Women's Empowerment through Education -

Advancing in STEM

(Science, Technology, Engineering & Math)

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Introduction

Nelson Mandela once said, "Education is the most powerful weapon which you can use to change the world". If there ever was a quote that so perfectly encompasses the significance of education that is it. The importance of education cannot be overstated, and recent years have pushed the issue of education, in all aspects, to the front of movements promoting global change. Many governments and organizations have focused new policies and stances in support of bettering education, and the topic is consistently used as a measure of development around the world. For these reasons, education has become one of the central tenets of the UN's 2015 Millennium Development Goals (MDG's) initiative. Consequently, the 2015 MDG's are this year's theme for the 58th Commission on the Status of Women, and as we look toward the post-2015 agenda, we must also look at our progress with the current agenda. As such, I have chosen to dedicate my research on the advancement of education and it's role in improving the status of women. Over the past few months I have focused on exploring ways to achieve women's empowerment through education from the local to global levels. In doing so, I analyzed one of the greatest challenges in women's education—representation in STEM—and observed the aspects of women's education that make it a pressing issue today.

The Big Picture

As stated earlier, education has become a principal topic explored throughout all of the MDG's. Since my research focused on women's education, most of my data centered on the third millennium goal, "Promote gender equality and empower women". This goal encompasses all facets of gender parity and disparity, and education is one of the main areas of concern.

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Target 3.A aims to "eliminate gender disparity in primary and secondary education, preferably by 2005, and in all levels of education no later than 2015" (*MDG Report 2013* 18), thus asserting where intensive action and progress should be concentrated in terms of education. It calls for equalizing access to education for both genders as well as insuring the provision of quality education for all students. Under the objectives of this target, we have seen both areas of improvement and concern since the implementation of the millennium development goals.

Progress

Of the improvements we have seen, advancement in primary education has been the most notable. The *MDG Report Card: Measuring Progress Across Countries* claimed that there was a 10% increase in the number of countries who achieved gender parity at the primary level of education over a sixteen-year period (33-34). This improvement is a major advancement in reducing gender disparity, and regions such as Central Asia, Latin America, the Caribbean, and South-East Asia have shown particularly impressive progress in this aspect over the past few years (*MDG Report 2013* 19). Furthermore, more countries have come to acknowledge the importance of educating women and the impact it has on society. The United Nations Population Fund reported in 2003 that many countries "formally recognize the important of reducing the gender gap in education between boys and girls" ("Empowering Women through Education"). This is due to the fact that women's education has risen in prominence as the media, women's movements, and organizations draw attention to the issue of women's human rights. According to a statement from *The Status of Women in North Carolina*, it is clear that women with higher degrees of education tend to fare better socially, economically, and domestically than women with limited access to education thus allowing them to have better access to healthcare,

housing, food, et cetera (33-36). This increased awareness of the importance of women's education, coupled with the improvements made in eliminating gender disparity in primary schooling signify the ways in which the MDG's have empowered women through education. However, target achievement is far from reached, and many studies have highlighted the areas of most concern in regards to women's education.

Areas of Concern

One of the main concerns in regards to the women's empowerment centers on achieving parity on all levels of education. Charts from the 2013 *MDG Report* show that "only 2 out of 130 countries have achieved [the] target at all levels of education" (19). From this we can conclude that despite the successes in one area of target 3.A, the overall attainment of gender parity has not been achieved. Looking closely at many regions in the world show shortcomings in enrollment rates, as well as women's participation in secondary and tertiary education (*MDG Report 2013* 18-19). Figure 1 from the 2013 *MDG Report* further displays the ways in which gender disparities increase at higher levels of education, although the rise in the number of women shows that "girls [are] not always at a disadvantage" (19). However, it should also be noted that disparity still exists at extreme levels, thus allowing us to conclude that girls are impacted more by educational inequality than boys (19).
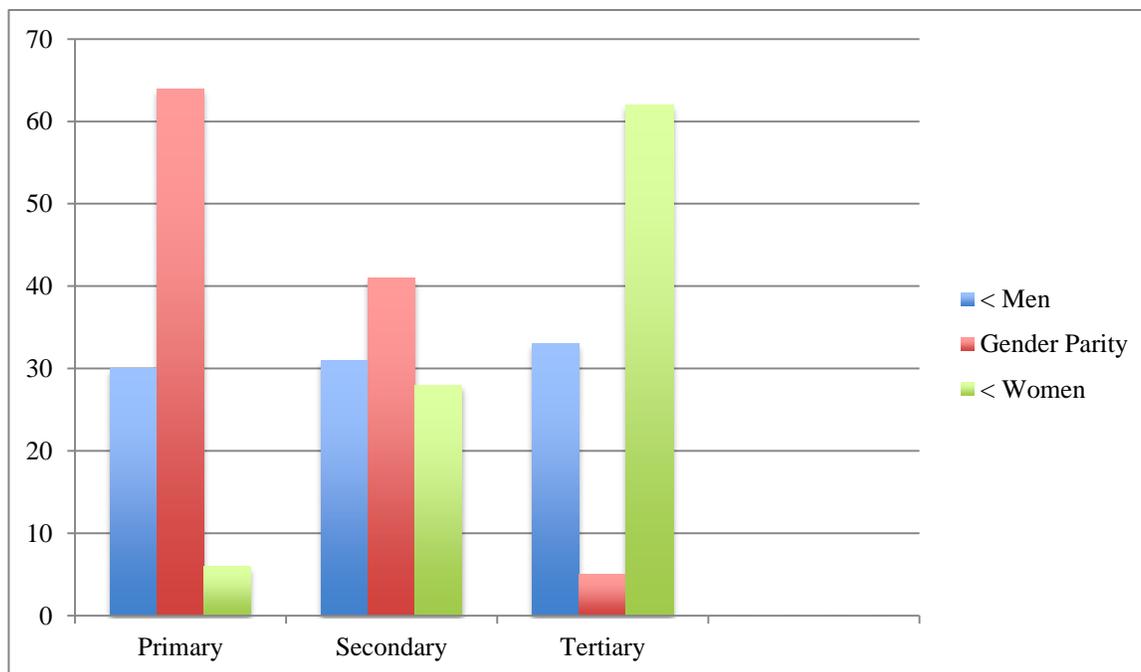
Fig. 1. United Nations. "Distribution of countries by gender parity status in primary, secondary, and tertiary education". Graph. *The MDG Report 2013.* United Nations, 2013. Print.

Furthermore, it is important to recognize that educational issues differ when looked at from diverse perspectives. From the local to global levels, we see different limitations that hinder the advancement of women's education in various ways. By examining these limitations, we will be able to proceed in our movement to achieve women's empowerment through education.

In the global arena, the main issue of women's education is generally a matter of accessibility. It is shown that that "an educated girl will reinvest 90 per cent of her future income in her family, compared with 35 per cent for a boy […] yet 250 million adolescent girls live in poverty and are more likely than boys to be uneducated" (TheGirlEffect.org). This statement is very true, and many young women are denied access to schooling past the primary level, or they are not given the resources and incentives to achieve a higher level of education. This is especially true in the Middle East and Oceania, regions where scholars have the most concern

for women's educational development (*MDG: 2013 Progress Chart*). These regions have yet to reach parity at the primary level, and the UN has stated that the "progress [is] insufficient to reach the target if prevailing trends persist" (*MDG: 2013 Progress Chart*). Similarly, the 2013 *MDG Report* states that the regions of Northern, Western, and sub-Saharan Africa have continuously faced obstacles impeding their access to education (19). These obstacles include the outright denial of girls to receive an education, as well as lack of funding, encouragement, and protection (many girls face violence and harassment in and around the school grounds, preventing their attendance) (Right to Education Project). From these facts, we see that the lack of women's equal access to education has prevented the achievement of educational parity in regions worldwide.

In contrast, the most pressing matters on the local and national levels are representation and support. Women within the United States are given access to schooling, but studies have shown that they do not always receive the same benefits from education when compared to their male counterparts. For example, observing the poverty rates of North Carolina men and women at various levels of educational attainment provides us with the best visual of the difference between the economic settings of men and women in correlation with education (see fig. 2). The findings, presented in *The Status of Women in North Carolina* report, show that women tend to have higher poverty rates when compared to men with a similar academic standing. This demonstrates how gender disparity can exist as an outcome of poor representation and support of women's schooling, often at extreme levels, in the state of North Carolina.
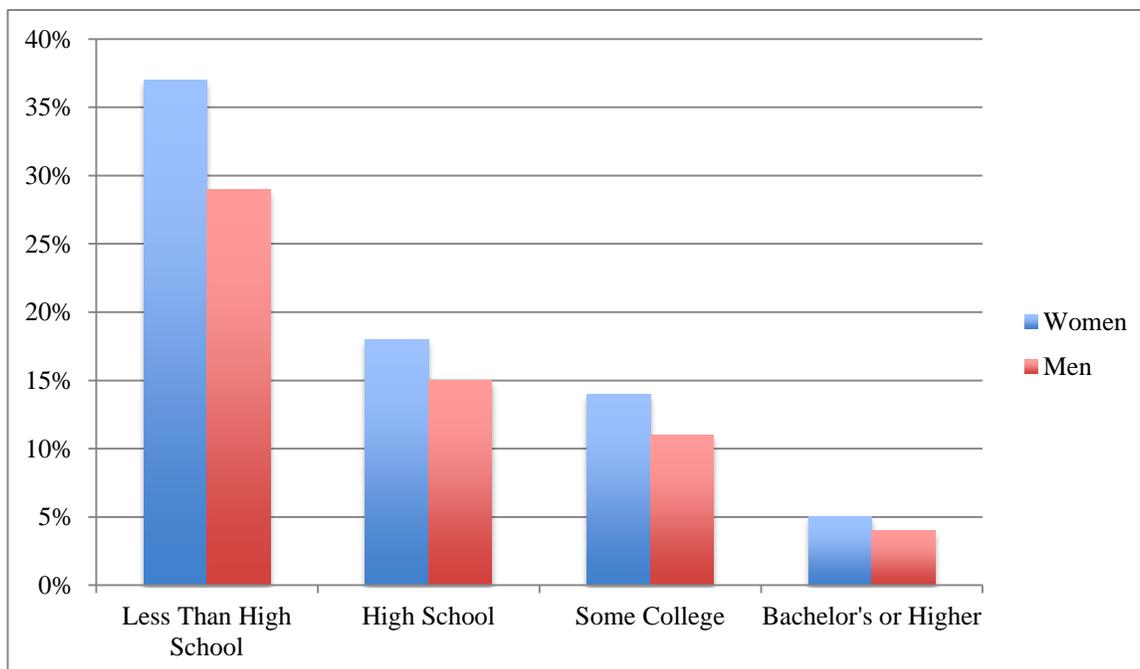
Fig. 2. Institute for Women's Policy Research. "Poverty Rates for Women and Men Aged 25 and Older by Educational Attainment, NC 2010". Graph. *The Status of Women in North Carolina.* Institute for Women's Policy Research, 2013. Print.

While it is clear that there are various issues on all levels of women's education—ranging from local to global—one of the most prominent and consistent concerns centers on women's status in STEM. As advancements and setbacks have occurred in all areas of women's education, from lack of accessibility, to increased gender parity, recent emphasis has been placed on recognizing the importance of women in STEM, and the issues involved with achieving advancement in that field.

Women in STEM

Science, technology, engineering, and mathematics, also known as STEM, is one of the largest fields of study in the educational system. It is also the largest field where women are significantly underrepresented. Over the last century, women have made improvements with

assimilating into what was once seen as a male-dominated field. However, significant disparity between women and men in STEM is still existent, and very little progress has been made to achieve a higher level of representation by women in the field. This is true locally, nationally, and globally, and this concern is one of the crucial points for achieving women's empowerment through education, particularly through STEM advancement. As I have researched women in STEM, I attempted to determine if there was a best practice model that could be applied to allow women to further achieve advancement within various science and mathematics fields. While I came across multiple methods and practices, many of the approaches were used on a small-scale, and while effective on a micro-level, it was difficult to see large range advancements for women in STEM. However, by analyzing these small-scale approaches, I noticed many recurring themes in practices implemented by organizations, policies, and programs. Two of the most prominent approaches, which I have determined to be the best practice, involved intensive support systems and role-model representation, or the model-and-support method. This method has been utilized in multiple ways on all levels of education, from local to national to global.

Local

The first level of analysis involved research at the local level in North Carolina. As a student of North Carolina State University, a predominantly science and engineering institution, I had a wide range of access to various researches, organizations, and reports. Data from *The Status of Women in North Carolina* showed the levels of women's involvement in STEM, particularly at a young age, when women tend to become "disinterested" in science- and logic-based fields. This early disinterest, which is explained more in-depth at the national level, is an important factor in understanding why young women tend to shy away from education in STEM. *The Status of Women in North Carolina* goes on to state that "meeting one's full educational

potential often begins with a strong foundation in early childhood" (35). By building up this foundation, improved support can lead to an advancement of women in education. Again, *The Status of Women in North Carolina* recommends, "implementing a policy that supports science, technology, engineering, and mathematics (STEM) programming and strong career and education counseling for girls in school" (74). In doing so, many believe that such a policy will facilitate and improve young women's access and experience education, thus encouraging young women to aspire to careers in STEM. Still, I wanted to determine for myself if the support-based approach was as impactful as I had read about. I decided to conduct my own study by partnering with an established organization aimed at helping underrepresented populations in STEM fields.

The PURPOSE Institute

For my research of the model-and-support practice, I partnered with The PURPOSE Institute, which stands for "Promoting Under Represented Presence On Science and Engineering" faculty. The organization operates out of NC State University and primarily serves minority faculty members in STEM fields by providing them with the means to promote and develop their research and encourages the education of other underrepresented groups on campus. When I met with the organization, my initial interest concerned their developments with women faculty in STEM. However, discussion quickly turned to the Institute's work with young women in STEM. The director of the organization revealed that in 2007 The PURPOSE Institute held an event targeting middle school aged girls (mainly minorities), and their mothers and invited them to a summit held in Raleigh. The event, "Advance-ENG Girls to Women", was intended to expose young women to the possibility of a future in STEM, and to encourage a drive to achieve academic excellence and empowerment. By allowing the girls to interact with

successful women with careers in STEM, the girls were given the chance to recognize the power of education and see that it was achievable, even in a field that is commonly though of as male-dominated. Additionally, the participants were given college prep seminars, exercises that connected them with their mothers, and opportunities to listen to poets regarding minority women in STEM. Several of the women in attendance held leadership positions in their careers, were esteemed scientists and engineers, and were seen as female pioneers in STEM. However, while these women were impressive in their fields, many were "hidden" or unrecognized by younger generations. Thus, by highlighting the achievements of these professional women, the mothers and daughters in attendance were able to view exemplary models of successful women in STEM. Over 125 young women applied for the initial 25 attendance openings, and 70 girls participated. The event was largely heralded as a success, but due to budgeting setbacks, it was only held once. Upon hearing this, I turned my attention to the girls, many of who were now in college pursuing degrees in STEM. We met for an informal discussion where I got their opinion of the "Advance-ENG Girls to Women" summit and their notion of women in STEM in general. The young women were unanimous in their responses, sharing the same opinion as to what they considered to be the biggest concern for today's women in STEM: It is not whether women can be in STEM fields, it's whether or not they are supported in pursuing it. In addition, the women also agreed on what they saw as the biggest impact of the summit: The chance to have a close interaction with esteemed women in STEM fields. One young woman stated that the summit "encouraged her want to be a professional", while another said that she felt the drive to "do something big" as a result of the event. From the unanimity of this response, I concluded that it was important for young women to see that success and achievement in education is possible. In order for this possibility to be adequately represented, I figured it is then important

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for young women to become associated with "role models" at a young age, as well as have the support necessary to follow the paths trail blazed by these models.

Other Organizations

Similar to The PURPOSE Institute, there have been other organizations that have helped to advance women in STEM. Project Scientist, an organization based in Charlotte, North Carolina, works "to change the world's view of 'who' a scientist is and 'what' a scientist does" ("Project Scientist"). To do this, the organization supports young girls with the aptitude and skill to pursue STEM fields and provides enhancement through a academy-like summer camp. The camp allows girls to explore various STEM topics alongside local women scientists, thus cultivating a passion for learning, leadership, and empowerment. Like The PURPOSE Institute, Project Scientist also uses a model-and-support approach to captivate young women in STEM. By facilitating and encouraging support and role model behavior, both organizations help to improve women's advancement in STEM.

National

At the national level, we can observe that women lack representation in STEM on a greater scale. In the United States, it is clear that sociological and psychological factors often hinder women from achieving their full potential within STEM fields, especially in academics. While this is relatively unnoticeable on the surface, a closer look at societal norms shows that men tend to be more supported in education because they are "expected" to be more involved with schooling. This is due to the fact that young men have a greater level of support and more role models in STEM early on in life. For example, many young boys cite astronauts or chemists as their reason for aspiring to research various STEM fields, from physics to engineering. In

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contrast, young girls are not given the same female role models in STEM in their childhood. This is best exemplified through the "Draw-A-Scientist" test (Project Scientist), which observes the stereotypical notions of "what a scientist looks like" in the eyes of children. In all versions of the study, most young girls draw a male scientist, often wearing glasses and a lab coat. This idea of a scientist points to the fact that many children, male and female, see STEM as a male-centric field, thus asserting the notion that women have less of an aptitude in STEM fields in comparison to men. Consequently, as archaic as the notion may seem in today's world, the idea that science is a male-controlled field smothers many women's desire to enter into a STEM occupation. Moreover, these ideas are emphasized by sociological factors. In the book *How Has Feminism Changed Science*, author Londa Schiebinger states that from a young age, boys are taught to expect to "achieve social standing almost exclusively through occupational success" while girls presented with the outlook that "they can rely on the socially sanctioned safety net of marriage" (Schiebinger 59). These latent, yet impactful perceptions regarding gender and education affect students from a young age by establishing notions of how boys and girls "should" behave, especially in the education system. In response, many women tend to feel less supported throughout their schooling and immediately feel the effects of mental setbacks that could affect their academic achievement. This common lack of interest then peaks women feel towards STEM often originates at the end of adolescence. Schiebinger writes that "boys and girls display similar mathematical interests and abilities until about seventh or eighth grade, when many girls begin losing confidence in their mathematical skills…[and scholars have] correlated this drop in mathematical confidence with a general drop in girls' self-esteem" (Schiebinger 58). This drop in confidence, coupled with a lack of outside academic and emotional support, is often believed to be the main reason young women tend to shy away from

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STEM fields during the early stages of education. The "Journal of Women and Minorities in Science and Engineering" asserts the same notion, where an article states, "as students become less confident in their math and science abilities, their attitude about the subject worsens" (Schumacher et al. 378). The same article goes on to say that "high school students who perceive little support toward their science identities are likely to drop out of the STEM pipeline" (Schumacher et al. 377-378). The decline of women in STEM becomes even more notable at the university level, where men significantly outnumber women in STEM-related majors. In fact, the AAUW reported in their "Why So Few" report that while 29% of the male freshman class was enrolled in a STEM major, only 15% of the female freshman class represented women in STEM major ("Why So Few?" 5). The number lowers even further to a shocking 5% when biological sciences are subtracted from the equation (many women in STEM majors tend to fall under biology-related majors, thereby adding a significant increase to the total number of women undergraduates in STEM fields) ("Why So Few" 5). The report goes on to display the percentage of men and women in various STEM majors, thus providing us with a visual of the differences in STEM enrollment across gender and field (see fig. 3).
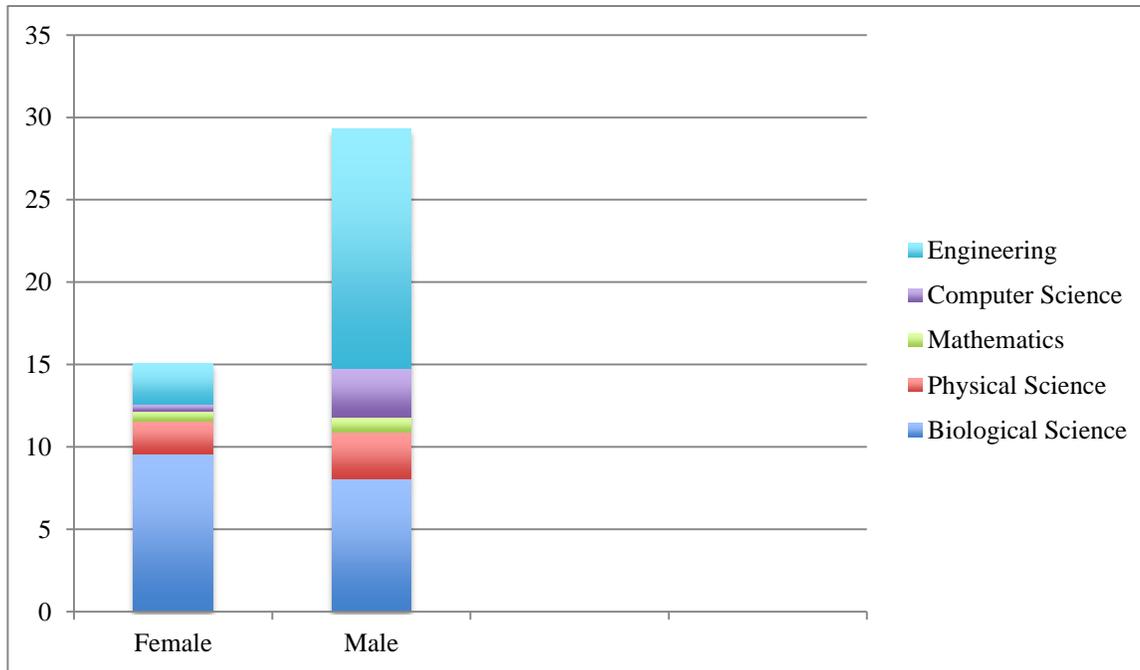
Fig. 3. AAUW. "Intent of First-Year College Students to Major in STEM Fields, by Race-Ethnicity and Gender, 2006". Graph. *Why So Few Women in Science Technology Engineering and Mathematics*. AAUW, 2010. Print.

From Fig. 3 we can see the immense level of disparity in the US for women in STEM fields at the undergraduate level. With only 15.1% of women in STEM total (compared to the 29.3% of men in STEM), it is important to note that the majority of women appear to enroll in biological sciences. In contrast, women in computer science only make up about 0.4% of first-year females. These results have an immense impact on our understanding of women in STEM, and many researchers have contemplated the factors leading to this severe underrepresentation of females in STEM. Once again, several findings point to a lack of support and female role models as the chief cause of this underrepresentation. Forbes magazine quoted Facebook's director engineer Jocelyn Goldfein saying "The reason there aren't more women in computer science is because there aren't more women in computer science" (Forbes.com). This quote exemplifies the catch-22 in trying to improve women in STEM and recognizes that when women

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lack role models in STEM, they are less inclined to pursue an education in those fields. Overall, we can see that the underrepresentation of women in STEM has a range of causes, and thus combating these issues must be intensive and thorough. With that in mind, many national organizations, institutions, and programs have attempted to reach out to young women and encourage their pursuits in STEM. Not surprisingly, the model-and-support method is often in use.

National Programs

On a national scale, many programs seek to reach out to young women all over the United States to encourage their advancement in STEM. Several programs have proved to be successful through their own models, but, like The PURPOSE Institute and Project Scientist, many employ their own versions of the model-and-support practice. In 2013, the Executive Office of the President released a report in regards to Women and Girls in STEM stating, "The key to accomplishing this vision [of women in STEM advancement] rests not only in raising the number and performance of students currently excelling in STEM subjects, but also engaging girls and other students who are historically underrepresented in these areas" (*Women and Girls in STEM* 1). The report continues to highlight the achievements and movements of various organizations and agencies that have worked to develop the status of women in science- and math-based fields. For example, a "Memorandum of Understanding" was developed through a partnership between the Girl Scouts of America and NASA, which focused on motivating and supporting young girls in STEM education. At the Girl Scouts of America convention, NASA representatives engaged more than 17,000 young women in hands-on STEM activities, thereby providing the girls with the experience and support necessary to "inspire them to pursue careers in STEM disciplines" (*Women and Girls in STEM* 2). This immersive approach, which requires

high levels of interaction between young women and professionals, mirrors the local efforts of The PURPOSE Institute and Project Scientist, and a pattern of success is evident. Also evident is the fact that all three organizations focus on inspiring women in STEM through engagement with role-models (typically esteemed professionals) and by building a support system that encourages women to pursue futures in STEM careers.

Global

Finally, we also see STEM-related issues for women on the global front. As previously acknowledged, there are other issues regarding education as a whole on the worldwide, but women's representation in STEM is a prominent concern at the global level. In this sense, many women experience the same underrepresentation experienced here in the United States and North Carolina. Globally, we have seen that men represent 80% of the engineering workforce, while women only represent 20% (Osava, "Rights: Women More Educated, Not More Equal") and while this statistic may seem astounding, the reasons do not deviate too far from the previously discussed causes. Like the local and national figures, many women around the world remain disinterested in STEM due to the fact that the field comes across as male-dominated. In contrast, there are global cases in which women are barred from pursuing an education, not to mention STEM, thus preventing their advancement and fulfillment of their own academic capacity. For this reason, we see the issue with women's representation in STEM persist at a universal level, thus making it an immense concern for the global status of women. In spite of this, international programs and organizations are still making moves to encourage women to pursue and thrive in STEM education.

Notable Movements

Many movements on the global level occur through either partnerships or international organizations and programs. One such example is the US' Department of Energy's "Clean Energy Education and Empowerment Women's Initiative" (*Women and Girls in STEM*). The partnership involves seven nations and many private organizations and seeks to reward and recognize women in energy-related careers. In doing so, the partnership aims to inspire high-levels of achievement for women in STEM careers, and the monetary and networking awards act as an incentive for this achievement (*Women and Girls in STEM*). Similarly, movements like "The Girl Effect", which focuses on women's empowerment on all forms (including STEM advancement) and the IEEE Women in Engineering, which promotes advancement of professional women in STEM, also work on the international level to empower women in STEM. One of the most famous examples of partnership is the United Nation's "Equal Futures Partnership", launched in 2012, which involves 22 countries in a massive women's initiative program (*Women and Girls in STEM*). While the partnership mainly focuses on eliminating economic and political obstacles for women, several nations have included the advancement of women in STEM education as a means to empowerment (*Women and Girls in STEM*). All in all, these international organization and partnerships focus on supporting women in the STEM-related endeavors, and seek to widen the door to advancement in the sciences, as well as education as a whole.

The Next Step

After determining the model-and-support-based approach as the best model for encouraging the advancement for women in STEM, I turned to see how the model could be applied on an all-encompassing educational scale. Similarly to its application for women in STEM, the model relies on forming a strong emotional and intellectual support system for young women pursuing their education. There is a multitude of ways to achieve this support system— creating programs for girls in academics or certain fields of study, offering specialized outreach counseling for young women at school and in the community, and by developing a more secure and quality educational system. Additionally, providing young women with the access to relatable role models will not only inspire them to achieve academically, but it will assure them that success in all fields—whether it is STEM or liberal arts—is attainable. By implementing these pillars of support, providing role models, and investing time and money and inclusive policies will insure an improved, encouraging system of advancement for women in education.

Works Cited

Dunham, Charlotte, et al. "I Just Need Someone Who Knows the Ropes: Mentoring and Female Faculty in Science and Engineering." Journal of Women and Minorities in Science and Engineering 18.1 (2012): 79-94.

Hess, Cynthia, et al. *The Status of Women in North Carolina.* Institute for Women's Policy Research. January 2013. Web. 17 December 2013

Kristof, Nicholas, Sheryl WuDunn. Half the Sky. New York, NY: Vintage Books, 2010.

Schiebinger, Londa. Has Feminism Changed Science? London, England: Harvard University Press, 1999.

Schumacher, Mitzi, et al. "An Early Intervention to Encourage Girls' Interest in Careers in Drug Abuse Prevention: More Than Improving Science Achievement and Attitudes." Journal of Women and Minorities in Science and Engineering 18.4 (2012): 377-396.

United Nations. Department of Economic and Social Affairs. *The Millennium Development Goals Report 2013.* UN. June 2013. Web. 17 December 2013.

United Nations. Department of Economic and Social Affairs. *Millennium Development Goals: 2013 Progress Chart.* UN. June 2013. Web. 17 December 2013.

United Nations. UN Millennium Campaign. *Millennium Development Goals Report Card: Measuring Progress Across Countries.* ODI Publications. September 2010. Web. 17 December 2013.

U.S. Department of Education. Office for Civil Rights. *Gender Equity in Education.* n.p. June 2012. Web. 6 January 2014. http://library.laguardia.edu/research/mlagov.

U.S. Government. Executive Office of the President. *Women and Girls in Science, Technology, Engineering, and Math (STEM).* n.p. June 2013. Web. 6 January 2014.

U.S. Government. The White House Council on Women and Girls. *Keep America's Women Moving Forward: The Key to an Economy Built to Last.* n.p. April 2012. Web. 6 January 2014.

"Why Aren't Girls in Schools?" Right to Education Project. Web. 17 December 2013.

Wyer, Mary, et al. ed. Women, Science, and Technology: A Reader in Feminist Science Studies. New York: Routledge, 2001.

Yousafzai, Malala, Christina Lamb. I Am Malala. New York, NY: Little, Brown and Co, 2013.

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