Women in Technology, Issues and Challenges: A review

Sangita Sharma
Department of chemistry, Hemchandrachrya North Gujarat University,
Patan, GUJARAT- 384 265, INDIA

Abstract

Inspirational female scientists and tech figures are not a new concept. It has been hearing more and more about the importance of women in science, technology, engineering and math (STEM) fields. Yet, while women make up nearly half of the total workforce, they represent only 26% of the STEM workforce, as of 2011. In 2016 women represented 59 percent of the workforce, but on average only represent 30 percent of the workforce at major technology companies. As the technology sector continues to grow, statistics highlight that women remain underrepresented for a variety of reasons, and though there has been a doubling down on the importance of STEM education over the last 10-15 years. There has only very recently been a big push to encourage girls and young women to take a seat at the tech table. Despite a lot of initiatives taken in the last decade to address under representation of women in both science, research and technology, women are facing considerable difficulties when perusing a career in science and technology. Without more women in technology, the year 2050 could be our most backward in a century.

Key Words- STEM, Scientist, Technology, Career, Mismatch

I. INTRODUCTION

A study by the Institute of Technology and Engineering in 2014 in US found that just one per cent of parents with daughters see them growing up to be engineers. So what would the technology industry and society look like in 2050 if there were more women in STEM? In a world of female technologists, one thing we might expect to see is the creation of more products focused on improving the quality of life for the individual. According to a study by Carnegie Mellon University, women innovators put more emphasis on the importance of integrating technology with people (1-7). Studies also show that women prefer more collaborative ways of working and building businesses. In a brave new world of women-powered development, then, one might also expect to see a focus on technologies that enable more joined up forms of innovation like holograms and virtual reality tools to give us a physical presence in online meetings (8-12). What is more, young women are still too often told that STEM isn't for them. When it is to consider the pool of future female talent in technology, it is clear there is still a lot of work to do. Although girls outperform boys in the majority of STEM subjects at graduate level, the number of young women choosing to study STEM at A levels and at university falls significantly behind that of their male counterparts. Just 8.5 per cent of the engineers in the UK are women and 62 per cent of 11-21 year-old girls believe STEM is just for boys. Such inaccurate perceptions hold girls back from considering a future in the technology industry (13-14). Things are starting to change slowly. Awareness is being raised, which promotes diversity in technical fields from the classroom to the boardroom.

One of the factor that makes the difference in the degrees of science and engineering and patenting performance and is decided by the disciplines chosen, as engineering is a patent rich discipline and it is attracted by fewer women. Survey of 2010 suggested that women accounted 58 percent of biological science degrees and 39 percent of physical science degrees, 20 percent of engineering and computer science degrees in the United States (16). The United States is one of the countries that show lowest representation of women as far as women engineers are concerned in the world. It is even less than one half the proportion of Denmark, Poland, or Malaysia and even lower than many other developing countries (17).

Since 2001, the National Science Foundation in US has invested more than $130 million to support ADVANCE projects at nearly 100 institutions of higher education and STEM-related, non for profit organizations across the US. Focuses on improving conditions for female STEM faculty, with a unique emphasis on women of color and women who are deaf and hard of hearing at the university. Some observations made even in developed countries like US (18) are

- Although women fill close to half of all jobs in the U.S. economy, they hold less than 25 percent of STEM jobs.
- Women with STEM jobs earned 33 percent more than comparable women in non-STEM jobs – considerably higher than the STEM premium for men. As a result, the gender wage gap is smaller in STEM jobs than in non-STEM jobs.
- Women hold a disproportionately low share of STEM undergraduate degrees, particularly in engineering.
- Women with a STEM degree are less likely than their male counterparts to work in a STEM occupation; they are more likely to work in education or healthcare.

II FACTORS RESPONSIBLE FOR LESS PARTICIPATION IN ADVANCED TECHNOLOGY

There are many possible factors contributing to the discrepancy of women and men in STEM jobs, including: a lack of female role models, gender stereotyping, and less family-friendly flexibility in the STEM fields. Regardless of the causes, the findings of this report provide evidence of a need to encourage and support women in STEM.

A.Domestic Responsibility: The Domestic Responsibility is responsible for less participation of women in the technology. For gendered patterns of occupational segregation in the *labor* market, research has shown that women's labor market disadvantage can be on account of the demands of motherhood and the family. The married women in share a commonality of life style and that unmarried or child free women do not have responsibilities in the private sphere, and that women have restricted mobility and are in fixed situations from which they *cannot* easily escape. *The competing* demands of professional and family life and these conflicts are particularly marked for women in the tradition all male dominated occupations. Women in science and technology occupations tend to have children later in life than those in other *occupations. They* are also more likely not to have children at all. Family formation patterns may reflect the he institutional contexts in which women with Science, engineering and technogical qualifications study and work. The study appear stolen support to the idea that here is a relationship between the gender balance of an occupation and he level of tolerance and provision of flexible working practices for *deed* to women *with children*. Nevertheless, it is important to point out here that women manager and even lower level staff with in female-*dominated* occupations may themselves show a lack of to lerance and negative attitudes towards flexible working practices (19).

The question arise as to what extent career paths are influenced by persistent cultural attitudes and expectations, all these are based on pervasive social stereoty*pes. A qualitative survey in* Finland on women in STEM, revealed that the problems raise due to prevalent attitudes, prejudices, practices, organizational responses and regulations concerning motherhood in the scientific community'. So, women consider such fields to be 'woman-unfriendly' for not easily 'fitting around' the family. But on the other hand, women are choosing medicine as a career; in spite of the long hours of working, women have been entering that profession in equal proportions to men for some time.

*B.*Dual Role: Effect on Academic Performance and on Family Commitments Nature of family commitments and household responsibilities for sampled student respondents: care for the elderly, household chores, household maintenance and care for children are the commonly cited responsibilities. 50% of students reported that their career and study commitments did not have any effect on their family commitments and household responsibilities. For these *respondent's* dual role has not had any adverse effect on their family life. Significantly larger proportions 22% and 14% respectively have responded that their career and study commitments have had a somewhat positive and very positive effect on their family commitments and household responsibilities. Many of the respondents volunteered information that the positive effect was associated with financial support for *family (20*).

C. Reasons may include industry structure and networks*:*
Women in science streams are *having less patents* than men, but biotechnology is an exception. Biotechnology stream tends be flexible, flatter and has better network *and women* perform better there and are in higher positions in hierarchical structures. Contacts in industry is a strong predictor *of getting* patents and women have a fewer needed contacts.

III REPRESENTATION OF WOMAN IN TECHNOLOGY

A. Gender Stereotyping:

Only 10 percent women have patent authorships around the world as per data of 2013. Even advanced countries like US, the rate of increase from innovation (as reflected in patents) is still male dominated and is 3.4 to 18.8 percent in 1977 to 2010. Calculations on the basis of Sugimoto measure for the period of 1976-2013; this ratio is best represented in East Asian countries. Malaysia and Taiwan shows 30 percent share and China and Singapore above 20 percent.

B. Women inventors work for traditional female roles:

In chemistry, natural resins or derivatives 50 percent patents are woman inventor in US. In general women have patents as primary investors in technologies associated with traditional female roles in travel goods, personal belongings, jewelry, symbolic insignia and ornaments etc.

C. Problem is not with education rates:

As per worldwide data available, women with bachelor and master degrees constitute 53 percent and PhD degrees constitute 43 percent. In the United States, women and men are at par as per educational background is concerned. But for patents only 7 percent representation is from women side. Reasons are still to certain.

D. Gap between professional degrees and productive research: As compared to 43 percent share of PhDs holder is women, only 28 percent pursue for researcher worldwide. In the countries like UK, there are 28 percent of researchers, 16 percent of publications and 6 percent of patent holders; and in Germany, it is 24, 14, and 4 percent, respectively. There is seems to be a gap as far women's representation is concerned at different research positions (21-24).

E. Fewer Women apply for public funding for Research:

One reason for less representation at innovation level may be due to fact that they do not apply for competitive grants
although they are eligible for that. Between 2011 and 2013, out of total venture capital funding, only three percent was handled by a woman CEO in US.

IV SUGGESTIONS TO INCREASE PARTICIPATION OF WOMEN IN TECHNOLOGY AND ADVANCED RESEARCH

Advancing Women in Technology (AWIT) should believe in diversity is good for business and helps companies create inclusive and supportive work environments for all people. The community also provides networking opportunities develops member-driven initiatives involving women and careers. AWIT supports women working in information technology and helps women and girls discover ways they can play important roles in the industry (25).

A. Increment in women's Participation

A lower quality human capital stock is developed due to current imbalance in research and innovation which is driven by both internal and external bias. Moreover, productivity will double if both male and female engineers will join hand together (26).

B. Role of Funding Agencies

Agencies and institutions that fund scientific research should have soft corner and give leverage to reduce the existing gaps, so that women can compete on equal footing as innovators and that their research can cater to the needs of women and girls (27).

C. National and global scholarship programs

Such scholarships can help women for conducting research and develop new technology. Some are Organization for Women in Science for the Developing World helps women scientists from sub Saharan Africa and less developed countries (LDCs) to pursue PhD fellowships and come to another developing country (28).

A Fulbright scholarship is given to about 4,000 foreign students annually. Fulbright Program gives extra points to female students and scholars who want to do research, particularly in the areas of STEM. Presently 39 percent of Fulbright scholarships in the fields of biological sciences is given to traditionally

underrepresented students. 61 percent of women, as opposed to men are awarded in engineering, health sciences and physical sciences

The US National Science Foundation (NSF) launched ADVANCE program in 2001. The objective was to increase the participation of women in science and engineering academic careers. ADVANCE supported reforms in classrooms and laboratories so that greater women can participate in it. It included childcare and elder care units, permitting career breaks and offering maternal leave.

European Union has launched a big program named Horizon 2020 to support research and innovation. It will be funding
€80 billion from 2014-2020 with private investments also. The aim of HORIZON is to develop new technologies. Through Horizon 2020, the EU with be awarding annually a prize to outstanding women innovators and the will promote tem as role models (29).

The Consultative Group for International Agricultural Research, CGIAR has started a number initiation so as to guide and to incorporate various women into many research areas of their choice. 250 AWARD fellowships are also given to women researchers to improve the gender balance. CGIAR funding primarily goes to underdeveloped countries.

D. Awards and additional financial assistance for institutions that encourage women researchers

A model to consider here is UK Athena SWAN charter that was founded in 2005 to encourage and recognize contribution of women in science, technology, engineering, math, medicine, employment in higher education and research. Awards were given to academic institutions in the United Kingdom via Equality Challenge Unit (a private charity) which is funded from the UK's higher education council. [9]

E. To create women's venture top-up fund

To directly encourage innovation by and for women, governments could create a women's venture fund, which could provide additional finance up to 10 percent of a given investment round for women-led firms.

F. Advance market commitments (AMCs)

AMCs are financial commitments to purchase a specific new technology with set features and on set terms if it is developed. For example, Gavi (the vaccines alliance) has used an advance market commitment to incentivize the development of a vaccine variant for pneumococcal strains common in the developing world. Both prizes and AMCs could be focused on technologies of particular benefit to women and girls in areas such as obstetric and gynecological health and small-scale farming or towards ensuring technologies have equal utility for women and men in different socioeconomic settings.

G. Global networks of women working in technology

Tech Women, an initiative of the US State Department's Bureau of Educational and Cultural Affairs, seeks to connect and support women from Africa, Central and South Asia, and the Middle East through a 5-week program and continued mentorship. Since 2010, over 400 women have participated, but there is considerable potential to expand or replicate this program, which can work to overcome women's constraints in accessing networks.

H. Global policy

Technology is a global public property. So, there is need to have a global policy on decision making regarding involvement of women in research and development. A cross- country partnership model has to be developed on the basis of Open Government Partnership. This model will see that countries are committed to make policy that is related to gender equality in technology and submit a review report on the progress of the model.

V SCHEMES TO SUPPORT WOMEN IN TECHNOLOGY IN INDIA(30,31)

A. DST has launched a scheme called KIRAN, through which a number of programs are added for women like (a) Science and technology for women (S&T for women) (b) women Scientist Scheme (WoS) (c) Capacity/Orientation Building
(d) Institutional Support/Development and (e) Mobility.

B. The women Scientist Scheme has three components (earlier known as WoS-A,WoS-B and WoS-C) (i) Basic Research Fellowship (Societal Research Fellowship- SoRF) and (iii) Intellectual Property Rights

C. In 2009 special programme 'Consolidation of University Research for Innovation & Excellence in Women Universities (CURIE)' was initiated for women universities to strengthen their R&D infrastructure. Phase-I, 6-women universities have been supported for 3 years on the basis of overall performance. Phase-II of CURIE has also been started in order to maintain the pace of progress in R&D.

D. The Department of Biotechnology (DBT) has many useful and successful programs to provide ways and means to encourage and empower woman on the career path. Some schemes are (i) Biotechnology Career Advancement and Re-orientation Programme for Women Scientists (BiO- CARe) (ii) Golden Jubilee Biotech Park for Women, under the TWAS umbrella, (iii) OWSD - organization for women in science for the developing world). Effect on their family commitments and household responsibilities. Many of the respondents volunteered information that the positive effect was associated with financial support for family.

CONCLUSION

The problem of women's under-representation in academic science requires clearer delineation, recognizing that their career trajectories are likely to vary markedly between the scientific disciplines. Serious attention needs to be paid to the point that women experience the academic labor market in a variety of ways on account of their individual differences so that a holistic approach can be reached. To date this has largely been overlooked. This will require exploring the ways in which differences such as ethnicity, class and gender intersect. Another requirement for deeper examination is to find the connections between participation of women in science and their role in generation of new ideas for scientific knowledge. It is well said that we should not only consider women in science, but also women and science relationship. Sustained efforts are needed with well decided goals rather than short-term fixes. The implementation plans, and schemes should be evaluated quantitatively and qualitatively. The analysis of processes as well as outcomes should be done keeping in mind that any initiatives are taken to consider knowledge production. For this agenda both Government and non-government agencies should to join hand together, so that gap between degrees and innovation participation of women get reduced. Also 2050 becomes advanced century.

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