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EMPOWERING GIRLS WITH STEM

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Abstract

The "STEM" is an acronym for Science, Technology, Engineering and Math. STEM is not just limited to the classroom; it has become significant to everyone as we evolve into a more technological and innovation dependent world. It plays a pivotal role as a tool for reformation in the developing countries as better solutions can be found out in fewer resources with the help of STEM. Within developing economies such as India, girls and women are more likely to have less exposure to STEM-related coursework in schools due to which they abstain from choosing STEM-related careers. STEM-related careers in newer fields ranging from Techno Management to Environmental Engineering have the potential to move girl students into a higher income bracket. The complicated issue is many children lack STEM education in developing countries. One of the major issues is the rural-urban divide where children from rural areas hardly get any educational opportunities in the field of science and technology, especially women. Another reason is the gender gap in the field of education where women are underestimated in technical and digital fields due to which there is a percent of population in the country which leads to lesser awareness in STEM education. There is also a dearth of female role models which contribute to the disparity in occupations in STEM. This paper will identify various obstacles to STEM education currently in an urban metro of India. It also tries to suggest solutions to how STEM skills can be cultivated in schools making it more interactive.

Keywords: STEM, Mentor and Mentee, India.

Introduction

APJ Abdul Kalam stated,

> **"The purpose of education is to make good human beings with skill and expertise... Enlightened human beings can be created by teachers."**

Overview of STEM Education in India

The term "STEM education" refers to teaching and learning in the fields of science, technology, engineering, and mathematics. It typically includes educational activities across all grade levels—from pre-school to post-doctorate—in both formal (e.g., classrooms) and informal (e.g., afterschool programs) settings (U.S.Cong, 2012). In broader perspective STEM education is used to identify individual subjects, a stand-alone course, a sequence of courses, activities involving any of the four areas, a STEM-related course, or an interconnected or integrated program of study (English, L. D, 2015).

The primary development of STEM education started in the United States (Xie, Fang, & Shauman, 2015) and today many nations are developing competencies to strengthen their education system to reduce the shortage of workers in STEM jobs (https://www.cde.ca.gov/ PD/ca/sc/stemintrod.asp). In comparison with the education system in the West, STEM is a relatively new term in Indian education system. Hence, development & growth of STEM education has been sluggish. On the other hand, exam focused models in India fail to test innovation and problem-solving skills. According to the National Science Foundation, it is projected that in the next decade 80% of overall jobs created will require some or the other form of science and math skills.

We live in the world where STEM education plays a vital and integral role in various sectors such as security, health, business as well as contribute to the overall development of a nation which demonstrates new thought processes.

Studies show that there is a growing challenge in educating students who can perform jobs that require skills in science, technology, engineering and mathematics (STEM). With a view to build a skilled workforce, Indian Government launched few initiatives in recent years to support STEM education (Davies, Fidler, & Gorbis, 2011). Despite taking initiatives such as Skill India and Digital India to promote and encourage technology usage and skill development in the country (OECD, 2016), India still faces an acute shortage of human skill. Promoting STEM in girl students hence becomes all the more necessary.

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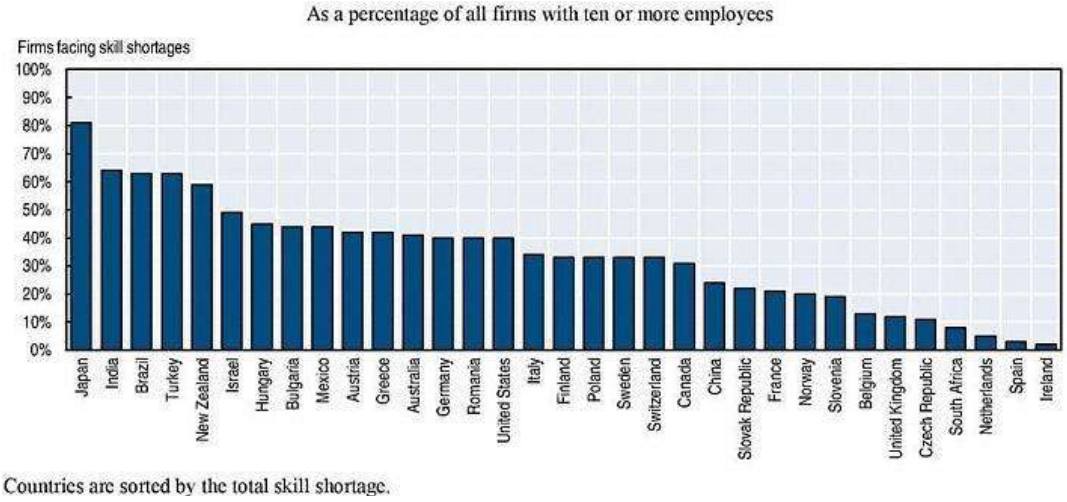

Figure 1. Skill shortage in selected countries (OECD, 2014)

Majority of Secondary schools' emphasis on textual knowledge and the only criteria to access the learning ability of students is marks secured in theoretical examinations. Hence, students lack ability to apply classroom concepts to problems in real life situations as they lack critical thinking, problem solving skills and project-based learning approach which forms the bases of STEM education.

Girls and STEM education

It is always assumed that STEM education related challenges often exist in rural areas whereas problems in metros are overlooked.

One of the major challenges for sustainable STEM education in K-12 schools is funds and quality infrastructure. Apart from resources and facilities girls studying in secondary schools should be encouraged for STEM education as women are underrepresented in both STEM undergraduate degrees and STEM jobs, and have been consistently over the last decade (Beede, Julian, Langdon, McKittrick, Khan, & Doms, 2011) this contributes to skill shortage in STEM workforce.

Various studies demonstrate underrepresentation of women in STEM disciplines. The most common explanation is women demonstrate less interest in STEM topics. Hence, they are likely to turn towards Non-STEM disciplines like Arts and Humanities (Sassler, Glass, Levitte, & Michelmore, 2017). Female students have a more negative attitude towards science compared to males that starts at elementary school level (Unfried, Faber, & Wiebe, 2014). The gender gap increases as many girl students between the ages of 14 to 17 are not quite considerate about careers due to lack of awareness of going to STEM fields or take for granted that STEM is male dominated field and girls don't fit in. Therefore, women and girls experience stereotype threat (Spencer, Steele, & Quinn, 1999).

The gender distinction and gap in the vocational orientation of young students has been well recorded for years in the majority of OECD nations (OECD, 2006, 2012). The tenacity of gendered routes in career decisions has lately been demonstrated in the present Global Gender Gap Report of the World Economic Forum (WEF), which asserts that in the fields of education, health and welfare, men on an average have been inadequately represented, whereas in the field of STEM, women on an average have been inadequately represented (WEF, 2017, p.31). Moreover, on the basis of the occupational aspirations of 15-year-old adolescents, the prognosis for change in gender-based disparities in occupational and academic choices suggests that gender segregation in the education and labor market will remain persistent (OECD, 2017).

The existence of lateral gender inequality in educational and occupational fields adds substantially to the propagation of gender stereotypes regarding women's perfect match in more verbal and human-centered fields and men's sensible choice in scientific and math-intensive fields (Charles and Bradley, 2009). Gender norms are part of a larger belief structure that involves views on female and male functions in the family, female and male professions, and gender-related self-perceptions. Also, among students with good results in STEM subjects, traditional gender roles have a negative effect on students' STEM-specific self-concept, according to a recent analysis of female students in STEM subjects with a lower percentage of women (Ertl et al., 2017). An analysis of undergraduate science majors found that a higher gender-science stereotype reduces women's association with science and career aspirations in technical fields, while a greater gender-science stereotype increases men's affiliation with technology and career aspirations in technical fields (Cundiff et al., 2013).

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Changing the face of STEM

In this section we take a closer look at the experiences and motivation of Indian girl students studying in school(mentees) and Afghan girl students (mentors) majoring in Computer Studies who participated in a pilot project. A program designed to mentor secondary school girls and encourage them to learn computers and introduce career prospects for girls in the STEM workforce.

The project was based on following studies: (1) A study by The University of Michigan, motivating project-based learning: Sustaining the doing, supporting the learning that highlights a dynamic approach of teaching STEM subjects in which students come across real-world problems and simultaneously develops skills to solve problems while working in collaborative groups (Blumenfeld, Soloway, Marx, Krajcik, Guzdial, & Palincsar, 1991). (2) According to study by Lockwood, girls need a female role model or mentor to inspire and encourage as it reduces gender bias and negative stereotypes (Lockwood, 2006).

The participants were chosen such that girls from Afghanistan majoring in computer studies in India were mentors and role models to Indian schools' girls studying in class 8 in urban metro in India. Afghan girls were selected as mentors based on their voluntary participation in the project and they fit as role models as they have made their way through challenges in education (Burde, & Linden, 2013).

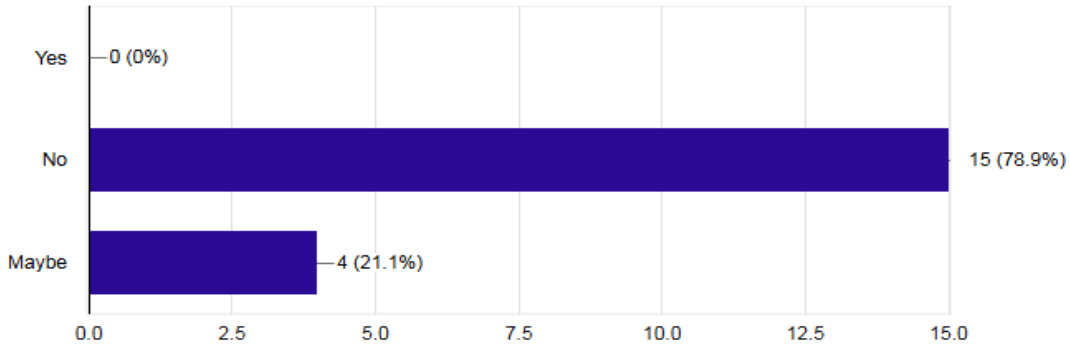
Each mentor headed a group a small group of mentee girls motivating them by their experience with computers and teaching them web development with a project as the outcome at the end of program.

After completion of the program survey was conducted and following results were recorded for responses by school girls

1. Did the program help you to understand more about computers?

All the students positively answered the question.

2. After completion of the project still you think computer coding is difficult?



78.9 % girls don't think computer coding is difficult

3. Have you considered computers as a career?

60 % girls do not consider computer as career

4. How was your interaction with Afghan sisters?

Students replied that their interaction with mentor sisters was friendly. Few stated that they were comfortable with them and were able to clear their doubts.

5. List 3 things that you have learnt from Afghan girls?

Majority of girls replied that they were confident in teaching hence; they learnt programming well and are confident that they can work on their own.

Conclusions

On the basis of the work done, the following conclusions were drawn:

To encourage girls to STEM education and ultimately in the STEM workforce, a mentor or role model plays a vital role in inspiring girls as they show relativity between STEM workforce and girls. We should push for more STEM related information to girls to develop a passion for these subjects.

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STEM has influenced everyone's life from smartphones to health-care services that are provided and innovation in STEM is the fuel for the future. Hence, K-12 schools should adopt project-based teaching and learning models so that students can relate and solve critical problems and develop STEM skills. Corporate sector and STEM education companies should collaborate with schools to develop programs for girls to motivate them to learn Math and Science in schools.

Girls' students should be introduced to Lego blocks, Computer based games, Goldy Blocks to develop spatial skills required in STEM education. Girls given a programming experience show higher technology interest and give a positive STEM experience (Master, Cheryan, Moscatelli, & Meltzoff, 2017).

Day after day, many women in STEM face a variety of challenges. Lack of ambition, insecurity, family problems, discriminatory behavior, and an overall lack of representation of females in positions of power and higher education continue to be structural failures. Women's involvement in STEM fields, on the other hand, is critical because diversity is an important factor in expansion and creativity.

Achia Khaleda Nila earned a bachelor's degree in computer science and engineering from United International University and a master's degree in computer science and engineering from Daffodil International University in Bangladesh. When she was in the second year of her undergraduation, she began working as a junior software engineer for a multinational IT firm. Throughout her undergraduate years, she was able to successfully balance both her studies and her office work. However, Nila encountered very few female CSE classmates, and she was always the only female student in the room.

In 2013, Nazia Tajrian Amin received her BSc in Avionics from the Military Institute of Science and Technology's Department of Aeronautical Engineering. She started working for Novo Air, a private airline firm, in 2014 as a senior CAMO engineer. Her key job responsibilities include, but are not confined to, aircraft maintenance data analysis, maintenance personnel, repair, and overhaul, handling aircrafts and aircraft parts, and analysing different plans to ensure that they are economically as well as technically feasible.

Students working in diverse environments have better thought processes as they are influenced by minority prospective (Antonio, Chang, Hakuta, Kenny, Levin, & Milem, 2004).

No subject is gender bias and young girls having dreams of pursuing STEM should not be ruined by gender inferiority complex.

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