The Undergraduate Research Journal

Volume 8 *2020-2021* Article 3

March 2022

# Women in STEM: Gender Biases and Employment

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## Abstract

This main focus of this paper is to reduce the gap between women engagement in undergraduate and career level trends in STEM fields. The literature explored points to the major influence of sociocultural factors in the gender gap at the employment level. Therefore, this study examined possible success factors for solutions to this disparity specifically at the workplace. The findings showed that the implicit gender biases programs became more effective when they enforced experiential learning and occurred at appropriate durations. It was also found that the hiring phases could be more gender balanced using language and application screening tools along with objective assessment replacing interviews. Finally, recommendations regarding workplace policy reformations, bias training programs, and fairer hiring processes are proposed for the context of Egypt.



## Key Words

STEM; Gender Inequality; Employment; Sociocultural Views; Gender Socialization; Implicit Bias; Experiential Learning.


## Introduction

The scope of this paper is confined to the gender equality Sustainable Development Goal of Egypt's vision for 2030. This research study aims at investigating why rates of female employment in the high-tech sector in Egypt don't correlate with their enrollment rates in science, technology, engineering, and mathematics (STEM) majors when offered college education. The scope of the research is narrowed down to discover such patterns in the Math-intensive fields. Math-intensive fields are those which are heavily dependent on use of mathematics such as engineering, computer science, economics, chemistry, and physics (Ceci & Williams, 2010). In this scope, gender inequality can be defined as differences across gender in attainments and opportunities on the academic and employment levels in a specific area of specialization. The research question decided in this study investigates how women's employment in Math-intensive streams in Egypt can be increased through reducing effect of gender biases.

## Problem Statement

*Evidence*

Egypt stands in a very critical position regarding women representation in multiple disciplines. The World Economic Forum (WEF) released the 2018 Global Gender Gap report which ranks Egypt as number 136 of 149 countries scoring 0.614 in 2018 (WEF, 2018) compared with its rank of 135/ 145 in 2015 on Gender Gap index (WEF, 2015). This can also be an indicator of the gender equality status in separate specializations of participation, specifically STEM-related employment. Analyzing gender differences in terms of degree type in Egypt, in 2017, UNESCO reported only 21-25% of Engineering, manufacturing, and construction students are female

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(UNESCO, 2017). In 2018 the Global Gender Gap report gives a female to male ratio of 0.33 in Engineering, Manufacturing and Construction, 0.45 in Information and Communication Technologies, and 1.50 in Natural Sciences, Mathematics and Statistics (WEF, 2018). These statistics show that women's university level engagement is of a good status in most STEM majors except engineering and field-related studies. While the undergraduate level is somewhat imbalanced, the employment level gender gap is even more alarming.

The 2017 UNESCO report suggests that this gender gap widens as female students experience transition from undergraduate to post-graduate studies and even to employment (UNESCO, 2017). This suggestion is strengthened by the 2015 Global Gender Gap report which shows Egypt to score 0.935 in educational equality index, but 0.443 in economic participation index. Moreover, Baseera and UNFPA (2017) found women to constitute only 36% of high-tech professions, placing Egypt behind Tunisia and Israel in women participation in these fields. Comparing statistics about the gender gap in both educational and career scales drives us to conclude women's level of participation in STEM jobs does not reflect their university level engagement.

*Causal Analysis*

UNESCO (2017) identified 4 main types of factors which lead up to the gender gap in STEM fields both on the academic and professional levels. They categorized them as individual, peer and family, school, and societal factors.

On the individual level, the report identified several sub-factors where the female student is the source of the gap. The sub-factors might be biological differences, self-perception, or interest in the subject. However, Wang & Degol (2016) found the effect of biological differences between genders inconclusive and unreliable to explain the gap. Furthermore, several studies found the psychological component very effective in manipulating girls' evaluation of their own abilities (Shaffer, Marx, & Prislin, 2012). Their self-evaluation is very likely to limit their interests or preferences, which highlights the importance of psychological conditions.

The family's attitudes towards gender differences might influence girls' decision to pursue science and technology majors. In fact, multiple research studies investigated how effective the role of parents can be. Research has shown that beliefs of parents, especially mothers, can affect their daughters' beliefs of their own innate abilities, and consequently their career preferences (Gunderson, Ramirez, Levine, & Beilock, 2011).

There are multiple elements of the school environment which might've showed some correlation with girls' interest in STEM subjects. One of them is teaching, where teachers have been shown to be the main influencers for girls' interest in STEM from at least the ages of 6 -12 (Heaverlo, Cooper, & Lannan, 2013). One study shows that teachers' unconscious bias and gender stereotypes and expectations can be transmitted to their female students (Keller, 2001). Another potential component of the educational environment is the advice of faculty members. It was found that female teachers, when presenting motivation towards technologic careers, boosted their female students' interest and confidence in related subjects (Stearns, et al., 2016).

As for the societal context, it has almost immediate impact on gender equality status in math-intensive and research careers. One study found that women were more resistant to stereotypes surrounding these careers and so showed more confidence in preferring them in societies with improved gender equality (Stout, Dasgupta, Hunsinger, & Mcmanus, 2011). On the other hand, a similar study conducted in Pakistan with high level of patriarchal values, found women aspirations for high-tech diminished (Mujtaba & Reiss, 2015).

### *Negative Consequences*

While there is a gap in literature concerning quantitative implications of the gender gap in STEM fields in Egypt, international scenarios can still apply to the national scale. Wodon and La Briere (2018) estimated that gender inequality causes a loss of nearly $24,000 per person globally, yielding up to $160.2 trillion loss that could be harvested if we narrowed gender gaps in multiple disciplines worldwide. These estimates tend to increase in lower income and developing countries where women represent less than 30% of human capital wealth. Of the regions studied, the Middle East and North Africa showed $3.1 trillion loss per capita in 2014, almost double the estimated $1.6 trillion in 1995 (Wodon & Brière, 2018). It is also easy to anticipate that the economic hardship would overwhelm more women than men nationally as there is a decreasing trend in women's participation in the increasingly profitable high-tech fields.

The data gathered provide evidence that gender inequality in STEM careers might be more severe than most other professions. The fact that the rates of women pursuing STEM-related degrees does not match the rate of their employment in Egypt is even more concerning, urging efforts to be invested on multiple scales. Therefore, it is urgent to target this gap widening first before investigating other aspects of inequality. It is clear that closing the gender gap in this area would increase women's income and raise overall wealth per capita for Egypt and the region.

## Key Debates in the Literature

The main target of this paper is to reduce the gender gap within math-intensive fields in Egypt. Trying to define the problem, the previous section proposed an analysis of four main broad categories of causes for both the educational and professional levels of the gap. However, since this paper is only concerned with the career and employment level aspect of the problem, it is important to determine the root cause of this aspect in order to find the most suitable solution approach. There has been a debate in the literature surrounding the dominant factors contributing to the career level gap. While some scholars tend to see the problem from an individual perspective, others blame it more on the sociocultural context. We will try to illustrate that although neither of the perspectives is wrong, one of them can give a clearer and more complete picture of the problem.

### *Ongoing Debate*

The individual lens gives a sensible explanation for the problem since career pursuit is more of an independent decision. However, the claims made by the individual view do not eliminate the possibility of the influence of contextual and societal factors on the STEM gender gap (Miner, et al., 2018). Therefore, an analysis of the main explanations proposed by the individual view will be assessed from a sociocultural perspective. The purpose of this analysis is to determine whether the sociocultural view can explain the problem more comprehensively, and is therefore, more reliable to solve the problem effectively.

One way the individual perspective constructs the gender gap in STEM professions as women's responsibility is the alleged incompetence of women. The evidence proposed for this claim is the weaker spatial abilities of women and their own poor self-evaluation in STEM related subjects (León, Tascón, & Cimadevilla, 2016). These abilities frame cognitive reasoning about space, patterns, figures, and multidimensional object visualization. Thinking spatially is particularly essential for STEM fields, where, for instance, engineering requires at least 3D crosssectional structure imagination skill (Uttal & Cohen, 2012). However, multiple studies have shown that the gaps in spatial abilities disappeared in a non-biased environment (Tarampi, Heydari, & Hegarty, 2016). Even if existent, they're easily improved by a combined mental imagery and analytic problem-solving intervention training that eliminates all sex differences in this area (Stieff et. al., 2014). Furthermore, women's performance in STEM related subjects are easily influenced by the surrounding conditions which manipulate women's perceptions psychologically. A 2012 study found that women's performance in Math tests was equal to that of men's given equal variables. They also found that women's performance worsened when they were exposed to negative stereotypical material in various media forms discouraging women from math-intensive careers beforehand (Shaffer, Marx, & Prislin, 2012). The psychological influence on women's performance suggests that there are further dimensions to evaluating their aptitude for STEM. Shaffer, Marx, and Prislin (2012) emphasized that negative stereotypes impact the way women perceive their competencies. Since these stereotypes are always introduced by the surrounding conditions, it is fair to consider the work environments offered in STEM careers as a contributor to women's poor performance if existent.

Gender disparities in STEM occupations can be explained by women's preference for family expectations, according to the individual lens. That is, they choose not to pursue STEM careers because they prioritize their familial roles or they tend to leave their jobs for child-care (Ceci & Williams, 2011). Ceci and Williams (2011) argue that the fertility choices impact is magnified in STEM fields because the numbers of employed women are small to begin with. However, this standpoint doesn't explain why employment rates are initially low. It's also important to note that this familial responsibility is experienced by women in all career domains, including those where they're fairly represented. Since some careers are women-friendly and allow their progress regardless of their personal priorities, it's justifiable to consider the contextual differences as a valid concern. The individual view simply deals with this disparity as women preferring family over their jobs. The sociocultural view, on the other hand, takes into account the job conditions that might make work-life balance difficult. These conditions can simply be workplace policies and regulations and designing them suitably for women might tackle this work-life correlation issue immediately.

Some scholars argue that men are more represented in sciences and engineering than women because men are attracted to jobs involving practical applications with things while women prefer working with people, and consequently choose Liberal Arts related jobs (Su, Rounds, & Armstrong, 2009). This assumption makes gender gap in STEM purely a matter of interest-driven choice. Nonetheless, multiple research studies have been conducted on women who do not seek careers congruent to their STEM related undergraduate degrees. With women more likely than men to pursue occupations inconsistent with their STEM majors (Xie & Shauman, 2009), multiple socially constructed factors contribute to these occupational choices. For instance, women tend to consider how far their prospect careers can suit their family life (Perna, 2004). They're also sometimes discouraged from STEM careers because of masculine culture reputation associated with them (Xu, 2015). Other social conditions influencing women's choices are the educational attainment of their parents and the state of their income level, where studies suggest a positive correlation between these two factors and women's STEM jobs pursuit (Goyette & Mullen, 2006). This analysis emphasizes the role of socio-cultural factors in some thing as personal as occupational choices.

### *The Sociocultural Lens*

Since the debate addressed shows the sociocultural view is more likely to give an elaborate picture of the problem, the key factors this view highlights will be the target areas for development in this paper. Consequently, the literature is investigated to find the sociocultural root causes for the STEM gender gap. The literature explores three main reasons for the problem. One factor is the general stereotype that assumes motherhood for all women (Yamina, 2018). This stereotype leads to work environments perceiving women as inevitably future child bearers which, according to most employers, makes them sound like a poor investment in competitive fields like STEM (Miner, et al., 2018). Another factor highlights the negative structural policies of many STEM careers. Addressing the increasing underrepresentation of women in STEM jobs, Hewlett et al. (2008) cited females who found their work environments negative and unwelcoming, pointing at a general gender stereotype against women. These women found no clear schemes for advancement, a phenomenon usually referred to as glass ceiling, which led to them opting out of their jobs. Other socio-cultural factors involved are the implicit unconscious gender biases that tend to favor men over women in these streams' employment. Researchers found women tend to drop out of STEM professions when exposed to negative stereotypes regarding their abilities (Gunderson et. al., 2011). This bias starts from the employment phase. Through laboratory-controlled trials, Reuben, Sapienza, and Zingales (2014) found that both women and men tend to discriminate against women, although unconsciously, during the hiring process even when no differences in qualifications between the sexes exist.

The previously mentioned studies regarding all three main sociocultural causes for the gap support the gender socialization theory. This theory is based on the socialization of gender specific roles to a community's members through family, school, or any other social environments starting from infancy. The effects of this socialization extend from differences in behavior to career preferences between both genders (Reinking & Martin, 2018). One consequence of this socialization is attributing STEM careers to men. Therefore, the theory naturally predicts the prevalence of bias in these careers' workplaces which is, in fact, the case. The gender socialization theory, therefore, explains the sociocultural view and emphasizes the role of bias in the STEM gender gap.

### *The Research Question*

So far, the literature has pointed to the sociocultural importance in solving gender inequality in STEM careers either implicitly or explicitly. Since this research aims at addressing this imbalance in the context of Egypt, it's significant to note that although sociocultural conditions might differ from those cited in the literature, they are still the key pathway into the issue. Most importantly, addressing this debate signified that when discussing underrepresentation on the professional level, the solutions targeting the individual might be ineffective on the long term. Since girls show a fair level of interest in math-intensive streams as evidenced in their college level engagement in Egypt, the career level imbalance won't be solved by exposing them to motivational programs. That is, this debate highlights the need for programs aimed at biases in the workplace and career level implicit stereotypes to really solve the issue. Since this paper is more concerned with the falling trend in math-intensive domain employment, it shall address implicit stereotypes involved in the workplace. Therefore, the proposed research question is: How can women employment in Math-intensive streams in Egypt be increased through reducing the effect of gender biases?

**Analysis of possible solutions**

The gender socialization theory predicted the development of gender roles from early stages such as infancy of both sexes. It, therefore, predicts that early stages intervention would change this socialization. Early stages intervention is necessary for closing the educational gender gap in STEM majors. However, for the career level, it's anticipated that career level intervention would close the gap between undergraduate studies and employment. This paper is only interested in later stage intervention for the STEM workplace given that efforts to decrease gender disparity in this area haven't been effectively invested in Egypt. According to the literature review proposed, it was concluded that taking a sociocultural approach to solve gender inequality in STEM professions is more effective that other perspectives. The sociocultural view had 3 prominent explanations for the issue, and are, therefore, taken as target areas for development. As mentioned earlier, one explanation to this problem is the negative work environments towards women which are naturally a consequence to implicit gender biases in the workplace. Another factor is the obstacle of parental responsibility which makes STEM domains inflexible and unsupportive to working mothers. Lastly, the social perception of the gender gap specified finds that the gap starts with unconscious bias in the hiring phase. By investigating approaches used in different countries over the past 10 years, this section is particularly focused on analyzing the strengths and weakness of program-related solutions. These program approaches mainly target bias in day to day work and hiring process.

**Tackling Implicit Gender Bias**

Implicit gender bias is usually approached by training programs in the workplace. These programs mainly try to educate and change attitudes of employees about minorities in their areas. The programs' primary goal is raising awareness so that employees can identify unconscious gender biases in day-to-day communication. Gender bias training has been proven to improve implicit stereotypes about STEM women (Jackson, Hillard, & Schneider, 2014). Few elements have been identified to make one training program more successful than another.

*Experiential learning*

Experiential learning is simply defined as learning by doing (Jackson & Caffarella, 1994). It's a learning technique that depends on either spontaneous or structured experiences the learner has regarding gender bias. Then learners are exposed to possible scenarios and simulating experiences mirroring situations they can encounter in their workplace. Through peer discussions and guided delivery of information by mentors, the individuals formulate the desired conceptions about gender bias. It incorporates case studies among other simulating techniques that eventually lead to the individuals trying to assess these imaginary situations as biased or not, and if so, how to deal with them. This technique has been shown to be more effective than usual delivery of information especially in bias training programs (Zawadzki, Danube, & Shields, 2012), because direct delivery might induce reactance like denial (Brehm, 1981) that might give negative results (Brehm, 1966). One program that incorporates this approach is NAVIGATE Project by University at Buffalo aimed at restoring the gender balance in STEM fields ("About the NAVIGATE Project", 2017) by depending on case studies approach. This technique will be suited best to Egypt when case studies reflecting the situations faced contextually are used.

*Duration of the program*

While most companies seek a single session program when tackling gender bias in the workplace, research has shown that the outcome of the program is most effective with longer durations. That is, training sessions are recommended to be spread out over a span of multiple weeks with an average of 4 hours per session (Bezrukova, Spell, Perry, & Jehn, 2014). Although employers wouldn't easily welcome such a long time segment cut off their work hours, this duration management is effectively essential. Furthermore, employers will be more motivated to support these programs when they're run during off days, such that the sessions are obligatory so that employees attend them consistently.

**Preventing Bias During Hiring Process**

Since gender discrimination against women during the hiring phase has been proven in multiple studies, some firms have tried to reform their hiring systems to eliminate such biases (Reuben, Sapienza, & Zingales, 2014). However, most strategies followed would prevent this bias during early stages of hiring but fail to stop it during the interview phase. Therefore, three main successful elements have been identified to achieve consistently effective hiring strategy throughout all stages of hiring.

*Gender neutral advertising*

Research has shown that the way job postings are articulated affects women decision to apply to them or not. For example, women tend to view advertisements requiring “assertive or adventurous” candidates as male directed and, consequently, wouldn't apply to them (Gaucher, Friesen, & Kay, 2011). Therefore, some firms sought online tools to remove gender-coded language from their advertisements (McLaren, 2018). For instance, a software company named Atlassian reported the number of women in technical roles increased from 10% to 22.9% within three years of using an online inclusive screening tool called Textio (Jordannovet, 2018). While some of these tools need a paid subscription, finding free alternatives or even investing in business deals with companies hosting these interfaces will make it suitable for Egyptian firms.

*Blind evaluation of Resumes*

During the review of applications stage, multiple firms have developed systems to prevent knowing either the candidate's gender or name. GagJumpers firm developed a software which can screen basic information from applications. This firm ran 1400 auditions for other tech companies and found that without the screening, only a fifth of all minority candidates got an interview. On the other hand, when the software was used, 60% of the minority candidates did receive an interview (Miller, 2016). This process, when made available online, makes it effortless for high-tech companies in Egypt to monitor the bias.

*Objective assessment of candidates*

Since the bias eventually takes place during the interview process, some firms have developed an alternative system to interviews. They resorted to objective ability assessments for their candidates. For instance, a banking business called Lloyds Banking group used virtual reality assessment of possible candidates to see how they would react in real-life situations (McLaren, 2018). When evaluating this approach from the Egyptian context, such a procedure will likely be too costly to be sustained. Therefore, other affordable and effortless options might be online assessment activities and tests. For instance, Unilever replaced interviews with a soft skill test online based on which the hiring decision was made (McLaren, 2018).

**Recommendations for the Context of Egypt**

The sociocultural perspective outlined three main issues causing STEM gender disparity: family-work correlation difficulty, workplace biases, and unfair hiring. The previous section explored successful elements in solutions regarding only two main sociocultural problems: the implicit biases in STEM professional environments and gender disparity in hiring. Nevertheless, this section proposes some recommendations that could apply to Egypt regarding all three sociocultural issues. The recommendations are presented in three categories targeting different aspects of the workplace.

*Legislative Reformation*

The first step to solving this problem nationally is to adjust certain policies. Starting with limiting underrepresentation of women in STEM jobs, the most immediate way to ensure equal participation of women in high-tech professions is through enforcing an obligatory affirmative action policy. This policy obligates companies to design strategic plans to eliminate any components of discrimination against any minorities. This policy, consequently, ensures equal employment opportunity and diversity. It forces firms to set annual goals to employ a certain number of women or minority races that they’re expected to fulfill (US Legal, Inc, 2016). Affirmative action wouldn’t only promise diversity, but also improve overall performance of a workplace. A 2017 Swedish study found male employees become more competent when women were better represented in their careers, since men started facing a higher risk of losing their jobs if they didn’t fulfill the right performance (Besley, Folke, Persson, & Rickne, 2013).

Touching upon the alleged harassment issue that might arise in some workplaces due to implicit gender discriminations, it’s recommended that companies have a firm Zero-tolerance policy regarding such actions. According to an American Bar Association supported paper, Kahn (1999) suggests harassment policies should be characterized by ease of reporting, confidentiality, and disciplinary action with severity depending on the level of offence or harm posed. It’s also important to destigmatize reporting such incidents and even rewarding employers who encourage women employees to speak up. It’s also recommended to train employers on how to design and implement policies specifically tailored for their workplaces to minimize such unpleasant occurrences as much as possible.

It’s not enough to hold the bias training programs mentioned alone, but it’s also important to monitor the behavioral changes in a workplace and assess any attitudes improvement or worsening in the workplace through a continuous assessment policy. For instance, NASA holds systematic surveys on how employees regard implicit discrimination every three years to identify any areas of concern the agency must focus on. Other possible procedures can also be Implicit Association Tests and their results to be compared yearly ("Project Implicit", 2011).

Since women are more likely than men to report leaving their STEM job because of family related issues, the child priority obstacle could be solved in three ways. The first way is by providing child-care facilities. It’s particularly crucial in especially math-intensive careers like Engineering to guarantee optimum performance of employed mothers. Another way is to provide flexible parental leave regulations. Supportive policies might allow 6-12 months paid leave, which is particularly lacking from private sector high-tech profession in Egypt. Furthermore, women scholars have cited the difficulty to return to their STEM careers after a break exceeding 2 years, since any related job specifically requires active profile during the preceding 5 years of the applicant. This career break problem could be addressed by adjusting requirements to any 5 years in their professional lives.

*Training programs*

Based on the analysis of implicit gender biases programs in workplace proposed, the recommended programs are expected to have certain characteristics.

The programs are recommended to apply experiential learning techniques to avoid any negative reactance particularly from male employees. The information sessions should be designed to incorporate simulating scenarios and case studies concluded from the Egyptian context. The sessions should also be properly scheduled during non-working hours to encourage employers to sustain their implementation. They should be mandatory and crucial for the success of any non-discriminatory policies.

*Fair Recruitment*

Using prior experiences regarding the hiring process, the recommended strategy is expected to have the particular features.

To begin with, the hiring team should be trained on using language-monitoring tools to make any high-tech job advertising unbiased and make sure it's encouraging for prospect female candidates to apply. Then application reviews are expected to have any gender defining information screened. To prevent the unconscious bias that follows in interviewing phase, finding alternative ways to assess a candidate's credibility and suitability for the job is necessary. Since STEM jobs vary greatly and so demand varying requirements, it's expected for employers to design assessment tests and techniques that suit their specific requirements.

## Conclusion

As an effort to address the gender equality Sustainable Development Goal Egypt has included in its Vision 2030 development plan, this paper targeted a specific aspect of this disparity. The main focus of this study was the women underrepresentation in STEM professions. To approach this issue, the debate regarding the most prominent view of the issue was concluded to favor the sociocultural lens. The most critical aspects of this gender disparity defined by this lens were considered as target areas for development. Eventually, analysis of effective approaches led to the recommendations presented in three main categories. It's important to note that the sociocultural view supports the gender socialization theory which urges early stage intervention. However, this paper considered only later stage intervention in the hope of balancing undergraduate and career level pursuit in terms of gender representation. Nevertheless, it's highly encouraged to introduce early stage intervention efforts to alleviate the gender disparity initially found in educational levels.

**Works Cited**

About the NAVIGATE Project. (2017, December 01). Retrieved from http://www.buffalo.edu/navigate-project/about.html

Baseera, United Nations Population Fund (UNFPA) (2017). Population Situation Analysis Egypt 2016 Report (Rep.). Retrieved https://egypt.unfpa.org/en/publications/population-situation-analysis-egypt-2016-report

Besley, T. J., Folke, O., Persson, T., & Rickne, J. (2013). Gender Quotas and the Crisis of the Mediocre Man: Theory and Evidence from Sweden. *SSRN Electronic Journal*. doi:10.2139/ssrn.2465902

Bezrukova, Y., Spell, C. S., Perry, J. L., & Jehn, K. A. (2014). A Meta-Analytical Integration of over 40 years of Research on Diversity Training Evaluation. *Academy of Management Proceedings,2014*(1), 14813. doi:10.5465/ambpp.2014.14813abstract

Ceci, S. J., & Williams, W. M. (2010). Sex Differences in Math-Intensive Fields. Current Directions in Psychological Science,19(5), 275-279. doi:10.1177/0963721410383241

Ceci, S. J., & Williams, W. M. (2011). Understanding current causes of womens underrepresentation in science. *Proceedings of the National Academy of Sciences,108*(8), 3157-3162. doi:10.1073/pnas.1014871108

Cooper, Katelyn M., et al. "Who Perceives They Are Smarter? Exploring the Influence of Student Characteristics on Student Academic Self-Concept in Physiology." *Advances in Physiology Education*, vol. 42, no. 2, 2018, pp. 200–208., doi:10.1152/advan.00085.2017.

Dasgupta, N., & Stout, J. G. (2014). Girls and Women in Science, Technology, Engineering, and Mathematics. *Policy Insights from the Behavioral and Brain Sciences,1*(1), 21-29. doi:10.1177/2372732214549471

Eagly, A. H. (1983). Gender and social influence: A social psychological analysis. *American Psychologist,38*(9), 971-981. doi:10.1037//0003-066x.38.9.971

Eccles, J. S. (2007). Where Are All the Women? Gender Differences in Participation in Physical Science and Engineering. *Why Aren't More Women in Science?: Top Researchers Debate the Evidence.*,199-210. doi:10.1037/11546-016

Effect of Teachers Stereotyping on Students Stereotyping of Mathematics as a Male Domain. *The Journal of Social Psychology,141*(2), 165-173. doi:10.1080/0022454010960054

Gaucher, D., Friesen, J., & Kay, A. C. (2011). Evidence that gendered wording in job advertisements exists and sustains gender inequality. *Journal of Personality and Social Psychology,101*(1), 109-128. doi:10.1037/a0022530

Gendered wording in job ads. (n.d.). *The Engaging Manager*. doi:10.1057/9781137273871.0024

Goyette, K. A., & Mullen, A. L. (2006). Who Studies the Arts and Sciences? Social Background and the Choice and Consequences of Undergraduate Field of Study. *The Journal of Higher Education,77*(3), 497-538. doi:10.1353/jhe.2006.0020

Gunderson, E. A., Ramirez, G., Levine, S. C., & Beilock, S. L. (2011). The Role of Parents and Teachers in the Development of Gender-Related Math Attitudes. *Sex Roles,66*(3-4), 153-166. doi:10.1007/s11199-011-9996-2

Heaverlo, C. A., Cooper, R., & Lannan, F. S. (2013). Stem Development: Predictors For 6Th-12Th Grade Girls™Interest And Confidence In Science And Math. *Journal of Women and Minorities in Science and Engineering,19*(2), 121-142. doi:10.1615/jwomenminorscieneng.2013006464

Hewlett, S. A., Luce, C. B., Servon, L. J., Sherbin, L., Shiller, P., Sosnovich, E., & Sumberg, K. (2008). The Athena Factor: Reversing the Brain Drain in Science, Engineering, and Technology(pp. 1-112, Rep.). Boston: Harvard Business School.

Jackson, L., & Caffarella, R. S. (1994). *Experiential learning: A new approach*. San Francisco: Jossey-Bass.

Jackson, S. M., Hillard, A. L., & Schneider, T. R. (2014). Using implicit bias training to improve attitudes toward women in STEM. *Social Psychology of Education,17*(3), 419-438. doi:10.1007/s11218-014-9259-5

Jordannovet. (2018, October 09). Cisco is hiring more women and non-white employees than ever, and they credit this start-up for helping. Retrieved from https://www.cnbc.com/2018/10/09/textio-helping-cisco-atlassian-improve-workforce-diversity.html

Kahn, W. L. (1999, June). DEVELOPING AND ENFORCING EFFECTIVE SEXUAL HARASSMENT ... Retrieved from http://apps.americanbar.org/labor/lel-aba-annual/papers/1999/annual20.pdf

Kamerāsde, D. (2007). Shaping women or changing the system: Accounts of gender inequality in science. *Equal Opportunities International,26*(2), 162-170. doi:10.1108/02610150710732221

León, I., Tascón, L., & Cimadevilla, J. M. (2016). Age and gender-related differences in a spatial memory task in humans. *Behavioural Brain Research,306*, 8-12. doi:10.1016/j.bbr.2016.03.008

MclLaren, S. (2018). 3 Ways Companies Are Fighting Bias in the Workplace and Hiring Process. Retrieved from https://business.linkedin.com/talent-solutions/blog/diversity/2018/companies-fighting-bias

Miller, C. C. (2016, February 25). Is Blind Hiring the Best Hiring? Retrieved from https://www.nytimes.com/2016/02/28/magazine/is-blind-hiring-the-best-hiring.html

Miner, K. N., Walker, J. M., Bergman, M. E., Jean, V. A., Carter-Sowell, A., January, S. C., & Kaunas, C. (2018). From "Her" Problem to "Our" Problem: Using an Individual Lens Versus a Social-Structural Lens to Understand Gender Inequity in STEM. *Industrial and Organizational Psychology,11*(02), 267-290. doi:10.1017/iop.2018.7

Mujtaba, T., & Reiss, M. J. (2015). The Millennium Development Goals Agenda: Constraints of Culture, Economy, and Empowerment in Influencing the Social Mobility of Pakistani Girls on Mathematics and Science Related Higher Education Courses in Universities in Pakistan. Canadian Journal of Science, Mathematics and Technology Education,15(1), 51-68. doi:10.1080/14926156.2014.992556

Perna, L. W. (2004). Understanding the Decision to Enroll in Graduate School: Sex and Racial/Ethnic Group Differences. *The Journal of Higher Education,75*(5), 487-527. doi:10.1353/jhe.2004.0032

Project Implicit. (2011). Retrieved from https://implicit.harvard.edu/implicit/iatdetails.html

Reinking, A., & Martin, B. (2018). The Gender Gap in STEM Fields: Theories, Movements, and Ideas to Engage Girls in STEM. *Journal of New Approaches in Educational Research,7*(2), 148-153. doi:10.7821/naer.2018.7.271

Reuben, E., Sapienza, P., & Zingales, L. (2014). How stereotypes impair women's careers in science. *Proceedings of the National Academy of Sciences,111*(12), 4403-4408. doi:10.1073/pnas.1314788111

Rowe, K. (2013). School and Teacher Effectiveness: Implications of Findings from Evidence-Based Research on Teaching and Teacher Quality. International Handbook of School Effectiveness and Improvement Springer International Handbooks of Education,767-786. doi:10.1007/978-1-4020-5747-2_4

Shaffer, E. S., Marx, D. M., & Prislin, R. (2012). Mind the Gap: Framing of Women's Success and Representation in STEM Affects Women's Math Performance under Threat. *Sex Roles,68*(7-8), 454-463. doi:10.1007/s11199-012-0252-1

Shaffer, E. S., Marx, D. M., & Prislin, R. (2012). Mind the Gap: Framing of Women's Success and Representation in STEM Affects Women's Math Performance under Threat. Sex Roles,68(7-8), 454-463. doi:10.1007/s11199-012-0252-1

Stearns, E., Bottía, M. C., Davalos, E., Mickelson, R. A., Moller, S., & Valentino, L. (2016). Demographic Characteristics of High School Math and Science Teachers and Girls' Success in STEM. Social Problems,63(1), 87-110. doi:10.1093/socpro/spv027

Stieff, Mike, et al. "Strategy Training Eliminates Sex Differences in Spatial Problem Solving in a Stem Domain." *Journal of Educational Psychology*, vol. 106, no. 2, 2014, pp. 390–402., doi:10.1037/a0034823.

Stout, J. G., Dasgupta, N., Hunsinger, M., & Mcmanus, M. A. (2011). STEMing the tide: Using ingroup experts to inoculate womens self-concept in science, technology, engineering, and mathematics (STEM). Journal of Personality and Social Psychology,100(2), 255-270. doi:10.1037/a0021385\

Su, R., Rounds, J., & Armstrong, P. I. (2009). Men and things, women and people: A meta-analysis of sex differences in interests. *Psychological Bulletin,135*(6), 859-884. doi:10.1037/a0017364

Tarampi, Margaret R., et al. "A Tale of Two Types of Perspective Taking." *Psychological Science*, vol. 27, no. 11, 2016, pp. 1507–1516., doi:10.1177/0956797616667459.

The Global Gender Gap Report 2018(Rep.). (2018). Retrieved http://reports.weforum.org/global-gender-gap-report-2018/

United Nations Educational, Scientific and Cultural Organization (UNESCO) (2017). Cracking the code: girls' and women's education in science, technology, engineering and mathematics (STEM). Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000253479

US Legal, Inc. (2016). Affirmative Action Law and Legal Definition. Retrieved from https://definitions.uslegal.com/a/affirmative-action/

Uttal, D. H., & Cohen, C. A. (2012). Spatial Thinking and STEM Education. *The Psychology of Learning and Motivation Psychology of Learning and Motivation*,147-181. doi:10.1016/b978-0-12-394293-7.00004-2

Wang, M., & Degol, J. L. (2016). Gender Gap in Science, Technology, Engineering, and Mathematics (STEM): Current Knowledge, Implications for Practice, Policy, and Future Directions. Educational Psychology Review,29(1), 119-140. doi:10.1007/s10648-015-9355-x\

WEF (WEF) (2015). The Global Gender Gap Report 2015. Retrieved from http://reports.weforum.org/global-gender-gap-report-2015/?doing_wp_cron=1552594883.5680770874023437500000

WEF (WEF) (2018). The Global Gender Gap Report 2018. Retrieved from https://www.weforum.org/reports/the-global-gender-gap-report-2018

Wodon, Quentin T.; de la Brière, Bénédicte. 2018. Unrealized Potential : The High Cost of Gender Inequality in Earnings. The Cost of Gender Inequality. Washington, DC: World Bank. © World Bank. https://openknowledge.worldbank.org/handle/10986/29865 License: CC BY 3.0 IGO."

Xie, Y., & Shauman, K. A. (2009). *Women in science: Career processes and outcomes*. Cambridge, MA: Harvard Univ. Press.

Xu, Y. (2015). Focusing on Women in STEM: A Longitudinal Examination of Gender-Based Earning Gap of College Graduates. *The Journal of Higher Education,86*(4), 489-523. doi:10.1353/jhe.2015.0020

Yamina, Nater-Otero, "Biological Factors in the STEM Gender Gap" (2018). *Theses, Dissertations and Culminating Projects*. 109. https://digitalcommons.montclair.edu/etd/109

Zawadzki, M. J., Danube, C. L., & Shields, S. A. (2012). How to Talk about Gender Inequity in the Workplace: Using WAGES as an Experiential Learning Tool to Reduce Reactance and Promote Self-Efficacy. *Sex Roles*,*67*(11-12), 605-616. doi:10.1007/s11199-012-0181-z