are enabled by a combination of self-efficacy, interest, and personality (Larson et al., 2010). The claims made by Lent et al. regarding the SCCT of careers were as follows: (a) efficacy and interests are strongly correlated; (b) efficacy expectations mediate the relationship between achievement and interests; (c) efficacy beliefs influence the manifestation of goals and beliefs at the start and end of college; and (d) vocational interests, prior goals, and beliefs predict college major choice. This model was used in the study to investigate the relationship between interest and self-efficacy beliefs among female STEM majors, as well as the relationship between interest and college major choices.

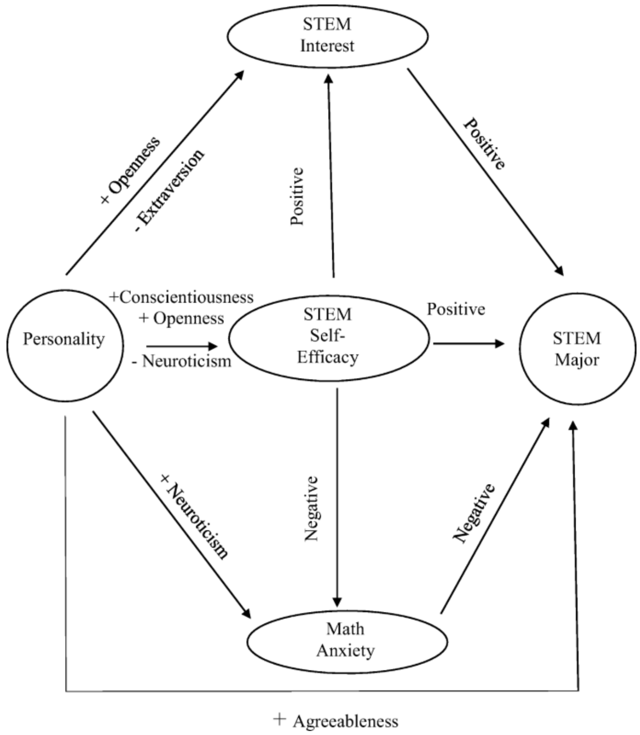

Figure 2: A chart showing the behavioral aspects of a Woman in STEM and how self-efficacy affects a woman's personality in science.
https://link.springer.com/article/10.1007/s41979-021-00050-6#Fig3

2.2.1 Mathematics Anxiety Self-efficacy concerning various individual variables. Self-efficacy completely enabled the aptitudes for interest relationships, and it was a significant element in STEM ambitions (Lent et al., 1994). The results of Lent et al. (1994) were extended by Lapan et al. (1996). According to Lapan et al. (1996), women's poorer math self-efficacy views led to a decline in their mathematical interests and investigative occupational efficacy beliefs (**Figure 2**). Interests decreased as a result of diminished ability beliefs. Lower efficacies were the cause of women's decreased interest in mathematics (Betz & Hackett, 1997; Lapan et al., 1996) (**Figure 2**).

Other variables were also predicted by self-efficacy. There was a strong correlation between mathematics self-efficacy and past achievement, prior high school mathematics courses, and mathematics anxiety (Hackett, 1985). Moreover, worry during task performance may lower endurance, composure, and contingent self-efficacy (Lent et al., 1994). Hackett and Betz (1982) discovered that mathematics anxiety was mediated by mathematics self-efficacy in a sample of undergraduate college students. According to Simon et al. (2015), there was a significant correlation between the reported reduced negative effect of STEM females and their higher levels of self-efficacy (NA; Simon et al., 2015).

In their 1986 study of secondary school girls, Eccles and Jacobs discovered three main negative effects of anxiety: (a) girls experienced higher levels of anxiety related to mathematics, and anxiety was found to be a significant predictor of mathematics grades and course intention; (b) anxiety hindered STEM intentions in a secondary setting; and (c) anxiety related to mathematics was more strongly associated with future mathematics intentions (i.e., course taking) than mathematics aptitude and achievement were. Similar to Eccles and Jacobs, but with a broader scope, were the findings of Hackett (1985). According to Hackett, factors such as gender, the quantity of math taught in high school, math anxiety, and self-efficacy all strongly predicted students' choice of STEM-related college major (Mckinney 2016).

2.3 Hegemonic Masculinity in The Sciences The upholding of behaviors that legitimize men's domination over women is referred to as hegemonic masculinity (Connell and Messerschmit 2007). These kinds of actions may be seen in the narrative titled "Blue Blazer Club." One professional society hosts a one-day specialist pre-conference before the main conference every year (Page et al., 2009). Traditionally, the top academics in the discipline provide their predictions for the field's future at the end of the day. Considering their numerical dominance in academia, it should come as no surprise that all of the distinguished professors selected in the 1970s and 1980s were men (Page et al., 2009). Because all of the distinguished men happened to be dressed in blue blazers and khaki trousers on a specific day, these academics came to be known as the Blue Blazer Club.

This research focuses on the tacit and unquestioning acceptance of institutional procedures and social rituals like the blue blazer club. Despite the language of complete inclusion, there is simply the appearance of full involvement in many sectors, including academics (Page et al., 2009). For instance, 84% of academic posts held by men were tenured or tenure-track, compared to 72% held by women (AAUP 2005). This indicates that males are more likely than women to hold tenured or tenure-track employment. Even while these figures show progress, there is still more to be done. For instance, women are disproportionately represented in non-tenure-track or contingent faculty posts, which are thought to be at the bottom of the academic hierarchy (Bergman and Waltman, 2009).

Gender parity was once believed to be attained after a sufficient number of competent women entered STEM disciplines, or the "pipeline" (Glazer-Raymo 1999). Women are still underrepresented at the full professor rank in science, despite advances in all areas, particularly biology, including doctorate degrees and associate professorships (Page et al., 2009). For instance, women only make up 19% of full professors and only 30% of tenured or tenure-track professors in doctorate awarding institutions (all scientific and engineering areas combined; 2003 figures reported in Burrelli, 2008). Only 5% of full professors in some professions, including engineering, are female. The percentages for math (8.6%) and physical sciences (8.3%) are much lower (Page et al., 2009).

Remarkably, Ash and colleagues (2004) discovered that women's slower rate of progression to full professor was not caused by productivity when they studied medical school faculty (Page et al., 2009). In conclusion, Marschke and colleagues ran several models predicting gender parity in faculty representation to the percentage of women with PhDs (40%) and discovered that there will never be more than 34% of women on faculty if institutions do not take any further action or steps to achieve gender equality; if they only hire women, it will take seven years to reach 40% and another to reach exact gender parity; if they hire men and women equally (and retain, promote, and retire), it will take 20 years to reach 40% and 57 years to reach 50%.

3.0 Diminishing Sexism in STEM Sexism in STEM stands as a prevalent issue in today's society. Women have been shunned out of opportunities that they have worked hard towards and have had no choice but to cap their passion and career aspirations.

3.1 Starting Early Sexism in STEM and other male-dominated disciplines is not usually addressed until the late teen and early adult age. Women step into a science career unaware of the adversities at hand and realize soon their raised hand won't matter in a room full of individuals who believe women do not hold the same amount of value.

One way that this could be remedied is by teaching women at an early age what to expect in a science career and developing tools to face the adversities in the world of science. At elementary schools, a day or class period could be dedicated to learning about the lost voices of women scientists who have made significant contributions to STEM, such as Chien-Siung Wu, a nuclear and particle physicist. Educating young girls of women in STEM could be followed with an arts and crafts activity or a fun experiment such as elephant toothpaste, catalase breaking down hydrogen peroxide into gas and water. If young girls become aware of the discrimination women face, they will become more aware of the challenges included in a prospective STEM career.

3.2 Recognizing the Achievements of Women in the Workplace At institutions, such as NASA, the amount of women in the workforce has increased exponentially compared to a decade ago. However, women are not being appreciated enough as the pay gap between males and females is significantly different. To exemplify, in 2013 women earned 82% or 87% of the paycheck that men earned in computer and mathematical engineering (Sterling et al., 2020).

To appreciate the contribution of women in STEM, there should be a designated work day in every STEM job for the women in the workforce, as they have also made important research contributions. Notable computer figures were Mary Jackson, Katherine Johnson, and Dorothy Vaughan. Their efforts guaranteed the mission's safety and assisted John Glenn, one of the first American astronauts, successfully orbiting the planet in 1962 (National Geographic). Their contributions have not been recognized as much as deserved to be and women in STEM workday could make the future women of STEM shine.

3.3 Amplifying the Voices of Women from the Past As previously mentioned, various female scientists have gone unnoticed throughout history. There are barely any platforms that notice these impactful women and the contributions they made throughout history. Creating a platform or database tailored specifically to these women would allow their contributions to gain the attention they deserve and inspire today's youth in STEM. This platform could be provided to the
school's libraries and research projects could be assigned around it to educate young women about the possible contributions that they can make as well. Women all over the world can be integrated into the world of science with one easy click, creating many more meaningful advancements.

4.0 Conclusion In all, women have experienced numerous struggles in science-related fields, and recognizing the importance of women in STEM fields should be applied to the workforce and society. Experiencing imposter syndrome, skill insecurities, and discrimination in the field; about 30% of women quit their jobs in STEM. A career in STEM is hard work over a myriad of years and it is devastating to see all that hard work going to waste. Incorporating women's appreciation days in the workplace, teaching young children the value of female skills, and recognizing the impactful women of the past could help future women navigating the pitfalls of careers in STEM feel more comfortable and appreciated. Following the indomitable discrimination towards women in science is a call to action for an inclusive future where every scientist, regardless of gender, can contribute to the mosaic of scientific accomplishment.

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