

GENDER GAP IN SCIENCE, TECHNOLOGY, EDUCATION, MATHEMATICS AND MEDICINE (STEMM)

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Abstract

The approach to look forward along collaborative, diversified multi- disciplinary research draws attention on gender equality for achieving sustainable development goals. For a major part of human history, women are constantly striving to rise up in ranks and prove themselves. Despite the noticeable progress made in the recent years shown by increasing representativeness in the fields of Science, Technology, Engineering, Mathematics and Medicine (STEMM), we still have a long way to go. Women in top leadership positions, decision making roles and officers of authority still remain a few. One of the main barriers for women is at the middle career level, balance in transition from college to post-doctoral researchers and even after crossing this gender gap they face problems at every step in their career. Such great loss and underuse of human resources in this field can be prevented by the gender parity method to create equal opportunities for entry and progress into greater STEMM innovations. But in the end, a mind open to progress and growth would offset all the differences as it provides perseverance in moments of hardship that steers us towards our desired goals.

Key words: gender gap, women, gender parity, STEM

Introduction

In spite of women gaining equality with men in the award of doctorate degrees and Doctor of Medicine, still the studies support their under-representation in leadership positions and as principal investigators in funded science projects provides the disparity. Over a time span of 40 years from 1969 to 2009, the percentage of doctorate awardees increased from 15 % to 52%. (National Science Board,2012)

Numerous causes have been suggested to affect the leaky pipeline in science, technology, engineering, and mathematics (STEM) fields. Career choices and undergraduate major are important deviation points for women in certain specializations. The proportion of bachelor degrees in physics and engineering is less than 20%, while more than 50% are awarded bachelors and doctorates in life sciences. This suggests that major leaks in the pipeline may occur in the transition from doctorates to academic

professionals. Academic footsteps are considered to be harder after Ph.D. than before.

Instead, the leaks in academic pipeline beyond doctorate degree occurs to a greater extent in the field of biological sciences compared to fields enriched with men like engineering or physical sciences(Ceci et al., 2014), suggesting that wider gap in the pipeline projects to the surface in later stages in the career. Differences in individuals' personal aspirations based on gender may explain some weakening from the academic life later.

According to a survey report from graduates and post-doctoral researchers, women prioritize parenthood issues and raising the family foremost than balancing the barriers work-life issues compared to men while working in a tenure track position. This introduces more leaks in the academic pipeline. (Martinez et al., 2007)

Though the metaphor, leaky pipeline has been used for the gender gap, according to David

Miller, 2015(4), the gaps in persistence have already closed in 1990. It no longer describes the gender gap in transition from Bachelor's to Ph.D in STEM. Though the 3:1 ratio is still higher towards men, the leaks need not be plugged, but attention is to focus on creating interest in more women and underrepresented minority students.

Significance of the study

The study reviews the gender gap which exists in the field of STEM and suggests the solution to improve the gap for greater contribution in STEM to advance the society.

Objectives of the study

1. To understand the contribution of women in publications
2. To identify the participation of women in conferences and the problems faced by women scientists and technologists
3. To offer suggestions to improve the gender gap in science, technology, education, mathematics and medicine.

Methodology

This paper is of analytical review from earlier studies. The secondary data have been collected for preparing the paper. The secondary information has been used from review papers, research papers and other websites.

Analysis and Discussion

Women in publications

The most prevailing understanding about authors order of arrangement depicts that last authors are generally senior researchers and first authors refers to the researchers in the early budding stage.

Publications of the academic research are the important means of spreading the scientific achievements and it's an indicator of productivity in research which influences wide career choices

and increases awareness of scientists' contribution in STEM (Ioannidis,2014).

The real difference in gender ratio between researchers in early career and senior research leaders would be greater due to the underrepresentation of women as last named authors and single authors in many fields of research and over representation as first authors. Multiple outcomes due to underrepresentation of women as last named authors include their slow progress in career towards higher academic positions despite passing through the barriers at work place and outside. (Nicholson, 2015) The priority of providing last authorship to women is few and even if they place a request for last authorship, hardly would their request succeed. This has an impact on choosing the women mentors by the research students as achievements made by women are less celebrated in public or they are judged in a favourable manner.

Hence according to the report by National Academies of Science, Engineering and Medicine, it's not the less entry by women into STEM or their contributions that is low, but the stereotypical conventional segregation based on gender that arise in the process of interactions and evaluations that slows the further progress in STEM. (National Academy of Science,2007)

In the field of life sciences, where the representation of women in doctoral and post-doctoral research is more than 50%, the gender issues seems not to be crucial in the early stages. The difference arises from the laboratory from which they have been trained, their access to resources and facilities and their collaborations. When the outcome in terms of number of publications and its impact is judged, they stand little chance in terms of receiving grants or scientists' positions in reputed laboratories. Moreover, priorities during selection for training young scientists based on gender in laboratories with higher recognition and outcome impedes the chances for women. Such distinction is not a common factor in female faculty playing mentor roles. The variation in selection based on gender might contribute to more loss of women scientists in the leaky pipeline. (Sheltzer and Smith, 2014)

As they graduate, very few women pursue in academic field and change career roles that contribute to loss of potentials in trained disciplines. In many circumstances, women under-estimate their talents and keep themselves away from applying to prestigious laboratories. A deviation in continuing into STEM is found in the mid-thirties for women when they have to make a choice between careers versus children. The fourth Industrial revolution could work in favour of these women in the short term. (Youth foundation, 2018)

A recent study interprets the bias in gender in funding for research is lesser importance given to women for their proposals rather than the quality of the writings. In a study with 24,000 applications, the findings suggest a focus on the science but not the track record of the scientist as there was four times increase in the gender gap when emphasis was made on expertise of the contributor instead of adding value to the scientific quality of the proposal. Recommendations were made to evolve new policies to reduce bias from various perspectives. (Witteman, 2019)

Women in Conference

After the establishment of women in cell biology (WICB) committee in 1970, WICB became the standing committee of American society of cell biology in 1992 with 50% representation from 13% earlier. However, it continues to be a challenging task to fulfil the target of supporting women to balance career and family, identify mentors and attain gender equity in job placements. (Masur, 2013) WICB organizes workshop to guide women in dealing with difficult people and situations, provide training for leadership skills, to negotiate conflicts and climb the ladder in one's career. The training session includes interactions amongst the participating members, real life case studies, and enacting plays to reveal the typical situations. Such mentoring provided to women might seal the gender gap at an earlier stage. Success stories of real cell biologists with their photographs who have managed to balance in work –life in the web site of WICB might encourage students and researchers to find themselves later in the same place.

Problems faced by women scientists, technologists

Women are exposed to bias in an unconscious manner in the work place. It is not lack of talent and skills, but unintentional bias outmoded the structural framework which hinders the progress of women. Women faculty are paid less, are promoted more slowly, receive few honours and hold few leadership positions than men.

All members of a scientific society, regardless of gender, should be equally able to access chances to be speakers, given opportunities to chair scientific sessions, and provided recognition with awards at national or international meetings as these act as stepping stones to march further to advanced stages in academic career. They provide a platform for researchers to share their contributions in the field, increase their professional visibility to gain new chances for further collaborations, and showcase external validation to hiring and promoting teams. Hence, they lay a strong foundation for a successful scientific career.

One of the mechanisms for achieving gender balance at scientific meetings is to involve more women as conveners as this encourages women participation in such symposia and conferences. (Casadevall and Handelsman, 2014) The announcement of equal opportunity guidelines has increased the proportion of women.

Including women to be part of organizing teams of scientific events, and the formation of evident Equal Opportunity strategies confirm greater number of requested female speakers in the future. (Debarre, 2018) Moreover going an extra mile to include travel assistance, child friendly conferences, and well-defined mandatory Codes of Conduct would greatly improve female participation. As results suggest that change, if desired, requires deliberate actions (Sardelis and Drew, 2016)

Suggestions to improve the gender gap

A study from Columbia University reports that while men tend to overestimate their abilities by approximately 30%, women tend to habitually underestimate their own skills. Our confidence should be a balance of how good we think we are

and how good we actually are. But competence is not the only requirement to earn a key to the C-suite. Putting our heads down, playing by the rules and working hard, will not fetch rewards for our natural talents, we will only watch from side-lines as the men around us get promoted. Confidence is equally important as competence to succeed. Thoughts are converted into action only by confidence.

Women are compelled into negative conventional behaviour, as regards their capability in the workplace. The presence of an inspiring female role model who provides hope for overcoming the gender barriers to rise up was found to create a positive atmosphere for female participants in studies rather than male role models.

The extent to which women participate in collaborative research is less compared to men and fewer chances for them to be listed as first or last author. With no concurrence for the causes attributing to gender difference in terms of collaboration based research, it might be due to bias, child bearing and care, or other factors. Since collaboration serves as a main driving force for valuable research outcome, support programmes that encourages world-wide collaboration among female researchers creates equal opportunity for all in the field with fair competition. (Witteman et al., 2019)

But, miserably, behind this universal imbalance lie localized and ancient traditional forces that moderately play a role in systemic imbalance that obstructs women's access to and progress in science. Policies to improve representation of women in STEM should take into account the diversity of social, cultural, economic and political contexts in which students learn science and scientific work. Each nation should carefully identify the micro-mechanisms that contribute to reproducing the past order. No country can afford to neglect the intellectual contributions of half its population.

The first and foremost step to be taken to move forward is to make a request for help. Women often fear that claiming for a demand on their part may create a negative impression, whether they want an increment in salary or even a small favour in domestic work. Women have not understood

that changes could be introduced from the monotonous pattern. They are scared that if they open up with their voices, the relationship may come to an end.

The significant finding of the Global Gender Gap Report 2020 reveals that gender parity will not be attained for 99.5 years which reveals that neither we nor our children would live in such a world. Women with an attitude to balance career and life and a tendency to postpone the family life until they reach a inclining stage in career are at an advantage from the policies imposed in the work place.

Departments where faculty have collegial respectful interactions have higher numbers of publications for both men and women faculty, and both genders benefit equally from the collegial environment overall. When faculty perceive that underrepresented faculty are treated well in their departments, they have higher grant production.

Research provides evidence that a "growing mind-set" (viewing intelligence as a shifting, adaptable attribute that can be developed through training) as opposed to a "fixed mind-set" (viewing intelligence as a hereditary, irresistible trait) is likely to lead to greater perseverance in the aspect of hardship and ultimately success in any field (Dweck, 2013).

The mind-set of a person does not take an alternate turn until the person is given a challenge. Differences evolve in the behaviour of intelligent students with a growing mind-set who tend to adapt to a new situation and survive through the hardships with increased confidence compared to students with a mind-set which is static or still. Such static mind set students are washed away in the storm of such challenges. Both the category of students appear in equal proportions in both middle school and college.

Findings by Dweck are equally applicable for women in STEM, as they not only have to constantly overcome stumbling block and tests of scientific nature but also overcome the long-standing label that men are more proficient in mathematics and science. So when women trust they have a static amount of intelligence, they are more likely to believe the categorization, lose self-reliance, and draw from STEM as a potential

career when they chance hitches in their course work. Eliminating categorization is a meaningful but enduring goal, but lessening their outcome by sharing a growing mind-set is something parents, educators can do to increase representation of women in STEM areas. (Good et al., 2012)

The more women have confidence to develop new skills to be successful in STEM fields in opposition of believing that they should be born genius; greater will be their success in STEM fields.

Parents and teachers can portray challenges, effort, and mistakes as highly valued and admired to encourage students with a fixed mind-set to not keep away from challenges, limit their effort, and try to avoid or hide mistakes, but rather learn from them and grow.

Suggestions and conclusions

Nurturing girls from a young age to overcome stereotypes and teaching them the values which lie in the core of science and mathematics will instil in them the confidence to pursue their dreams. To reach equality in gender in the field of STEM, girls must be motivated to be courageous enough to meet up challenging tasks with a strong determination. Showcase of success stories of women scientist's achievements and not to give up during failures, but to learn and advance further are to be inculcated in the minds of women to climb the ladder and seal any leaks in the pipeline.

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