Undergraduate Student Perspective

STEMinists: An Exploration of the Impact of Female Educators in STEM Fields

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Abstract

With a growing need for skilled STEM workers in the US, it is necessary to examine why minority groups such as women continue to participate in STEM at far lower rates. The historical exclusion of women from education created a system of STEM education that was formed for and by men. Despite changes in the education system that have allowed women to gain traction in almost every other content area, evaluation of the current status of the field reveals STEM subjects remain dominated by men. Additionally, there appears to be a new set of barriers that exclude women at all levels of STEM education. Changes to address these new barriers need to be made — and educators who are at the forefront of this occurrence have a unique opportunity to inspire change for future generations. Specifically, female STEM educators acting as mentors and role models have been shown to help female students overcome the obstacles they face in pursuing a STEM education and career. In order to fully realize the potential of female educators, the treatment of female educators in academia needs to be evaluated to ensure they are properly supported by the schools they work for.

Introduction

Within the United States, there has been a large push to increase the number of skilled Science, Technology, Education, and Mathematics (STEM) workers in order to keep up with the constant advancements being made in these fields. At the current rate, the U.S. is falling behind on the world stage in these areas (Hossain and Robinson, 2012). This lack of STEM workers is likely due to a multitude of factors, including the fact that many minorities, including women, are still represented at low proportionate rates in these fields (Burke and Mattis, 2007, pg 5). Addressing this underrepresentation is not only beneficial in increasing skilled STEM workers, but also in allowing innovation to continue in these fields by providing diverse perspectives.

The incorporation of women in STEM has had a long, complex history. It is this history and the progression into the current era that provides the key to addressing what barriers are preventing female persistence in STEM. Women have been faced with a multitude of barriers to access and success within STEM education and careers. Access to the necessary education is a particularly important factor in ensuring an individual is capable of succeeding in any field, and STEM is no exception. The first step in increasing female participation in STEM careers is ensuring they have the necessary education.

While STEM subjects are generally viewed through the lens of higher education, participation in these subjects begins much earlier. Children are likely first introduced to STEM subjects in elementary school. Developing the talent of these young students and maintaining their interests within the subject is an integral part of growing the STEM field (Hossain and Robinson, 2012). It is with this perspective that it is necessary to evaluate how science is being presented to young learners and how the presentation can be adapted to be more inclusive to girls in and outside of the classroom.

Getting girls involved in STEM from a young age is a good first step but is somewhat arbitrary if the institutions in higher education dissuade women from pursuing careers in these fields. For nearly the entire existence of higher education, women have struggled to gain equal access, especially in the fields of STEM, which were primarily established by and for men. While the outright discrimination within STEM education may not be a major factor in the lack of female participation today, the programs and institutions of colleges and universities still seem to be unwelcoming to female participation.

With all of these issues within STEM education, attention is frequently turned to educators at all levels. Educators exist to facilitate learning and in doing so have the opportunity to serve as role models and supporters to students. It is this potential and their proximity to the issues with gender in STEM that gives educators the opportunity to make a difference. By examining the evolving relationship between women, STEM education, and the role educators play, it is possible to consider options for making improvements in the future.

The Historical Role of Women in STEM

The first step in addressing the lack of women in STEM fields today is to look at past interactions. This approach allows the examination of past establishments that led to inequality, as well as an opportunity to evaluate the success or failure of any actions that may have been taken to address the issue. Historically, STEM education and employment opportunities have been dominated by men (NSB, 2018). This discrepancy has been theorized to have developed due to varying social barriers that prohibited women from being equal contributors to STEM fields. Several of the main contributors to this inequality are traditional gender roles, access to education, and access to equal employment opportunities (Bystydzieński, 2006, pg. 6). While these are not necessarily the only contributors, these factors have had a significant impact on women's ability to be accepted in STEM and, thus, need to be explored.

In order to participate in any field, there are certain requirements for entry. In some cases, those requirements may actually serve as barriers. It is necessary to have the background, knowledge, and training associated with the field. For the majority of jobs within the STEM fields, access to formal education is necessary to gain entry into the workforce. Access to higher education in these fields, like many other fields, has historically been restricted to men. Throughout the journey towards inclusivity, the argument for allowing women access to education has evolved. Initially, the role of mothers in educating their sons was the strongest argument for expanding educational opportunities to women (Solomon, 1985, pg. 2). Over time, educational opportunities, especially at the collegiate level, expanded for women, but these opportunities were frequently unequal to those available to men (Solomon, 1985 pg. 43). Colleges and universities were commonly divided by sex, with 59% of them being open only to men in 1890 (Solomon, 1985, pg. 44). This restriction to the necessary education to join STEM fields acted as one of the largest barriers to inclusion for women. From 1890 to 1928, the number of coeducational, degree-granting institutions increased from 29% to 92% (Solomon, 1985, pg. 44). This huge jump in the availability of education marked a change in attitudes about the abilities of women and their roles in society. This increase shows a marked improvement in educational opportunity for women and is credited in large part to growing feminist movements of the time.

Despite this increase in access to education, there still seemed to be large gaps between men and women in most STEM fields. Going into the 1970s, only 13% of PhDs in life sciences were awarded to females (Ceci and Williams, 2010). These shockingly low numbers show that, while the opportunity to receive the necessary education might be available, there were other factors that were holding women back from contributing fully to these fields. Opportunity varied within STEM fields as well. Bystydzienski notes that engineering schools were particularly resistant to admitting women and were structured in such a way as to be unwelcoming to the few women who did manage to get in (2006, pg. 27).

One reason women were frequently denied access to STEM education was that it was thought to interfere with the traditional roles assigned to women by society. Marriage, raising a family, and the work necessary for success in those endeavors, have traditionally been ascribed to women (Wharton, 2005, pg. 134). Because of this, men were viewed as better suited to filling positions that required a higher time commitment. Family matters were not considered to be an infringement of a man's time. The married family structure does not inherently limit women's career opportunities and, in some cases, can provide a support system for it. Alternatively, these expectations can conflict with women's abilities to commit their full time and attention to such work. Bystydzienski noted this phenomenon, stating that "research and personal memoirs also suggest how positive situations provided support and established safe havens during the sometimes tumultuous early years when a career is established, and, alternatively, how the family and community obligations that women are expected to assume could compromise or even curtail a promising career" (2006, pg. 27). All of this seems to show that women were more welcome in higher education and STEM fields as long as it did not inhibit their ability to fulfill their familial duties.

Looking at the structure of society throughout history, one of the largest barriers to women in STEM is the distinction between male and female work. There has been a longstanding belief that men and women are better suited for different jobs (Wharton, 2005, pg. 167). This institutional ideology has acted as a barrier for women entering many job fields including those associated with STEM. Circumstances such as World War I and II, however, allowed women to fill jobs left by men that they would not have had access to previously. The shift in the workplace demographic resulted in that which "has previously been viewed as quintessentially masculine were suddenly endowed with femininity and glamour for the duration" (Wharton, 2005, pg. 168). The change in the availability of jobs also shifted attitudes about jobs that were suitable for women. Wharton notes, "Masculine jobs that had been filled by men prior to the war were relabeled as appropriate for women" (2005, pg. 168). This subsequent shift in attitudes opened up new opportunities in the lives of women.

Gender cannot be assumed to be the only factor that influenced acceptance into education and, beyond that, into STEM fields. Many other minorities were restricted in their access to education and had compounding effects with the experience of women. Specifically, race has played an interesting role in its relationship with women in STEM. While women overall were kept away from work and discovery opportunities in STEM, there were even more discrepancies between women of different races and ethnicities. Award-winning journalist Rona Cherry offers more of a look into this in her book, ***Woman in the Year 2000***:

> However, in STEM fields, a lower percentage of bachelor's degrees were awarded to females than to males (36 vs. 64 percent). This pattern—in which females received higher percentages of bachelor's degrees overall but lower percentages of bachelor's degrees in STEM fields—was observed across all racial/ethnic groups. The gap between the percentage of STEM bachelor's degrees awarded to males and the percentage awarded to females was largest among White students (33 percentage points), followed by Pacific Islander (28 percentage points), Hispanic (25 percentage points), American Indian/Alaska Native (23 percentage points), Asian students (21 percentage points), and students of Two or more races (21 percentage points). Black students (11 percentage points) had the smallest gap between the percentage of STEM bachelor's degrees awarded to males and the percentage awarded to females.

While gender differences in STEM may be smaller within specific racial groups, these numbers show unequal representation across all listed groups. This is possibly influenced by the fact that household labor is generally more equally shared between men and women in non-white families, allowing for a more equal representation of women in the workforce and in STEM (Wharton, 2005, pg. 134). Additionally, with the combination of both racism and sexism, women of minority race groups were less involved in the STEM work fields and educational fields than even women of white descent (Solomon, 1985, pg. 76). Women of color had to fight even harder to be acknowledged and accepted in the world of STEM with less of a resulting outcome.

These results are contradictory to the statistics on women's pursuit of entering the workforce.

White women listed "balancing work with family responsibilities" as the number one significant issue/challenge female scientists face in their careers (Bystydzieński, pg. 75). However, African American families see more balance and equality when it comes to women entering the workforce and dividing labor between genders.

There were again significant differences that contradicted the participation in the STEM fields, according to an NELS (National Educational Longitudinal Survey) study comparing African American Females to White Females. In 1988, 59% of African American females were looking forward to science classes and a whopping 70% believed science would be useful in their future, compared to 55% and 65% of white females, respectively. However, in 1988, African Americans scored an average 45.12 on their science standardized testing versus White females' average of 52.73, resulting in an average difference of 7.61 in scores (1990 was even greater with an average difference of 9.08, favoring white females) (NCES, n.d.).

So why is there such an extreme difference between statistics about women in terms of STEM fields and education and breaking down the statistics to different races and ethnicities of women in terms of STEM fields and education? As Bystydzieński expressed, "This [NELS study] examination suggested that simple assumptions about the mismatch between women and science are often based on the experiences of white women. In fact, in the African American community, gender is constructed in a very different way and many of the characteristics that are considered appropriate for females (e.g. high self-esteem, independence, and assertiveness, as well as high educational occupational expectations) are not inconsistent with characteristics that contribute to success in science" (2006, pg. 136).

This follows Bystydzienski's findings of African American females not finding as high a disparity between work and family responsibilities as white females. Yet despite this desire for more equality in the STEM fields, women of color have been overlooked and ignored, even by those one would assume would be on their side. As Kimberle Crenshaw, lawyer and civil rights advocate, stated in her publication for the Stanford Law Review on intersectionality, "For example, racism as experienced by people of color who are of a particular gender - male - tends to determine the parameters of antiracist strategies, just as sexism as experienced by women who are of a particular race — white — tends to ground the women's movement. The problem is not simply that both discourses fail women of color by not acknowledging the 'additional' issue of race or of patriarchy but that the discourses are often inadequate even to the discrete tasks of articulating the full dimensions of racism and sexism" (1991, pg. 1252).

Women of color have found racism amongst those of the same race or the same sex, meaning that there is even a lack of understanding and support among their peers for their desire to pursue STEM careers, let alone acknowledgment for their efforts to enter said career fields. Women of color and their voices have been erased (Crenshaw, 1991, pg. 1253).

The differences in the numbers cannot be chalked up to or blamed on different attitudes. It comes down to the availability, access, and support different women had when pursuing STEM ideas and education. Yes, white women were not given the same access to STEM fields and acknowledgment for their contributions, but even less opportunity was given to females of minority races and ethnicities. They weren't provided the example of females that looked like them, nor were they held to the same expectations as others in their teachers' eyes. Women want to learn and want to be involved more than society gives them credit for, but without access to support and opportunities, their wants are left abandoned and disregarded and their voices are left erased.

Women in STEM: The Current Picture

Historical inequality between men and women's roles in society has led to a disparity in who was capable of partaking in STEM education. This resulted in a staggering underrepresentation of women in STEM fields. Women had to push past these barriers to show that they were capable of succeeding in these fields. All of this activism has had a clear impact on the involvement of women in STEM education. The number of STEM doctorates awarded to women was six times higher in 1995 than in 1970 (Burke and Mattis, 2007, pg. 29). This marked improvement shows that some barriers that previously existed were overcome and we as a society have made great advancements towards closing this gender gap. While women have made great strides across history in efforts to improve the gender gaps in STEM education, inequality still exists. Despite an increase in collegiate attendance as a whole, women hold a disproportionately low number of undergraduate STEM degrees (Beede et al, 2011). This suggests that while traditional barriers limiting women's access to education may have been overcome or removed, there are still barriers specific to STEM fields that are inhibiting participation.

The discrepancies of female involvement are not limited to education, but rather, also carry forward into the workforce. In a study entitled "Women in STEM: A Gender Gap to Innovation," Beede et al. found that "Although women fill close to half of all jobs in the U.S. economy, they hold less than 25 percent of STEM jobs" (2011). This disparity more clearly shows that the gender gap appears more noticeable within STEM fields than in other areas. Beede et al. went on to show that the disparity in employment in STEM fields exists regardless of education level, with the doctorate level having the closest to even proportions where men are still employed at almost double the rate of women (2011). While access to the necessary education was a major contributor to this gender gap in the past, this study shows that new barriers have emerged to take the place of those that limited women previously. This drastic statistic is explained at least partially by the fact that those women that hold STEM degrees are less likely to obtain jobs within that STEM field than men (Beede et al. 2011). In order to remedy this gap, these new restrictions must be identified and novel solutions must be implemented.

Educational institutions are not the only organizations concerned about the gender discrepancy in STEM. Several private organizations have already taken steps to address the issue. In 2018, Girl Scouts of America released thirty new badges for girls ages five to eighteen to earn and two new "journey" programs for girls to participate in — all of which were STEM-related. The thirty badges are given to girls for their advocacy and exploration in topics such as cybersecurity, robotics, computer science, space exploration, and more (Kelly, 2018). Girls in elementary school can earn badges for designing their own robot, creating algorithms for computer games, creating models of the solar system, and even creating their own home experiments to represent ideas such as static electricity or density. Sylvia Acevedo, CEO of Girl Scouts of America, stated that "Girl Scouts are learning how to proactively address some of the foremost challenges of today while also building skills that will set them up for a lifetime of leadership" (Kelly, 2018). Earning these new badges encourages girls to take charge of their own STEM learning and learn skills, such as problem-solving, the scientific method, computational thinking, and how to receive feedback to expand knowledge and understanding. These badges are the first step into a lifetime of learning, leadership, and STEM appreciation.

As of 2017, 1.7 million girls across the nation are involved in Girl Scouts. For many elementary school girls, it is a rite of passage to belong to this organization — earning badges, swapping stories, creating and exploring the world with their female peers and led by female role models in their community. For over 100 years, Girl Scouts of America has focused on developing young women to be strong ambassadors for their peers, promoting self-confidence, and making the world a better place to live. So why is the addition of thirty new STEM-related badges so significant?

The numbers speak for themselves. According to the Girl Scouts of America, between the years 2012 and 2015, the interest in STEM fields has skyrocketed in their young members. 71% of female participants agree that women can be good engineers as well as 58% disagreeing with the idea that engineering is better suited for men than women. Participants in the Girls STEAM Ahead program across the country (which includes Art with the original Science, Technology, Engineering, and Mathematics acronym) have grown in their appreciation for the subjects. “Between 42% and 56% liked science more and between 39% and 42% liked math more after the program than they had at its start.” As girls learn skills associated with the STEM badges and earn and participate in programs that encourage the growth of skills and knowledge, they are understanding the importance of STEM in one’s daily lives. With the support of girls and women around them, they are not focused on the gender aspect of STEM careers but are focused more on whether or not they have the tools and drive to reach for STEM careers.

The Girl Scouts of America have seen an increase in interest beyond just the STEM badges and programs they now offer. Girls STEAM Ahead participants are increasingly interested in STEM careers, with 77% to 90% now wanting more information about careers in math, science, and the arts. Between 79% and 83% of those that focused on winning robotics badges are now interested in majoring in a science or engineering-related subject in college. Girls are becoming stronger leaders in their schools and communities, they are getting more involved with STEM in class, and are recognizing that STEM careers are not boring or dull, but filled with advancements, discoveries, and revelations that they could be a part of later in life. With the implementation of these new STEM badges and programs, girls are more likely to want to pursue college careers in these fields.

Girl Scouts of America isn’t stopping there. They pledge to “add 2.5 million girls to the STEM pipeline by 2025” (2019). Programs aimed at young girls are helping promote interest in STEM fields. Just these past few years have seen an increase in interest due to these new badges. Girls are joining these programs for the badges but leaving with so much more: an appreciation for the work that comes with STEM as well as a realization that STEM isn’t just for men anymore. Girl Scouts of America hope that these kernels of interest, intrigue, support, and fun that are found in programs related to STEM that are designed for young girls will carry with them through high school and into their future careers.

While programs such as the one offered by the Girl Scouts provide an optimistic outlook for the future of women in STEM, female involvement in STEM education tells a different story. The lack of female participation in STEM education is seen at almost all levels: more females than males opt out of science and math courses, some as early as sixth grade; fewer women than men pursue degrees in STEM fields; and higher rates of women switch out of STEM majors than men (Burke and Mattis, 2007). Thus, the interest stops shortly after entering middle school and continues to drop for the next two decades. In fact, although girls at the age of 11 ½ show an interest in STEM subjects, they begin losing interest at age 15 (Trotman, 2017). A study done by Microsoft and KRC Research found that in the Midwest, only 46% of middle school females and 46% of high school females feel powerful doing STEM despite 51% of middle school females and 62% of high school females understanding how to pursue a STEM career (Choney, 2018). And "while the U.S. Bureau of Labor Statistics predicts that technology professionals will experience the highest growth in job numbers between now and 2030, only a fraction of girls and women are likely to pursue degrees that enable them to fulfill these new jobs" (Choney, 2018). These high attrition rates could indicate several things, including a lack of motivation to pursue degrees in these fields or the presence of factors that impact the willingness of females to continue their STEM interests.

The numbers don't add up. Based on the excitement and the stories that girls shared after participation in the new GSA STEM program, there should be an increase in the number of girls seeking STEM careers. Elementary school girls express interest in STEM fields, they promise to pursue STEM-related careers in the future, and they share a belief that women fit the mold for scientists, engineers, and mathematicians as much as men. And still, the numbers are discouraging.

In regard to motivation to join these fields, this lack of participation and high attrition rates are somewhat surprising considering that women in STEM jobs earn 33% more than women in comparable non-STEM positions (Beede et al, 2011). This financial incentive to pursue an education and career in STEM would seem to suggest that more women would be following this path. It also suggests that there are other factors within these areas that are discouraging female participation. All of this culminates in STEM careers that are lacking in the potential contributions of female minds and suggests that today's society has placed new barriers to the inclusion of women within STEM fields. The attention now turns to why the numbers don't increase, but rather decrease as time continues.

The National Survey of Science and Mathematics Education (NSSME) from December 2018 provides information that might lead to an answer. Only 34% of the elementary teachers surveyed have had courses in Earth, life, and physical science. 59% have only had one or two courses in these three areas. In reference to elementary teachers' preparations for mathematics, only 7% have taken courses in the following subject areas: algebra, geometry, number and operations, probability, and statistics. The majority group, 53%, have only had courses in one or two of these subject areas — all subject areas that the National Council of Teachers of Mathematics recommends elementary mathematics teachers take in their college careers.

This is reflected in the preparedness the surveyed elementary teachers have reported in each subject. 77% report feeling very well prepared for Reading/ Language Arts subject matter with Mathematics following behind with 73% describing themselves as very well prepared. However, only 31% report feeling very well prepared for teaching Science curriculum. While 58% of high school teachers feel very well prepared to develop students' conceptual understanding of science ideas, only 23% of elementary teachers feel very well prepared and only 9% of elementary teachers feel very well prepared to develop student's awareness of STEM careers. This means that elementary school-aged girls must find their intrigue in STEM-related career fields outside of the school. They are not getting proper support in developing their own understanding of STEM subjects or getting resources about STEM careers from their teachers and from their schools.

If teachers are not properly prepared for teaching STEM subjects at the elementary level, they are less likely to promote the preparation in their students. The lack of understanding when it comes to science and math leads to a lack of conceptual understanding in students and, consequently, leads to a lack of interest in these subject fields further down the line, despite continuous reports of secondary level teachers having more understanding and preparedness in their respective subjects. This could be a major source of the lack in pursuit of STEM field careers by women.

When asked how often elementary teachers spend on science and mathematics instruction, only 17% of K-3 grades taught science all/most days of the week and only 35% of 4-6 grades as well. The majority fall into the category of three or fewer days of the week. The average number of minutes spent on Reading/Language Arts was 82-89 minutes per day. Mathematics averages an hour a day and science takes less than half an hour in grades K-3. Students are clearly not getting a proportional amount of exposure to STEM subjects. This discrepancy could be caused by a multitude of factors. One probable cause is that elementary teachers are feeling unprepared or inadequately prepared for teaching science and mathematics and this is leading to a lack of focus on the subject matter in the daily curriculum.

It could, however, be more than just a lack of teacher preparedness and pursuit of STEM subjects in the classroom. There isn't just one cause and one effect at play here. Media plays a significant role in the lives of young people across the country and how women are presented in various media is a major influencer as well. How women are presented in the media, and the psychological messages it brings, could be a contributing factor.

According to Jocelyn Steinke, "A study focused specifically on television programs likely to be watched by adolescent viewers and broadcast in 2006 found... female scientists characters were outnumbered by male scientist characters by 2 to 1, appeared in fewer scenes, and were less likely to be shown as independent and dominant" (2017). Just a small depiction of women in STEM fields in media, such as television and film, feeds into the stereotypes that male STEM career holders are the heroes while female STEM career holders are less formidable. Take the award-winning television show, ***The Big Bang Theory***, which has been known to showcase one of the most diverse casts in televised scientific history. But even Dr. Amy Farrah Fowler (played by Mayim Bialik, who has a Ph.D. in neuroscience from UCLA) is seen continuously making decisions on what to sacrifice: her work or her personal life, and is often the butt of the jokes on the hit sitcom.

Media is often seen as a reflection of society, of culture, of truth, but "the lens through which we receive these images is not neutral but evinces the power and point of view of the political and economic elites who operate and focus it" (Gamson et al., 1992). It is not a reflection of the truth at all, rather what those behind the camera want the audience to believe is the truth, and their version of the truth leads to the lack of strong, independent, formidable female characters in STEM-related activities or careers. "Thus, exposure throughout childhood and into the adolescent years to media portrayals that support and perpetuate a socially constructed masculine image of these fields may elicit gender biases that directly and indirectly affect adolescent girls' views of who belongs in STEM" (Steinke, 2017).

Sixty percent of girls are more likely to pursue a career in STEM fields if they knew for certain that men and women were equally employed in these professions (Trotman, 2017). The media doesn't portray equal employment in STEM professions and, sadly, this is indeed the truth. Despite women making up half of the college-educated workforce in the United States, only 28% of women make up the science and engineering workforce, including the fields of computer science and physical science (National Girls Collaborative Project, 2018). Further surveys indicate only 9% of the 2015 mechanical engineering workforce were women (NSB, 2018). Despite the significant increase in female careers in STEM fields since the early 1990s, the numbers don't indicate equal employment rates between men and women. This doesn't bode well for the 60% of girls found in Trotman's study.

Unsurprisingly, this workforce gender disparity is seen at highly variable levels across the diverse areas of STEM. By taking a closer look at female participation in these fields, it might be easier to speculate what factors could be causing this inequality to occur. Figure 1 shows females' participation by field as of 2008 (Hill et al, 2010, pg. 14). In order to evaluate this further, these fields have been broken down into three broad categories: life science, computer science, and mathematics and engineering.

Certain STEM areas, such as those within the life sciences, have seen a marked improvement in female participation and, in some cases, approximately equal participation to men. Burke and Mattis found that roughly 53% of bachelor's degrees in Biology are awarded to females (2007). This improvement is a testament to the initiative of past movements to incorporate women into STEM and shows that equality is possible within STEM fields. Having seen the nearly equal proportion of women and men in this area, it is hardly shocking that 57% of females in STEM jobs are in life and physical sciences (Beede et al., 2011). Both of these statistics may be indicative of the importance of representation within the classroom and the field. Despite these relatively high numbers, the rates at which these degrees are being used for field-related jobs are significantly lower. One study found that "Women earned 31.3% of chemistry Ph.D. degrees between 1993 and 2003 but in 2002 were hired for only 21.5% of assistant professorships" (Ceci, Williams, and Barnett, 2009, pg. 218). These statistics show that regardless of academic achievement, there are societal and cultural factors that are impacting women's participation in STEM.

The improvements in life and physical sciences are balanced out by the acute inequality in the proportion of women in fields such as engineering and computer sciences. In the case of engineering, it is "the second-largest STEM occupational group, but only about

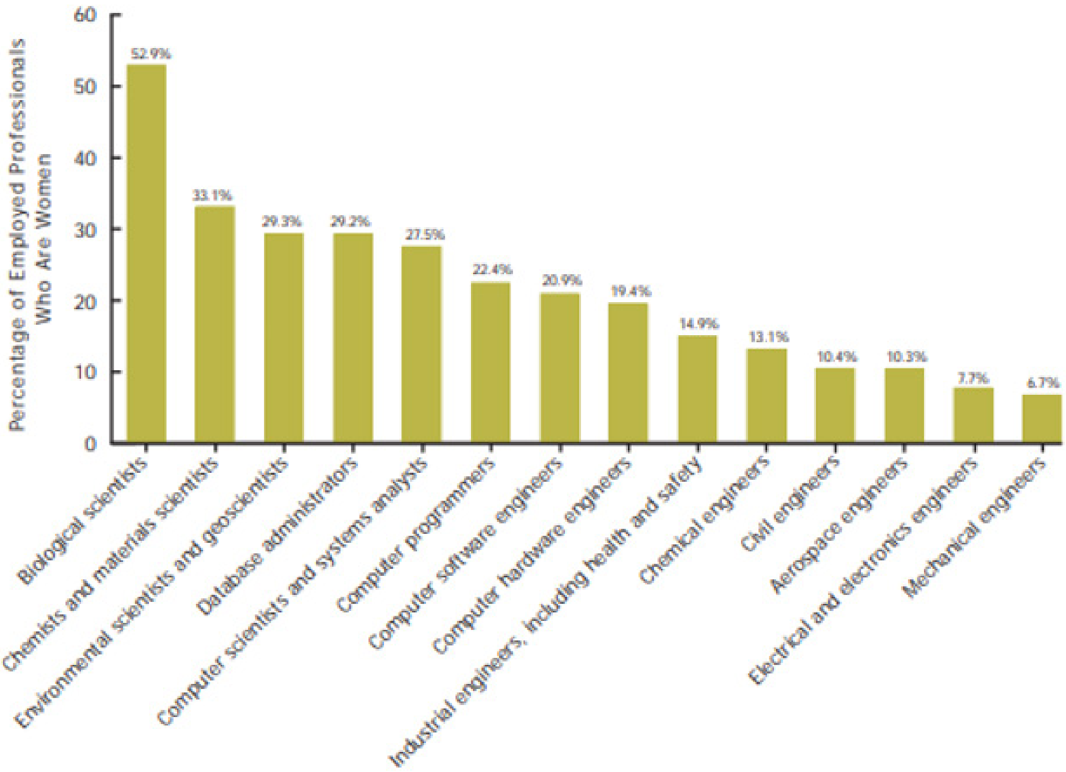

Figure 1. Women in selected STEM Occupations, 2008. All occupations are self-reported. Source: U.S. Department of Labor, Bureau of Labor Statistics, 2009, Women in the labor force: A databook (Report 1018) (Washington, DC), Table 11.

one out of every seven engineers is female" (Beede et al, 2011). One major contributor to this low rate of participation in the workforce is the gap that exists in education. Unlike life sciences, where the percentage of degrees earned is fairly equal between the sexes, only 20% of engineering degrees are earned by women (Burke and Mattis, 2007). Low rates of females earning degrees in engineering seems to indicate that the major issues limiting equal participation in this field stem more from educational systems rather than hiring or workplace institutions.

While these percentages are concerningly low, there has actually been an improvement in engineering degrees awarded to women and participation in the field. In 1970, only 1% of engineering degrees were awarded to women, and this statistic rose to 9% by 1996 (Christie et al. 2017). This continual growth of women within the field provides a basis for a positive outlook for women's participation in engineering in the future. This rise in degrees earned was accompanied by an increase in female educators in the field. In fact, by 2006, the number of female faculty in engineering programs had risen from 1% in 1976 to 16-25% (Ceci, Williams and Barnett, 2009, pg. 218). These improvements indicate that strides towards inclusion are making an impact. They may also indicate a connection between the role of diverse representation among faculty, and minority participation. Despite these vast improvements, the increases in faculty hiring are not proportional to the increase in the pool of female applicants for these positions (Ceci, Williams and Barnett, 2009, pg. 218). This mimics the same patterns that were seen in the life and physical sciences of increases in earned degrees not translating into a movement towards gender equality in hiring.

In computer sciences, female participation has actually been declining in recent years. In 1984, women represented 30% of computer science undergraduates in 1984 but that number decreased to only 20% in 1999 (Burke and Mattis, 2007). This trend does not follow with those established within the life sciences and engineering fields. This decline in female participation is not just limited to education but is seen in the job sector as well. Within the workforce, women are almost twice as likely as men to leave jobs in computer science fields (Burke and Mattis, 2007). This unusual pattern seems to indicate that the barriers to women within these fields may exist in different forms, or present themselves at different levels.

These factors indicate that while traditional barriers, such as the outright barring of women from a formal education, may not be present anymore, there is still something preventing inclusivity in these fields. There are many factors that have been proposed to have contributed to or have caused this inequality. These factors include social and cultural pressures, perceived competence, intrinsic bias, and establishments incorporated in STEM being exclusionary to women. While these factors may vary in their impact on this issue, it is necessary to consider as many contributors as possible in proposing potential solutions.

While past analysis of this gender gap in STEM has heavily considered potential biological differences, experts trying to understand the gender gap are now focusing on the impact of social pressures. Ceci, Williams, and Barnett addressed this shift in their paper "Women's Underrepresentation in Science: Sociocultural and Biological Considerations" by stating that increases in female participation in STEM fields over the past 30 years "are evidence of the strength of cultural factors in determining such outcomes, because biology has not changed over this period" (2009). Instead, it is more likely that these gender differences arise from differing expectations based on biological sex (Ceci, Williams, and Barnett, 2009). Despite the fact that biological differences between men and women have been shown to be fewer and of less magnitude than had been previously assumed, the implications of these assumptions are still present in our society (Wharton, 2005, pg. 24)

Another social factor that may impact women's desire to join STEM fields is the idea of an identity threat. This encompasses the fear of being marginalized within a field or the fear of fulfilling negative stereotypes of being in that field (Cheryan and Plaut, 2010). In this vein, just the possibility of being discriminated against or being perceived negatively acts as a deterrent to those who might otherwise be interested in joining different STEM fields. Even for women who choose to pursue this path, feelings of a social identity threat "can discourage women from persisting in these fields" (Cheryan and Plaut, 2010). Not only does this factor potentially impact enrollment rates, but it could also contribute to the higher attrition rates seen among women in STEM.

Individual cultures may also impact the achievement of women in STEM fields. Studies have found that "large cross-national variation in sex differences... suggests that culture rather than biology is involved because the observed patterns are not otherwise explicable" (Ceci, Williams, and Barnett, 2009, pg. 225). This variation between the achievement of women in STEM fields across cultures hints that this may be a factor that needs to be considered further. Ceci, Williams, and Barnett stated that all of the data regarding sex differences suggests that "culture may play a major, though poorly understood, role in creating proximal differences that lead to differences in STEM fields" (2009, pg. 226).

The institution of education is almost undeniably influenced by these societal constructions of gender. This can be seen in the application of expectations associated with various skills and predispositions. This differentiation between gender can be explained by gender polarization, which states that males and females have distinct roles and interests and the crossing of those boundaries is somehow wrong (Wharton, 2005, pg. 34). These schemas can influence the path individuals choose to pursue. Hill et al stated that "children — girls especially — develop beliefs that they cannot pursue particular occupations because they perceive them as inappropriate for their gender" (2010, pg. 22). In addition to impacting students choices, these roles and expectations can result in differential treatment based on sex. In an educational context, studies have found that teachers in STEM fields "provided boys with more formal and informal reward and support, and a good effective environment in which to learn" (Ceci, Williams, and Barnett, 2009, pg. 228). In comparison "girls were largely ignored" within the same classrooms (Ceci, Williams, and Barnett, 2009, pg. 228). This neglect in the classroom can leave females with a sense they lack belonging in STEM fields and discourage them from continuing within a given field.

Institutional factors such as the gender makeup of the classroom and faculty may also influence participation within a field. In fact, Wharton found that the "sex composition of the faculty and the type of institution a student attends are related (2005, pg. 67). While this refers to colleges and universities as a whole, the same principle can be applied within specific fields such as those in STEM. This lack of representation within collegiate faculty only worsens at higher levels. "Male and female students attending the most elite colleges and universities are least likely to be taught by female faculty members" (Wharton, 2005, pg. 67). This lack of diversity within STEM education can lead to students feeling as though they do not belong in the field. A study by Cheryan and Plaut explores the impact of the perception of the stereotypical student within a field on other's willingness and desire to join that field. They found "the extent to which a person's own perceived traits and attributes overlaps with these academic prototypes are related to improved attitudes toward the field" (2010). Based on this and the knowledge that men have historically dominated STEM fields, it is logical that women may be less inclined to pursue an education and career in these fields.

Many girls choosing their educational path state that they are not interested in pursuing STEM (Hill et al, 2010, pg. 21). This lack of interest is likely impacted by several factors, including a lower perception of their own aptitude for the area. In assessing one's own ability, "girls assess their mathematical ability lower than do boys with equivalent past mathematical achievement" (Hill et al, 2010, pg. 21). This lower assessment of ability may impact females' perceptions of their ability to succeed in STEM and, in turn, diminish their interest in exploring a STEM education. This perception of being capable of succeeding in STEM can be influenced by whether an individual perceives these skills as being learned or innate. Hill et al. found that "when a girl believes that she can become smarter and learn what she needs to know in STEM subjects — opposed to believing that a person is either born with science and math ability or not — she is more likely to succeed in a STEM field" (2010). This information suggests that the way STEM is presented to students matters in their willingness and interest in pursuing it at the higher education level. In a similar vein to underrating their abilities in STEM topics, females also have lower expectations compared to men that they will succeed in STEM as a whole (Cheryan and Plaut, 2010). The undervaluing of their skill and their potential achievement have the power to take a great toll on women's interest in continuing in STEM education or into a STEM career.

As girls venture more and more into what were traditionally male-dominated career fields, they still find barriers placed upon them at every turn. Yes, the stereotypes that were previously attached to STEM careers are starting to fade away as girls and women discover the benefits to pursuits in STEM, but the retention rates are lacking; the numbers still don't match. We must look to the future to see how the number of women in STEM careers can grow - if it's not too late.

"We have to rethink the way we raise our girls," CEO and founder of the program Girls Who Code, Reshma Saujani, states. "Boys are pushed to take risks; girls are not. In fact, they feel like they have to be perfect at everything they do; they see getting a 'B' in math class as bad. We have to teach girls to be imperfect" (Choney, 2018). The way girls approach their school work is much different than boys - on a cultural, social, and cognitive standpoint. Men and women's brains are different, there is no denying, but the problem comes from outside forces as well, not just internal emotions or cognitive development. There needs to be a wall of support surrounding girls in order for them to consider approaching male-dominated career paths, especially STEM.

The Future of Women in STEM

The failure of the current system in STEM education to encourage equal participation of women necessitates actions to diversify the individuals pursuing education in these fields. The ever-present question as to what can be done to mediate this gender inequality within STEM fields is one that has brought about an array of potential causes and solutions. Along this vein, a variety of programs have been enacted in recent years with the hopes of increasing female participation in STEM higher education, as well as increasing retention rates within the programs. These preliminary steps in addressing this issue have had varying degrees of success. Nevertheless, they lay the groundwork for improvements in the future.

The Specialized High School Admissions Test given to high school students in New York City found that ninth-grade girls were on average 4.2 points higher on a 100-point scale than their male counterparts (Barshay, 2019). When looking at exam scores, females taking the entrance exam made up 40 percent of the top 3 percent, meaning they were less than half of those receiving high marks on standardized exams for STEM. Looking at the ninth-grade math and science classes, however, females were half of the grades listed as 95 percent and above (Barshay, 2019). Despite what the admissions test may have led admissions boards to believe, girls were excelling at their classes such as geometry, biology, physical science, and algebra.

This goes completely against former Harvard University president Larry Summers's statement about how "one reason there are relatively few women in top positions in science may be 'issues of intrinsic aptitude'" (Jaschik, 2005). Females are capable of making the cut — the grades and statistics prove it plainly. Maybe one reason there are relatively few women in top positions in science (and technology, and engineering, and math) is that women aren't granted the same amount of access into these programs.

University of Michigan physicist Timothy McKay elaborates that "even the brightest women may not perform at their best when they feel that they are in a stressful environment where women don't traditionally succeed" (Barshay, 2019). Women feel this extra pressure to succeed when it comes to their schooling, especially compared to their male counterparts. There is less room for error in women's mindsets, just as Saujani was stating. Women "have" to be perfect at everything they do, so much so that even a decent grade, an above-average grade, is seen as failing and an embarrassment. Women are in no way suffering from "issues of intrinsic aptitude", but rather this idea that if they do not succeed completely the first time, then they are failing and the pressure to be perfect is winning.

A step to rectifying this inequity would be to further develop the opportunities to encourage women to join STEM programs, jobs, research, and more. The first step to getting women's feet through the door is to create acceptance of women in STEM career paths. However, this is a drastic change that will not happen overnight. The acceptance of new is not something easily accomplished by the typical person, much less an entire professional career integrated into the daily workings of the world. It must start smaller.

Young girls need to see a path forward in STEM. They need to see the opportunities and support that will meet them down the road. As the Microsoft survey found, young girls stated that one of the main reasons for their decision not to join STEM fields was because of a lack of female role models (Choney, 2018). Thus, mentors in universities would help ensure young women already interested can move from academia to career. By fostering the pursuit of a degree in the young women who are already interested in STEM, universities can bridge the gap between men and women receiving STEM degrees.

The relationship between faculty and student can be implemented in institutions of higher education through mentorship programs. Mentorship programs allow women to not only see themselves represented in STEM but also to engage with educators to develop a support system. While these programs can be implemented in many different ways, they allow students to gain greater insight into STEM topics and culture. Lopatto said on this topic "Mentors are teachers, but they are also coaches, gatekeepers to a community of scholars, and conduits for passing on the culture of science" (2010). Programs with the aim of increasing female participation in STEM have been implemented in various universities across the United States, as well as internationally (Barabino et al, 2019). These programs allow students to engage in professional relationships to gain knowledge and skills from female educators throughout their time at the institution. These preliminary programs have had promising levels of success, especially when female students were paired with female educators as mentors. Barabino et al found that "men could not act as role models in the same way women could" (2019). This information, coupled with the fact that the lack of role models serves as a deterrent to women considering STEM education and careers, is evidence of the integral role female educators play in ensuring a future with equal opportunities for all individuals regardless of sex.

The importance of having a mentor who could serve as a role model can be seen in a wide variety of improvements for the female students who took part in these programs. Higher levels of professional success were shown in women who were mentored by female educators in their field rather than male mentors (Barabino et al, 2019). These results suggest that mentorship in the education system carries through into future efforts within the workforce. Mentorship programs offer a promising solution to the women pursuing and obtaining positions within STEM fields, regardless of their degree earned. In addition to higher professional success, female students with mentors were more self-assured in their abilities and skills within their field (Barabino et al. 2019). This is an important finding in addressing the lower evaluation of knowledge and skills seen in female STEM students that have been cited as a contributing factor to the gender gap. Providing female students with female educators as mentors increased the retention rates of these students by providing them with a stronger sense of belonging in STEM (Barabino et al, 2019). This increased sense of belonging could overcome the perception of scientists and mathematicians being primarily male that dissuades some from pursuing these fields in higher education.

With the overwhelming success of mentorship programs within STEM, it is unsurprising that organizations like Achieving XXcellence in Science (AXXS) are considering it as a necessary tool in combating inequality in STEM fields at educational and professional levels (Burke and Mattis, 2007, pg. 38). AXXS even includes mentorship programs in a list of concrete steps professional organizations can take to promote leadership, visibility and recognition of women in STEM (Burke and Mattis, 2007, pg. 39). In regards to mentorship, AXXS calls professional organizations to

1. Establish a national mentorship system for women,
2. Establish mentoring as a core activity of professional societies,
3. Develop effective mentoring programs, and
4. Create a networking website for scientists.

All of these steps, while meant for a professional setting, can also be applied in an educational setting. Establishing mentorship programs and building networks of support for women on a national scale could be essential to overcoming many of the barriers that dissuade women from continuing in STEM education.

As successful as these programs seem to be, they are difficult to implement largely due to the low numbers of female faculty in STEM areas. Currently, females make up only 4% of the full professors and 6% of associate professor positions in U.S. medical schools (Burke and Mattis, 2007, pg. 246). This occurrence is not isolated to the graduate school level. In the top 50 chemistry departments in the U.S., women make up only 12% of tenure track positions (Burke and Mattis, 2007, pg. 246). Clearly the teaching profession is not excluded from the disproportionate representation seen in the rest of the field. Without the female faculty to enact these mentorship programs, the opportunities these programs offer in mediating gender inequality in STEM are lost. Thus, to offer a better educational experience to women in STEM and increase the success of these students, the treatment and hiring of female faculty need to be considered.

While hiring more female faculty seems like a simple solution, the women considering these positions face the same deterrents as students considering STEM studies. To address this, women need to be incentivized to consider these jobs or, better yet, the barriers to pursuing a career as a female STEM educator need to be removed. Smith et al addressed this challenge directly in their attempt to implement a program that addresses the needs of female STEM faculty (2018). They primarily focused on the areas of autonomy, competence, and relatedness as a means to improve overall job satisfaction in those faculty (Smith et al, 2018). Within the timeframe of this study, the percentage of tenure track faculty who were female increased from 32% to 38% largely due to increased job satisfaction (Smith et al, 2018). Not only did the satisfaction of the female faculty increase, but these diversity programs increased the satisfaction of all individuals involved, regardless of whether or not they directly benefited from the program (Smith et al, 2018). The results of this study provide hope for solving issues of gender inequality among STEM faculty. An increase in hiring and retention of female faculty members in STEM has the potential to increase female participation in STEM higher education and in STEM careers.

Implementing programs to increase the experience of female faculty and students in STEM higher education is something all colleges and universities should consider as a means of diversifying participation in these fields. These programs take resources to implement, which is why programs such as ADVANCE are so important. The NSF ADVANCE program seeks to broaden the implementation of evidence-based systemic change strategies that promote equity for STEM faculty in academic workplaces and the academic profession (NSF, 2019). This is accomplished by providing grants for work that is being done in accordance with that goal (NSF, 2019). The existence of funding like this and the strong focus that is being cast on this topic make now the perfect opportunity for higher education institutions to evaluate what they are doing to promote female participation in STEM.

The programs initiated under ADVANCE and other similar initiatives have produced data that give insight into some key characteristics found in successful programs. Responses from the National Conference for Women in STEM Disciplines, which was funded by ADVANCE, clearly outlined several of these factors. The survey found respondents sought more flexible hiring practices for STEM faculty and promoting a healthy work-life balance (Burke and Mattis, 2007, pg. 35). These may seem like broad goals that would benefit all faculty regardless of gender and, in fact, that may be the better approach in these programs. In general, the consensus at this conference was that "these policies should be available to both women and men equally in the department; the best departments have almost no measures targeted solely at women" (Burke and Mattis, 2007, pg. 35). While this may seem counterintuitive, these initiatives act to make STEM faculty positions more accessible to everyone, especially women who have more pressure on them from society to perform housework and raise children. Because of this additional workload, factors such as pausing the time clock for tenure track for women who are on maternity leave are critical for providing women with the same possibility of success in following this career path (Burke and Mattis, 2007, pg. 35). Additionally, they addressed hiring factors that may result in women being perceived as less qualified applicants. The information addresses materials for female applicants such as recommendations where women are seen to be described differently and often less enthusiastically than men with the same level of qualification (Burke and Mattis, 2007, pg. 35). Acknowledging these differences allows faculty selection committees to adjust for them and potentially hire more equally qualified women into positions where they can mentor and inspire future women entering STEM higher education.

Mentorship programs have huge potential in promoting enrollment and retention of women in STEM higher education. It is this potential that causes organizations such as the NSF, Association for Women in Science (AWIS), and Achieving XXcellence in Science (AXXS) all to promote mentorship as a means to combatting the current issues that exist as barriers (Burke and Mattis, 2007; NFS, 2019). In order for these kinds of programs to be feasible, higher education institutions need to prioritize hiring and supporting women educators in STEM. Creating an atmosphere that is inclusive for female educators paves the path for the inclusion and support of the future contributors to STEM.

Unfortunately, it can be hard to change older voices and minds. It may be easier to start young when children are first learning, growing, and discovering themselves. This is why it is equally as important to change how STEM is approached at the elementary level. The rest of this section will be devoted to the changes needed in elementary STEM in order for further growth and inclusion of women in STEM career fields.

The Girl Scouts of America are on the right track, with their STEM pledge to "galvanize a new generation of girls to explore STEM and become confident STEM leaders". They started this initiative with the release of thirty STEM-related badges for girls ages five through eighteen to earn and two new STEM programs that will integrate girls into new STEM projects. This is an initiative that is needed for young girls — an initiative that changes the game and evens out the playing field. It gives girls the opportunities they might be denied later down the line in their careers, or even opportunities not granted by their teachers in their everyday classrooms. As stated before, programs and opportunities like this are encouraging females who want to pursue STEM career fields.

But it's not just the Girl Scouts of America's responsibility to promote new generations of girls as STEM leaders. If they don't have support, their efforts will not amount to anything and the cycle will only continue. STEM needs to be more predominant in the classroom, and this starts with teachers being ready and wanting to include STEM in the everyday classroom.

Teachers don't want to teach the unfamiliar. They want to stick to what they know, a natural human instinct. In order for teachers to want to teach STEM subjects, they must feel confident in their abilities and understanding of said subjects. As stated earlier, the National Survey of Science and Mathematics Education reported that only 34% of teachers have taken collegiate level courses in all three of the recommended sciences: life, physical, and earth. A simple switch would be improving this number and making sure 100% of teachers have taken at least one course of all three recommended science subjects. Just that alone can help improve teachers' confidence in teaching science. The same can be said about mathematics. Universities could follow the NSSME's recommendation of five mathematical courses for teachers: algebra, geometry, number and operations, probability, and statistics. Having at least one course in engineering and another in technology would allow preservice teachers the familiarity of the topics and help improve their confidence in teaching said subjects in their classrooms.

Once teachers are adequately prepared to teach STEM subjects, the next step is for teachers to do just that: teach STEM. However, STEM is an entirely different world than English/Language Arts and thus cannot be approached in the same way. There are two helpful guides to teaching STEM: student-centered instruction and inquiry-based learning.

Student-centered instruction is rooted in the constructivist theory of learning and is a newer idea in the educational world. According to Edglossary.org, student-centered learning includes the following important characteristics:

1. Teaching and learning are "personalized," meaning that it addresses the distinct learning needs, interests, aspirations, or cultural backgrounds of individual students.

2. Students advance in their education when they demonstrate they have learned the knowledge and skills they are expected to learn (for a more detailed discussion, see proficiency-based learning).

3. Students have the flexibility to learn "anytime and anywhere," meaning that student learning can take place outside of a traditional classroom and school-based settings, such as through work-study programs or online courses, or during non-traditional times, such as on nights and weekends.

4. Students are given opportunities to make choices about their own learning and contribute to the design of learning experiences.

Allowing students the flexibility and personalization of learning will give students the opportunity to be more involved with the subjects (particularly STEM subjects as they tend to be more hands-on) as well as feeling a larger responsibility for their success in learning. It also allows teachers the opportunity to understand where each of their students is personally and allows them to develop content and instruction that helps students exactly where they need help. It takes the focus off of the teacher and places it on the students, as the name suggests and as the learning should be.

The second teaching strategy that is important to adopt in STEM subject teaching is inquiry-based teaching. According to the Center for Inspired Teaching, "inquiry-based teaching is a pedagogical approach that invites students to explore academic content by posing, investigating, and answering questions" (pg. 1). Inquiry-based teaching is designed for all subjects at all ages and pairs nicely with student-centered learning as neither includes direct instruction from teachers to students. Inquiry-based teaching allows students to generate their own questions and explore possible answers on their own with guidance from their teacher instead of direct explanation and lecturing. Inquiry-based classrooms are designed to help students develop skills beyond just understanding of instruction. "It teaches students to pose difficult questions and fosters the desire and skills to acquire knowledge about the world. Students are given opportunities to take ownership of their own learning, a skill necessary for one to succeed in college and in most professional settings" (pg. 1).

Having student-centered teaching and inquiry-based learning allows students the opportunity to dig deeper with their learning, to understand the importance of struggling to find a solution, to acknowledge that there isn't always one right answer, and to feel empowered by their own learning. Developing these approaches to STEM subjects in the classroom will allow students, especially girls, a deeper appreciation of the subjects and what they are learning than they would should they just be lectured and told the answers.

This is exactly what the Girl Scouts of America are encouraging with their STEM badges and programs: the enjoyment of STEM subjects by allowing girls the opportunities to take charge of their own learning. Having student-centered teaching and inquiry-based learning can help support this promotion of girls learning and enjoying STEM beyond just what their textbooks teach them. Having this support both in and out of the elementary classroom can help girls recognize their strengths in the STEM subjects and set them up for a future career in the STEM fields.

Conclusion

Girls deserve to explore STEM. Women deserve to be involved in STEM. The voice is lacking, and the inclusion of women cannot and will not come overnight. But there are many tiny steps that can set up women for success from the beginning and implementing these ideas for girls as early as kindergarten will allow for the future growth of women in STEM career fields. "I was taught that the way of progress was neither swift nor easy," Marie Curie, first female Nobel prize winner, once said. Women's voices are missing in all elements of science, technology, education, and mathematics. For now, the wheels of progress for the inclusion of women in STEM education fields are slowly turning.

Women in the past fought and advocated for their inclusion in STEM. The struggle started with a lack of access for women to higher education (Solomon, 1985, pg 44). Yes, more women were allowed into colleges and universities starting in the 1920s but welcomed may not be the right verb to express their inclusion. Despite their attendance in higher education institutions, in the 1970s less than 15% of life science Ph.D.'s were awarded to women (Ceci & Williams, 2010). If that was not enough, marriage and family came into play as a barrier between women and STEM fields, as women were seen better fit for jobs that focused on family life. These were just a few of the issues in history, not to include the major barriers faced by women who were also part of another minority group. Scores in science and mathematics tended to favor white men the most, but even white women were seen to outscore women of color (NCES, n.d.). Women of color and their voices have definitely been erased (Crenshaw, 1991, pg. 1253).

These barriers have shifted and evolved to lead to the current situation of women in STEM education fields. Currently, women are receiving much more recognition for their work than historically speaking, and they are receiving degrees at significantly higher rates than previously seen. Despite this, women hold less than 25% of STEM jobs as careers despite making up over half of those in the current workforce (Beede et al., 2011). This means that men are being employed at double the rate of women in STEM career fields. This imbalance indicates issues within the field that need to be mediated on many levels.

There are current stances to help level out the playing field, especially at a younger age. An in-depth look at the Girl Scouts of America reveals that their thirty new STEM-related badges and two new STEM programs have geared more girls into seeing themselves as future scientists, engineers, mathematicians, and technicians (Kelly, 2018). Up to 90% of girls who participated in one of the new STEM programs agreed that they wanted more information about careers in math, science, and the arts (Girl Scouts of America, 2018).

Despite the efforts currently being made, there is still a lack of female voice in STEM education and careers. Girls as early as sixth grade are losing interest in STEM, with less than half of middle school females and high school females feeling capable of doing STEM (Choney, 2018). On top of the dwindling numbers still occurring, current elementary education teachers are not properly equipped to teach STEM subjects in their general education classrooms, resulting in a lack of time on those subjects. In fact, 93% of teachers have not taken the 5 math classes at the collegiate level that the National Council of Teachers of Mathematics recommends (NSSME, 2018).

Another current issue involving women in STEM career fields is the manner in which female scientists and mathematicians are represented in the media. Female scientists on television and in movies are outnumbered by men 2 to 1 and are seen as more dependent and less capable than their male counterparts (Steinke, 2017). This means that despite efforts of new programs and more acceptance of women at higher educational levels, girls are still not seeing STEM careers as a viable option for themselves, nor are they seeing proper role models already in these fields for them to look up to.

This is why we must look toward the future and take steps to start making changes today. Women's voices are lacking in STEM education and STEM careers. While an immediate solution will not just happen and women will not automatically be accepted and welcomed into STEM fields, as Marie Curie pointed out about a century ago, small steps can be made toward a brighter future.

First, there needs to be the understanding that women are put under more pressure to be perfect (Barshay, 2019). This expectation of perfection leads girls to undervalue their own skills compared to equally qualified boys. The acknowledgment that women do not suffer from "issues of intrinsic aptitude" for this very reason is important as well (Jaschik, 2005). Women are capable of doing the work, they just are not always fully recognized for their successes due to the high pressures placed on them by themselves and others.

Next, there should be more mentoring involved in STEM fields. A large reason behind girls and women not wanting to be a part of the STEM career is the lack of role models they have to look up to. Having mentoring programs in place at the collegiate level and higher educational institutions will help bring women together as students and teachers in recognition that we must all learn from one another. Mentoring programs can lead to higher retention rates, especially women (Beede et al., 2019).

In addition, there should be efforts made to increase the number of female faculty at the collegiate level. This goal can be addressed by improving the working conditions of female faculty, who regularly face the same barriers that affect their students.. As of now, females are only 4% of the full-time professors in medical schools and only 12% of the tenure track (Burke and Mattis, 2007, pg. 256). Having more women on the tenure track and as overall faculty members will help in the retention rate as well as encourage the mentorship programs that should be put into place. It will also help with diversifying colleges and universities and providing strong examples for students, the goal of this being the ultimate diversity of individuals working in STEM fields.

At the elementary level, there needs to be an increase in knowledge for teachers, starting with teachers taking the recommended mathematics and science classes. For example, 100% of the teachers should have all 5 mathematics courses at the collegiate level that are recommended by the National Council of Teachers of Mathematics. Having teachers more knowledgeable on STEM subjects will increase their willingness to teach and confidence in teaching STEM subjects in class. If teachers are more comfortable with the material they will be better able to translate it to their students and hopefully get more students interested in those topics.

After this, teachers must take a student-centered learning approach and inquiries approach to teach STEM at the elementary level. Doing so will help young students, especially girls, feel more comfortable and confident in their abilities while spreading their understanding and knowledge of the topics (Center for Inspired Teaching, pg. 1). Improving girls confidence in their STEM abilities has the potential to increase retention rates in higher levels of STEM education.

Building on society's seeming willingness to change, these are some of the many small steps that must be taken in order to bring more women into STEM. As this world becomes more and more science and technology-based, this goal is more important than ever. As was stated in the research book, ***Women and Education***, "I would like to see more women in science, not only for the sake of the many women who could do talented work but for the sake of science, because it would present a different face to society if the women in it were sufficiently numerous and confident not to follow the male models or definitions" (Maccia, 1975, pg. 158).

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