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Empowering women through STEM education: A key driver of development

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This paper mainly focuses on the role of Science, Technology, Engineering and Math (STEM) education for empowering women to participate in development. It argues empowering women with knowledge, skills and self-confidence necessary to participate fully in development process. It can be attained through expansion of quality education of women especially STEM field. The study is conducted in qualitative approach based on document analysis. Secondary sources such as books, journal articles, media reports and official records are taken up to collect data required. The purpose of this paper is threefold. Firstly, it identifies the necessity of STEM education behind women empowerment in Bangladesh. Secondly, it examines how empowered women could play a significant role in helping the country's development. And finally, it analyzes what roles government play to ensure quality education of women. It suggests a set of measures to be taken in an effort to establish development through quality education of women in STEM field. The study findings may provide some new ideas and information by which policymakers, students and researchers of the social sciences can be enriched.

Keywords: Women empowerment, STEM education, Development, Quality education, Ideas and Information.

Introduction

Over the past 40 years, the United Nations has played a major role in championing gender equality and the empowerment of women through the declaration of the International Women's Year (1975), the UN Decade for women strategies for the advancement of women to the year 2000 (1985-2000), the Millennium Development Goals (2000-2015) and most recently Sustainable Development Goal 5, 'Achieve gender equality and empower all women and girls', launched in 2015.

Education is considered as one of the key drivers for human development. Following the promulgation of Sustainable Development Goals, almost every signatory countries of the United Nations have showed

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their readiness to meet the targets by 2030. Bangladesh is no exception to that. The issue of Science, Technology, Engineering and Mathematics (STEM) education become one of the concern policy area as part of its commitment to ensure gender equality and women empowerment.

In the last few decades, many national-level initiatives have sought to encourage girls and women to take up science, technology, engineering and math's (STEM) subjects. The 'Women in Science and Engineering' campaign in the UK, which has included engineering apprenticeship schemes working with target schools, scholarships for women studying engineering subjects, workshops about careers in construction and engineering for young women aged 15-22, and resources for teachers of STEM subjects in schools. Another example is 'Girls Who Code', a US-based organization working to encourage girls to pursue computer science-related careers. In 1984, 37%of computer science graduates in the US were women, but today that number has fallen to 18%. Their activities include summer schools embedded in technology companies, and a school clubs programs for girls in secondary school.

Organizations which aim to address this issue at the global level include the Organization for Women in Science in the Developing World (http://owsd.net/) and Women in Global Science and Technology (http://www.wisat.org/). A recent study jointly conducted by these organizations concluded that women remain severely under-represented in engineering, physics and computer science — less than 30% in most countries – while the numbers of women working in these fields are also declining (WISAT, 2012). UNESCO Institute for Statistics (UIS) has estimated that of the world's total science researchers, only 27 per cent are women. (UIS, 2006)

In Africa, Guinea has the lowest percentage of female science researchers (5.8 per cent), and also the lowest percentage out of all 118 countries included in the study. Only two African countries — Lesotho (55.7 per cent) and Cape Verde (52.3 per cent) — have achieved gender parity for science researchers.(UIS, 2010)

In Asia and the Pacific, Myanmar has the highest proportion of female researchers anywhere in the world (85.5 per cent). But only five other countries in the region — Georgia (52.7 per cent), Azerbaijan (52 per cent), the Philippines (52 per cent), Kazakhstan (51.3 per cent), and Thailand (50.3 per cent) — have achieved gender parity. Women scientists are most poorly represented in Japan (13 per cent), Bangladesh (14 per cent), India (14.8 per cent), Republic of Korea (14.9 per cent), and Nepal (15 per cent). (UIS, 2006, 2010)

Despite many such efforts by the UN and other internationals and local organizations, gender inequality and disparity in science and technology are

still very prevalent all over the world. Empowering women in science and technology is a challenging task and requires continued and collaborative efforts by the government, academic institutions and societies and industry.

Education is a milestone of women empowerment because it enables them to respond to the challenges, to confront their traditional role and change their life. It can only be attained through expansion of quality education especially in Science, Technology, Engineering and Math fields. A strong science and technology sector will alleviate poverty by promoting technological development, creating jobs, increasing agricultural and industrial productivity and improving health.

With women accounting for half of a country's potential talent base, empowering them yields one of the highest returns of all development investments. Therefore, a nation's competitiveness in the long term depends significantly on how it educates, trains and equips this half of the total base. Many countries made progression through education. These countries have given a high priority to science and technology education in formulating education policy. The population is required to provide science & technology based education with some revision of education policy in order to ensure the sustainable development.

In Bangladesh women education is a major cause of concern, as literacy rate of women is low- that is 69.9% (UIS, 2016). Their participation in work force is also very low. It shares 27%. Their representation in national parliament is also very low. Expansion of STEM education enables them to cultivate confidence and habits, and develop their right attitude to work and lead a life as good citizens. Empowering women with knowledge, skills and self-confidence is necessary to participate fully in development process.

Objectives

The main objective of this study is to investigate how does STEM education contributes in women empowerment by transforming them as human resources to meet the challenges of development. Following from this broad objectives, it also arises-

1. To understand the current state of STEM education in Bangladesh
2. To understand the factors responsible for the low interest in STEM fields of women.
3. To understand the engagement of women with development issues through the use of participatory and experiential education methodologies, either within or outside the formal education system.
4. To make a deep study of government policies for empowering women.

Methodology

This paper is based on qualitative method. The data are mostly secondary in nature which have been collected by reviewing books, scholarly journal articles and online media sources.

Literature Review

There are relatively scant of literature which explicitly discusses the nature and prospects of Stem education in Bangladesh.

A study by Smart & Rahman (2009) pointed out the barriers for female students to choose science, engineering and math as their main subject of study in the higher level. The author argued that women are disinterested to study hard subjects compared to their male counterparts. Even this tendency is much more influenced by their family decisions. The perception varies among new generation parents as they want their daughter to learn more science oriented subjects in order to catch up in the technology driven society.(Smart, S., & Rahman, J. (2009))

Choudhury (2014) in a report entitled Women in Science and Engineering in Bangladesh: status and future highlighted the correlation between science education and development. The author argued that the quality science education for women is equally important as for men and therefore, a sound policy and necessary steps should be taken by relevant stakeholders to upgrade the status of women in science and engineering education field. (Choudhury, S.K. (2014)

Devi (2017) described in his article that Indian women came out from the feudal and patriarchal tradition only through education and become financially self-reliant and consequently empowered. But still there are some social barriers that hinders women empowerment. Author suggests that there should be some changes in teaching method and curriculum free from gender bias. (Devi, K.J. (2017))

A study by Alam (2008) pointed out the importance of technical, technological and vocational program in education system for transforming population as a human resources. Bangladesh people needs to come out from traditional type of education and to be trained in modern professional-based and job-oriented technical, technological and vocational programs. But Bangladesh's government does not offer different educational programs in terms of population. (Alam, G. M. (2008))

Seddiky and Ara explain that to improve the quality of education and human resource development, Bangladesh government has started ICT in education system. Government provides computer in every schools with internet connections. Now student can participate on a topic discussions through tele- conference. Government transform education sector more transparent, accountable and time oriented through remarkable performance and publishing results, updating curriculum etc. But this paper does not explain specifically the participation of women in ITC by which they can be empowered. (Seddiky, M. A., & Ara, E. (2015))

Conceptual Clarification

Stem Education

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. (Gonzalez, (2012, August))

STEM education, "Science, Technology, Engineering, and Mathematics education programs are defined as those primarily intended to provide support for, or to strengthen, science, technology, engineering, or mathematics (STEM) education at the elementary and secondary through postgraduate levels, including adult education". (Brown J. , (2012))

Concept of Development

Thomas & Potter (1992), go on to argue that "All the definitions of development contain the central notion of change from a less desirable to a more desirable kind of society…development of what? How is what is desirable defined, and by whom? How is progression to be achieved?" (Thomas & Potter, 1992)

From the human needs perspectives, development is not only focus on economic growth as the primary indicator of development, but also give importance on the assessing the needs of individuals: their freedom, equity, participation and empowerment to fulfill their potential capabilities. (Thomas & Potter, 1992)

Education and National Development

Education is a key agent of development and a key agent of developing human capacity, increasing the skilled workforce for modernization, personal freedom and empowerment.

Education is a human right and should receive priority in the allocation of national resources. Education contributes to-

- Individual creativity, improved participation in the economic , social and cultural roles in society
- Improved understanding of an individual and their respect for others, thus promoting social cohesion and material understanding
- Improvement in health and nutrition
- Improved changes of economic development
- Improved technological development
- Socio-cultural change
- Democracy and equality
- Ecological development and quality of life (increasing people's awareness of their environment.

Concept of Governance

Governance has been defined to refer to structures and processes that are designed to ensure accountability, transparency, responsiveness, rule of law, stability, equity and inclusiveness, empowerment and broad-based participation. Governance also represents the norms, values and rules of the games through which public affairs are managed in a manner that is transparent, participatory, inclusive and responsive.

In a broader sense governance is about the culture and institutional environment in which citizens and stakeholders interact among themselves and participate in public affairs. It is more than the organs of the government.

The 2009 Global Monitoring Report sees governance as 'power relationships' formal and informal processes of formulating policies and allocating resources, 'process of decision-making' and 'mechanisms for holding governments accountable'.

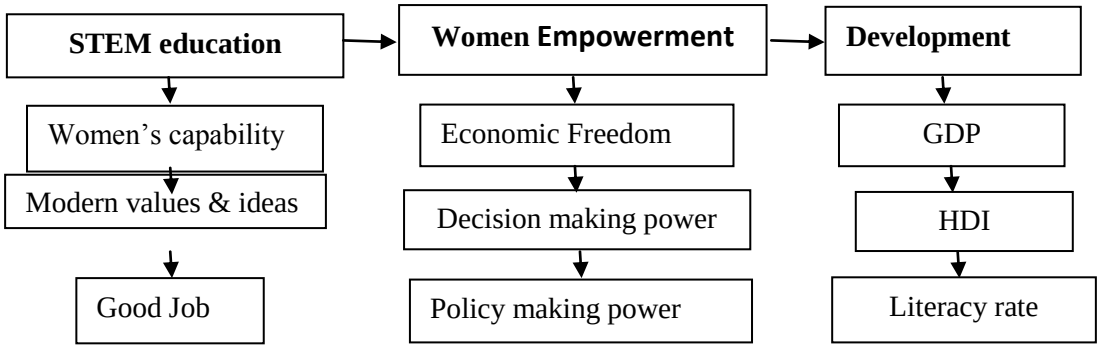
Women Empowerment

In the 1990s, development programs started to notice the role of women's empowerment in economic development and human development. The term women's empowerment was firstly defined by the United Nations after the 4th World Conference on Women: Action for Equality, Development and Peace in Beijing in 1995. The United Nations identified that women's empowerment has five components: women's sense of worth, their right to have and to determine choices, their right to access to opportunities and resources, their right to have the power control their own lives- both within and outside the home, and ability to influence the direction of social change to create a more just social and economic order, nationally and internationally (United Nations, 1995).

Empowerment is about ability: women's ability control individual health; the ability to control her life; and the ability to change the world. (Bradley, 1995)

Women empowerment can be defined as a process of achieving women's choices including decisions about their health and bodies, employment and political representation at all levels from individual to state.

Causal Framework of STEM education, women empowerment and development: Model



Analysis and Findings

The necessity of STEM education for national development

STEM education is a global concept that encompasses the process of critical thinking, analysis, and collaboration. In a world that is becoming increasingly complex, where success is driven not only by what you know, but also by what you can do with the knowledge, it is imperative for girls to be equipped with skills to solve tough problems, gather and evaluate evidence, and make sense of information. These are the types of skills that students learn through STEM education.

Science, Technology, Engineering and Mathematics are some of the key subjects to study now for the country to evolve the scientific and technological innovations needed to face the challenges of globalization and to build an evolving knowledge-based economy.

It's impossible to find a part of society that does not, in some way, interact with these subjects. Economy revolves around mathematics, medical research is fueled by the study of chemistry and biology, and environmental efforts like sustainable energy and nuclear power are also steeped in the sciences.

Through STEM education, women can help fill the growing IT skills gap while contributing to higher productivity activities and economy-wide competitiveness.

STEM education promote women's participation in decision-making process, and their decisions which take into account the needs of a wider segment of society, can lead to more inclusive policies and results.

Occupations in STEM related careers are some of the fastest growing and best paid of the 21st century.

Factors affecting low participation of women in STEM

- Currently, women and girls often self-select themselves out of STEM tracks.
- Government policy for higher education, Including affirmative action (more seats for women)
- The fee structure and scholarship incentives programs.
- Physical distance to educational institutions and the quality of education affect women to advance to higher education.
- Lack of support for women who want a career in STEM and raise a family.
- Lack of mentors and role models.
- Lack of trained teachers lack of female teachers.
- Inadequate school materials.

- School environments that are unfriendly to girls.
- Educational institutions do not offer many courses on STEM research methodology and support students research projects.
- Child trafficking

The real scenario of STEM education of women

Women participation in the science and technology is much lower than men. Marriage and childbirth are important factors that cause educated women to leave their jobs. Societal situations discourage women from continuing in science. Even for highly qualified women scientists, traditional roles pressure them to be responsible for the majority of household work. As women give up their research and careers, their talents go to waste.

The state of science education in schools and colleges in Bangladesh is far from satisfactory.

Enrolment of women (98.1%) in primary education in Bangladesh is higher than that of men (95.4%) and in secondary education 63.6% women compared to 51.6% men (UNDP, 2012). The enrolment of women increases as the education is free for women up to secondary level. However from high school to the highest academic positions, the representation of women in science declines substantially as shown in Table 1. Very few women enter the University for Higher Studies and a significant number drops out after HSC.

Table: 1. Women in science - academic ladder (Choudhury, 2010)

Stage	Students (%)	Teachers (%)
SSC	45	25
HSC	40	22
University	23	15

The percentage of female teachers of Dhaka University is significantly less.

Table: 2. Women Teachers of Dhaka University (DU annual report, 2014)

	Professor		Associate Professor		Assistant Professor		Lecturer	
Faculty	**Total**	**Women (%)**	**Total**	**Women (%)**	**Total**	**Women (%)**	**Total**	**Women (%)**
Science	72	19 (26.4)	26	4 (15.4)	29	4 (13.8)	30	7 (23.3)
Engg. Sc	34	3 (8.8)	19	3 (15.8)	29	5 (17.3)	32	7 (21.9)
Earth Sc	25	5 (20.0)	11	1 (9.1)	8	3 (37.5)	9	1 (11.1)
Bio Sc	108	29 (26.9)	27	12 (44.5)	38	15 (39.5)	40	21 (52.5)
Pharma cy	29	5 (17.3)	8	1 (12.5)	17	4 (23.5)	21	6 (28.6

The representation of women in different research organizations is not satisfactory.

Table: 3. Women scientists in different agricultural research organizations (Akter2007)

Organization	Total	Women (%)
BJRI	144	14 (9.7)
BARI	598	127(21.2)
BRRI	161	40(24.8)
BINA	105	11(10.4)

BJRI: Bangladesh Jute Research Institute; BARI: Bangladesh Agricultural Research Institute

BRRI: Bangladesh Rice Research Institute; Bangladesh Institute of Nuclear Agriculture

In higher academic and scientific leadership positions, women are substantially underrepresented. In the Bangladesh Academy of Sciences only 4 (6.7%) of the 56 fellows are women. At the top research or academic institutions, less than 1% of the top executive positions are occupied by women. There are only two female vice-chancellors and one female Pro vice-chancellor (among 37 public university and 80 private universities) even though there are many qualified and experienced women. (Choudhury, S. K; 2014)

Women scientists in leadership positions play a key role in increasing diversity of mentorship and perspective for planning and decision making. Also having female scientist in leadership positions such as deans, chancellors and academy members, as role models is also important for young women when they are making career choices.

Women role in development process

Through STEM education women's knowledge, attitudes, and skills will develop to identify questions and problems in life situations and draw evidence-based conclusions.

Education has a significant impact on development specially STEM education. There is a direct correlation between development of a country and its practice of science and technology. For this purpose, women - along with men - should be given ample opportunities to enter into and excel in science, technology, and related professions.

In Bangladesh more than 16.2 million women are directly involved in different economic sector. (BBS)

According to the Labor force survey of 2010- about 65 percent of women work in agriculture, close to 22 percent are in the service sectors, and 13.3 percent are in industry.

The biggest contribution of women is in the country's booming garment sector, where they account for more than 80 percent of the industry's 4 million workers.

Bangladeshi women's now are also making their mark through remittance income from abroad. In 1991, for instance, a parity 2,000 women went abroad annually as migrant workers. Nowadays their numbers exceed more than 300,000, accounting for 13 percent of the countries remittance sector, valued at around U.S $ 26 billion.

In spite of such recent achievements, Bangladesh is still a medium human developed country with HDI of 0.554 with a low Adult literacy rate (59%).

The advancement of women in many sectors is quite satisfactory but enhancement of woman's' participation in Science and Engineering is still far from satisfactory.

Government Policies

A number of initiatives have been taken in general to uplift women status and integrate their role in the development of the country. These initiatives are in terms of legislation as well as non-legislations. But no conscious effort has been made for the enhancement of women participation in science and engineering.

Bangladesh constitution and status of women:

The constitution of Bangladesh grants equal rights to women and men in all spheres of public life.

According to Article 27 of the constitution states that-All citizens are equal before law and are entitled to equal protection of law.

Article 28 of the Constitution of the People's Republic of Bangladesh

"i. The state shall not discriminate any citizen on grounds only of religion, race, caste, sex or place of birth

ii. Women shall have equal rights with men in all spheres of state and of public life.

iii. No citizen shall, on grounds only of religion, race, caste, or place of birth be subjected to any disability, liability, restriction or condition with regards to access to any place of public entertainment or resort or admission to any educational institutions.

iv. Nothing of this article shall prevent the state from making special provision in favor of women or children or for the advancement of any background section of citizen.''

Article 29(1) states that –No citizen shall, on ground of …sex... be ineligible for, or discriminated against in repent of any employment or office in the service of the republic.

National Women's Development Policy, 2011

To establish equal rights for men and women in areas of state and public life in the light of the Constitution of Bangladesh, the government has formulated the National Women Development Policy. The policy aims to ensure full and equal participation of women in the mainstream socioeconomic development; to bring up women as educated and skilled human resources; to recognize appropriately women's contribution in socio-economic spheres; to innovate and import technology favoring the interest of women and discourage those act against the interest of the women and to provide support services essential for the development of women. Quota system has been introduced to empower women.

According to article 21.2 of NWDP 2011-"To continue all out efforts to eliminate illiteracy of the women and in particular, to give utmost importance to educate and train the female children and women in technical, technological and scientific pursuits."

Primary education is compulsory and free for all children aged between 6to10. All children attending primary and secondary schools receive textbooks free of cost. The education of girls up to grade X11 in public institution is also free. To encourage girl students to continue their students and also to reduce drop-out rates, stipends are awarded.

National Science and Technology Policy, 2011

The government adopted a new science and technology policy in 2011. The policy has taken into account the present situation of women in science and scientific professions. An action in this regard plan has been formulated for the implementation of the NCST Policy 2011. Pro-women activities of the action plan are mentioned below:

- Providing special incentives to women's professions in research and development (R&D)
- Ensuring participation and empowerment of women in all areas of science and technological education and research.
- Providing opportunities to women in higher studies, research and fellowship under NST (National Science and Technology) fellowship programs.
- Encouraging female students of school/college and members of science club to get involved in innovative activities organized by: National Museum of Science and Technology on science seminars every year on World Science Day.

Recommendations

There should be made some organized efforts for increasing the involvement of female in STEM education.

- Stem education should be compulsory from primary to graduate study in our education system.
- Social barriers, gender bias should be removed from society and created such an environment in which women feel comfortable and take part easily in science and technology.
- Policy makers should implement such policies that support the role of women in science and technology.
- Women should give support to develop academic and professional career and fulfill their potential.

Conclusion

Promoting increased participation of women in science and technology is highly essential for changing of attitudes from the family to the policy making at national and international level. Science's role in improving quality of life is now more prominent than ever. According to the UN Education, Scientific and Cultural Organization (UNESCO), active inclusion and participation of women in science is crucial in countries' efforts to alleviate poverty. STEM education enables women not only to find out the problems but also give them strength to solve the problem in a logical way. To progress well in the face of increasing global competition, it is essential to provide modern up-to-date science and technological knowledge to women. A well-organized STEM program for women may help Bangladesh to improve its economic growth. So the country urgently needs to take substantial steps if it wants to develop herself.

References

Alam, G. M. (2008). The role of technical and vocational education in the national development of Bangladesh. Asia-Pacific Journal of cooperative education, 9(1), 25-44.

Akter, N. "Role of women scientists in Bangladesh jute sector"(2007), http://www.jute.org/Documents_Seminar_Workshop_Meeting/gender_workshop/07DR.%20NArgis%20Akter,%20Role%20of%20Women%20in%20Bangladesh%20Jute%20Sector.pdf

BBS (Bangladesh Bureau of Statistics), (2008),"Gender Statistics of Bangladesh", pdf, p123-168., http://www.bbs.gov.bd/dataindex/statisticsbook.pdf

Bangladesh Bureau of Educational Information and Statistics (BANBEIS) http://www.banbeis.gov.bd/

Brown, J. (2012). The current status of STEM education research. Journal of STEM Education: Innovations and Research, 13(5), 7.

Bradley, C. (1995). Women's Empowerment and Fertility Kenya. In S. Greenhalgh(Ed.), Situating Fertility. Demographic Inquiry, Cambridge, (157-178)

Bybee, R. W. (2013). The case for STEM education: Challenges and opportunities. National Science Teachers Association.

Choudhury, S.K. (2014). Women in Science and Engineering in Bangladesh-Status and Future. Final ASSAA report, Panmun Education Co., Ltd, Korea, 51-66

Choudhury,Shamima K (2010), "Gender participation in the Development of Science", Invited talk in TWOWS Fourth General Assembly and International Conference- Women Scientists in a changing world; Beijing, China , "Regional Perspectives on the IAC's Women for Science Report: Recommendations for Global Network of Science Academies", 28 June 2010.

Dhaka University Annual report, 2013-2014, University of Dhaka, Dhaka, Bangladesh.

Devi, K.J. (2017) Women empowerment Through Education. Journal, of English Studies International Research, 5(1), 127-130

Gonzalez, H. B., & Kuenzi, J. J. (2012, August). Science, technology, engineering, and mathematics (STEM) education: A primer. Congressional Research Service, Library of Congress.

Seddiky, M. A., & Ara, E. (2015). Application Of E-Governance In Education Sector To Enhance The Quality Of Education And Human Resource Development In Bangladesh. European Scientific Journal, Esj, 11(4).

Smart, S., & Rahman, J. (2009). Bangladeshi girls choosing science, technology, engineering and math. Report by London East Thames Gateway Aimhigher and CfBT Education Trust.

Thomas, A, Potter, D & Allen, T. (1992). Development, capitalism and the nation state: Poverty and development in the 1990s. Milton, Keynes: Open University Press, 18

UNDP, Human Development Report-Bangladesh(2014) pdf, http://hdr.undp.org/sites/all/themes/hdr_theme/country-notes/BGD.pdf

http://uis.unesco.org/en/country/BD

WISAT (2012) National Assessments on Gender Equality in the Knowledge Society: gender in science, technology and innovation (Ontario: Women in Global Science and Technology).