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Challenges and Prospects of STEM Education for Girls in Bangladesh from Primary to Higher Secondary Levels

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Abstract

STEM education plays a critical role in fostering innovation and driving economic development in Bangladesh. Ensuring gender equity in STEM from early education is essential for building a skilled and competitive workforce in the 21st century. However, girls encounter numerous obstacles in accessing STEM education across all academic levels. This study investigates the perceptions of female students, parents, educators, and policymakers concerning the challenges, opportunities, and roles of girls in STEM. Identified barriers include pervasive gender stereotypes, restrictive social norms, inadequate infrastructure, and lack of female role models, early marriage, and weak policy implementation. Nonetheless, interventions such as government scholarships, NGO-led programs, awareness campaigns, and teacher training initiatives are working to enhance female participation. Employing a mixed-methods approach, data were collected from 60 students, 40 parents, 20 teachers, and 5 policymakers in both rural and urban settings through surveys, interviews, and focus group discussions, supplemented by secondary data analysis.

Keywords: Equality, STEM, challenges, infrastructure, technology.

Introduction:

Around the world, governments have implemented revolutionary changes in nearly every sector, including education, to keep up with the increasingly fast-paced global economy. A significant emphasis on STEM education has been placed on developing the human capital that powers economic expansion. Citizens who receive a STEM education become literate in math, science, and technology. Additionally, it encourages the holistic development of fundamental skills and their efficient application to the advancement of both the individual and society (Munir & Shams, 2020).

The topic of women in STEM is widely discussed worldwide, with the main goal of finding ways to boost the participation of women in these fields. Across the globe, STEM education often sees a decline in the number of young female students as they progress in their studies and careers. This trend persists across countries and societies, regardless of their levels of economic development and gender equality (Ahmed et al., 2020). Bangladesh, whose economy is among the fastest growing in the world, wants to reach middle-income status by 2021 and high-income status by 2041 (Siddique, 2019). It is only through the effective implementation of STEM concepts in the classroom that teachers can fully realize the potential of STEM (Farhana et al., 2023).

The number of female pupils enrolling in Bangladeshi schools has been steadily increasing in recent years. Nevertheless, capital-focused development and inadequate educational resources are unable to provide them with a high-quality education. Ensuring STEM education for the next generation is one of the crucial issues that must be resolved if we are to meet the Sustainable Development Goals of the United Nations by 2030 and turn our nation into a high-income nation by 2041. At present, Bangladesh has the lowest percentage of female stakeholders in STEM at 14%, which is the lowest in South Asia **(**Ahmed et al., 2020).

In this context, to secure a sustainable future, Bangladesh must recognize STEM as a crucial driver of progress. The country needs more scientists and innovators, and quality STEM education is essential to achieving this goal. Strengthening girls' education in STEM subjects is particularly important, as it will not only boost their active involvement in STEM fields but also help improve the challenging conditions in STEM-related industries. Increased participation of women in STEM can lead to economic advancement for themselves and their families, ultimately contributing to the growth of Bangladesh's economy.

Significance of the study:

Learning to live and uncover the truth, broadening one's perspective on life and the world, and gaining useful knowledge are all components of education. Technology is the process of putting knowledge into practice, utilizing matter, energy, and natural phenomena as resources to solve issues for people and improve their quality of life. Thus, education is essential to the advancement of civilization. With the advent of information and communication technology (ICT), the globe has become a global village (Sulai & Sulai, 2020).

Particularly in the area of science, technology, engineering, and mathematics (STEM), general education is undergoing significant transformation. New paradigms and ways to teaching are necessary as a result of changes, particularly when implementing new technologies. In the field of education, numerous innovative shifts have been made *(*Aberšek & Aberšek, 2016). The government of Bangladesh plans to use technology innovation and human capital investment to reach the Sustainable Development Goals of the UN by 2030 and turn the nation into a high-income nation by 2041. In order to comprehend the significance of STEM fields for the workforce of the future, it is imperative that we acknowledge the enormous job-creation potential offered by the latest technology revolution. According to study, there will definitely be a lot of job losses, but there will also be a lot of new opportunities that require new abilities. Therefore, the technical abilities related to STEM fields are essential for both gaining existing jobs and developing the transferable skills that are the foundation of innovation—skills that will become even more important for Bangladesh's workforce in the future. According to predictions made by the World Economic Forum's Center for the New Economy and Society, digital skills and technology will be essential for the majority of jobs that are in demand worldwide (Siddique,2019). Bangladesh's economy, which is among the fastest-growing in the world, requires an integrated approach to STEM education from elementary school through university education (Munir & Shams, 2020). Under such circumstances, STEM education ought to be implemented in elementary schools in order to cultivate students' understanding and perception of the subject from an early age.

Statement of Research Problem:

In Bangladesh, the percentage of female in STEM fields is very low among the South Asia countries. Moreover, there is still gender disparity in this sector from the very early stages. Bangladesh's current STEM education program has a poor infrastructure and takes little steps to integrate STEM areas. Although the government has taken initiatives like making Information and Technology courses mandatory for secondary school students, however, the effectiveness raises questions due to the lack of lab facilities in rural and isolated locations. Student dropout rates are the main factor influencing education at the tertiary level. Numerous sociocultural issues are also relevant in this instance (Munir & Shams, 2020).

Bangladesh thus experiences two stages of female dropout rates. In the first stage, after receiving their high school certificate, the majority of female students marry off and stop their education. These women deal with early childbirth, child marriage, and family financial difficulties. They frequently experience domestic violence at home as a result of their lack of voice. On the other hand, the dropout rate for female graduates is primarily related to concerns about marriage, family outlook, and the prevalent male domination in the workplace. These are the explanations for why a lot of women decide against pursuing a high-achieving career that requires concrete passion **(**Ahmed et al.,2020).

In Bangladesh, most of the low to middle-income families still frequently hesitate to invest money for their daughters' higher education. The frequent changes in education policy in the country often focus on a more theoretical aspect of education. The way STEM disciplines are taught in primary and secondary education today is the same as how social science or the arts are taught (Munir & Shams, 2020). Development of human resources is a priority for the Government of Bangladesh (GoB), that is why the education sector has seen a number of initiatives. Despite the significant scope of STEM education, its implementation at the classroom level was unsuccessful for a variety of reasons, including insufficient training, a lack of qualified STEM instructors, a lack of funding for teachers' professional development, a lack of collaboration on STEM-related research, etc **(**Farhana et al.,2023).

Literature Review:

This section discusses the previous studies which explicitly explains the challenges and prospects of STEM education for women in Bangladesh.

An individual can become self-reliant by using mathematics as an excellent instrument to acquire lifelong abilities. According to FRN (2013), mathematics is a crucial component of the Nigerian curriculum. Because of its importance in the country's development, the Federal Government of Nigeria made it a mandatory subject in primary and secondary schools, and passing it is a prerequisite for pursuing higher education (Sulai & Sulai, 2020).

In their work, Munir & Shams (2020) and Siddique (2019) explored the perspectives and obstacles to educational opportunities for rural girls in Bangladesh across three levels: societal, institutional, and individual. At the individual level, it was found that although girls are confident and interested in STEM subjects, poor teacher quality and infrastructural issues hinder their ability to thrive. At the institutional level, teachers often lack motivation and support, while school administrators have limited power to improve conditions within an unstable environment. At the societal level, economic hardships, safety concerns, and cultural norms, both at home and within the community, act as significant barriers to girls' full participation in STEM education. The survey's concerning conclusion is that female university students lack confidence in their technological skills in an age of rapid technological growth. Therefore,

the survey's findings suggest that, with the appealing and a demanding curriculum of STEM education program may attract to pupils. (Munir & Shams, 2020).

The Mathematics Olympiad, a well-known STEM competition across the country, demonstrates gender inequality, especially when it comes to young female pupils going through puberty. Nonetheless, a key conclusion of our research is the importance of young women's emotional and physical safety, as well as the prevalence of sexual harassment in the classroom, which has a big influence on young students. According to data on mathematics Olympiad participation over the past nine years, female students' involvement has decreased from elementary to junior, intermediate, and upper secondary levels. The main obstacles noted include a lack of institutional support, family constraints, individual limits in juggling academic coursework and additional practice sessions for advanced mathematics, and cultural impediments related to unspoken concerns like sexual harassment. The study suggest that a well-designed supportive environment can increase the number of female participants in the STEM field. According to the study, more women can choose STEM field if a supportive environment is well-designed **(**Ahmed et al., 2020).

This study seeks to explore primary school teachers' perceptions of STEM education and the challenges they face in implementing it. The findings reveal several barriers, including a high teacher-to-student ratio, limited time for lesson preparation, insufficient teaching aids and short class durations, inadequate school and classroom infrastructure, teachers' attitudes and mindsets, as well as a lack of resources and financial support—all of which hinder the effective implementation of STEM and activity-based teaching methods. Additionally, it was shown that instructors with scientific degrees and those from metropolitan regions were somewhat more self-assured and technologically proficient. The socioeconomic status of students influences their decision to pursue a career in STEM **(**Farhana et al.,2023).

While learning from the relevant studies, this study attempts to fill the gap by examining the role of STEM education for girls from the primary level.

Objectives:

The main aim of this study is to investigate the perceptions of students, teachers, parents and policy makers about integrated STEM education for girls and how policy makers bring these issues in policy agendas to ensure quality education. Following from this aim, the objectives of the study are mentioned below.

1. To find out the challenges of girls STEM education for implementation from primary to higher secondary level in Bangladesh
2. To understand the prospects for the engagement of girls with STEM in country's development.

Research Questions:

To address these objectives, the following research questions are selected:

a) What are the perceptions of students, teachers, parents and policy makers about integrated STEM education for girls?
b) What are the challenges in integrating the STEM approach to ensure quality education for girls from the primary to higher secondary level?

Research Method:

This is in fact a mix method research. Data was gathered from both primary and secondary sources. 3 rural schools and college from the Gazipur districts and 3 urban schools and college from the Dhaka districts

have been selected for this study. 30 girls, 20 parents 10 teachers from urban areas and 30 girls, 20 parents 10 teachers from rural areas have been selected from primary, secondary and higher secondary level respectively with a divers demographic background, ensuring representation from different socioeconomic status . The name of the schools from urban areas are Nobokumar Institution and Dr. Shahidullah College, Azimpur Govt. Girls School and College. The name of the rural schools are Shaheed Smrity High Schoo, Joydebpur, Gazipur and Kaligonj Govt. Girls High School and College. 5 officials from the Directorate of Secondary & Higher Secondary have been selected for interview who are working in Planning and Development wings to develop new project and study proposal on new ideas of education and assist to implement government perspective plan. The respondents had been selected by applying purposive sampling method. Secondary data were collected from different relevant publications, books, journals, newspaper, website etc.

Data Collection:

Multiple data collection methods were employed.

Methods	Dhaka	Gazipur	Directorate of Secondary & Higher Secondary	Respondents	Total
Survey	30+20	30+20		Girls and Parents	100
Focused Group Discussion	10	10		Teachers	20
In depth Interview			5	Officials	05
Total					125

A **survey method** was followed from rural and urban schools of primary, secondary and higher secondary level respectively based on survey questions to understand the factors like ideas and knowledge of STEM, carrier plan, challenges and prospects of girls in STEM education. Participants for this study will be selected from the 30 girl's students and 20 parents from urban areas and 30 girls and 20 parents from rural areas by applying a systematic random sampling method where there is an equal chance (probability) of selecting each girls of STEM education, teachers, and parents from within the population when creating the sample.

A focused group discussion involving 10 teachers from urban and 10 teachers from rural conducted to understand their teaching techniques, institutional facilities, training as well as responsibilities discussed within the educational environment.

In-depth interview involving policy makers conducted to gain different perspectives and insights related to STEM education for girls, their experiences and suggestions for improvement. Interviews were carried out via audio and video calls. All participants provided explicit consent to be recorded for research purposes, although they strictly insisted on keeping their identities confidential. The interviews were conducted primarily in Bengali, then transcribed and translated into English.

Data Analysis:

Data collected through various methods was rigorously analyzed and carefully integrated to gain a comprehensive understanding of the establishment and implementation of STEM education for girls within the educational institutions from primary to higher secondary level.

Statistical analysis of survey data to identify trends and correlations was analysed about their challenges like individual awareness, family support and institutional facilities over the times from primary to higher secondary level.

Data collected in the focused group discussion and in-depth interview was subjected to **thematic content analysis** to identify recurring themes and underlying patterns in participants' narratives.

Findings:

Part 1:

Survey Questionnaire: To conduct this study I have taken 60 girls students half from rural and half from urban to collect information through survey questionnaire. A semi-structured questionnaire carrying 20 questions has been developed for data collection. The questionnaire was mainly divided into parts, 1) Interest, and extra-curricular activities 2) Role models, 3) Challenges, 4) Recommendations, and 5) Future aspirations. To make the study more inclusive, I have also taken 40 parents from rural and urban areas through a semi-structured survey questionnaire consist of 21 questions and it was divided into two parts 1) Awareness, and challenges, 2) Encouragement and future plan.

Girl's student's interest, challenges, future plan and recommendation about STEM: To understand student's idea about STEM, this section has been divided into several category of questions.

Table 1: Interest, and extra-curricular activities

Particulars	Education Level					School Type	
	Primary	Secondary	High School	College	Sub Total	Public	Private
Interest in STEM Urban areas							
Very high				2	2	4	
High	6	6	4	8	24(80%)	10	14
Neutral			2		2	2	
Low			2		2	2	
Very Low							
Total					30		
Interest in STEM rural areas							
Very high							
High							
Neutral	4	10		10	24(80%)	14	10
Low			6		6(20%)		6

Very Low							
Total					30		
Access to extra-curricular activities in urban areas							
Yes	6	6	4	10	26(87%)	12	14
No			4		4(13%)	4	
Total					30		
Access to extra-curricular activities in rural areas							
Yes				4	4(13%)	4	
No	4	10	6	6	26(87%)	8	18
Total					30		

The results show that girls in urban regions are more interested than those in rural ones. About 80% of females in cities express a strong interest in STEM, whereas the same percentage of girls in rural regions express no interest. In remote regions, out of 30 students, 6 high school females from private schools have little interest in STEM, and 2 high school girls from public schools have the same lack of interest. In metropolitan regions, 87% of respondents said they have access to extracurricular STEM activities at school. Surprisingly, the opposite situation has been observed in rural locations, where 87% of respondents claimed to have no access to their school, of which 18 are private.

Table 2: Challenges

Particulars	Education Level					School Type	
	Primary	Secondary	High School	College	Sub Total	Public	Private
Faced Challenges in Urban areas							
Yes	2		8	4	**14(47%)**	12	2
No	4	6		6	16(53%)	2	14
Total					30		
Name of the challenges							
Lack of resources			4	2	6 (43%)	6	
Gender bias							
Stereotypes							

Lack of encouragement				2	2(14%)	2	
Difficulty understanding the materials	2		4		6(43%)	4	2
Total					**14**		
Faced Challenges in Rural areas							
Yes	4	10	6	10	30	12	18
No							
Total					30		
Name of the challenges							
Lack of resources		4			4(13%)		4
Gender bias							
Stereotypes							
Lack of encouragement	4	4		2	10(33%)	4	6
Difficulty understanding the materials		6	2	8	16(53%)	8	8
Total					30		

According to the questionnaire survey results, all of the rural respondents found it difficult to pursue STEM education, primarily at private school and college. In urban areas, 14 out of 30 girls encountered difficulties, primarily from public schools. Challenges reported by respondents can be categorized into five groups. The five issues are listed in the following order from the most frequently complained: 1) Difficulty understanding the materials, 2) Lack of encouragement, 3) Lack of resources, 4) Gender bias and 5) Stereotypes. In metropolitan regions, 47% of females reported having difficulties, the majority of which were from public institutions, while 53% reported having no difficulties, with 14 attending private schools. The most frequent challenges among girls are a lack of resources and trouble understanding the STEM content, which account for 86% of shared equal percentages. Furthermore, 14% of respondents stated that one of the difficulties facing girls' STEM education is a lack of support from parents and instructors. The most frequent issue raised by respondents in rural regions is their inability to comprehend the content. 8 college students, 2 high school students, and 6 secondary pupils from both public and private schools agree that they struggle to comprehend STEM-related terminology. 10 out of the 30 girls think that one of the problems in rural regions is the lack of support from instructors and family. 4 secondary school students attending private schools stated that one of the biggest problems in rural regions is a lack of resources.

Table 3: Role models

Particulars	Education Level					School Type	
	Primary	Secondary	High School	College	Sub Total	Public	Private
Role Models in Urban areas							
Yes	6	6	6	10	**28**(93%)	14	14
No			2		2(7%)	2	
Total					30		
Types of Role models							
Family	4	2	2	2	10(36%)	4	6
Teachers			2	2	4(14%)	4	
Scientist	2	4	2	4	12(43%)	6	6
Peers				2	2(7%)	2	
Total					**28**		
Role Models in rural areas							
Yes	4	6	4	8	**22**(73%)	10	12
No		4	2	2	8(27%)	2	6
Total					30		
Types of Role models							
Family	4		2	4	10(45%)	4	6
Teachers		6	2	4	12(55%)	6	6
Scientist							
Peers							
Total					**22**		

Respondents identified four categories of role models: classmates, instructors, scientists, and family. When asked if they had any STEM role models in their lives, 28 out of 30 girls in urban regions and 22 out of 30 girls in rural areas answered that they did. Scientists make up 40% of the most favored role models for girls in metropolitan regions. Female scientists serve as role models for two primary school pupils, four secondary school students, two high school students, and four college students. The most intriguing finding is that females from both public and private schools chose scientists as their role models in similar numbers. Out of the four categories of role models, teachers are the most desired in rural regions, with families being the only other choice. Of the 30 students in rural areas, 27% of the females reported having no role models.

Table 4: Future aspirations

Particulars	Teaching Level					School type	
	Primary	Secondary	High School	College	Sub Total	Public	Private
Pursue a career in STEM (Urban areas)							
Yes	6	6	8	8	28(93 %)	14	14
No							
Undecided				2	2(7%)		2
Total					30		
What motivates you							
Passion for the subjects	4	4	2	4	14(47 %)	6	8
Job opportunities			2	2	4(13%)	4	
Potential salary			4		4(13%)	4	
Desire to make a difference		2		2	4(13%)	2	2
Influence of role models	2			2	4(13%)		4
others							
Total					30		
Pursue a career in STEM (Rural areas)							
Yes	4	10	6	10	30	12	18
No							
Total					30		
What motivates you							
Passion for the subjects	2	4			6(20%)	2	4
Job opportunities		6	6	2	14(47 %)	2	12
Potential salary	2			4	6(20%)	6	
Desire to make a difference				4	4(13%)	2	2
Influence of role models							
others							
Total					30		

It is interesting that all of the girls from rural regions expressed a desire to pursue a career in STEM when asked about their future plans. According to 47% of the females in rural regions, STEM-related job prospects encourage them to pursue careers in the sector. 12 of the 14 students who attended private

schools desired to continue their education because of the greater job prospects. The other two choices, which account for the same amount of proportion of 20% in the STEM job choice, are passion for the subjects and potential salary. While 7% of females in metropolitan areas who attend the same number of public and private schools have not made a decision, 93% of them have plans in STEM-related fields. Two females are motivated by the employment prospects in STEM fields even if they have not chosen to pursue a career in these fields. In metropolitan locations, about 47% of females are passionate about STEM topics and want to pursue careers in the field. It indicates that urban females genuinely enjoy and are passionate about STEM disciplines. Nonetheless, it was comparable that 4 college students in rural regions and 2 secondary school students in metropolitan places wished to make a differences these sectors, which are still dominated by men.

Table 5: Suggestions

Particulars	Education Level					School Type	
	Primary	Secondary	High School	College	Sub Total	Public	Private
How to improve in Urban areas							
More female role models							
Better resources and facilities		2	5	2	10(33%)	8	2
Gender sensitive curriculum			2		2(7%)	2	
Encouragement from teachers and parents	4	4		8	16(53%)	4	12
More extracurricular activities	2				2(7%)	2	
Awareness campaign							
Scholarships and financial aid							
Total					30		
How to improve in Rural areas							
More female role models		2			2(7%)		2
Better resources and facilities	2		4		6(20%)		6
Gender sensitive curriculum							
Encouragement from teachers and parents	2	2	2	4	10(33%)	6	4
More extracurricular activities		4			4(13%)	2	2
Awareness campaign		2		4	6(20%)	2	4

Scholarships and financial aid				2	2(7%)	2	
Total					30		

According to the recommendations made by females in both rural and urban regions, parental and teacher support ranks highest (33% and 53%, respectively). Improved facilities and resources as well as awareness campaigns rank second in rural regions with 20% of the respondents respectively. Only 2 public high school girls in metropolitan regions proposed a gender-sensitive STEM curriculum however, in rural areas, they did not mention this option because they are less curriculum-conscious. According to two public school primary students more extracurricular activities can inspire girls to pursue STEM. Since STEM is more expensive than other topics, 7% of girls attending public colleges in remote regions stated that financial aid and scholarships enable them to pursue their interest in the field.

Parent's perceptions about awareness, challenges, and encouragement techniques in STEM: To understand parents' observation how they are conscious about girls STEM education, what kind of challenges girls faced and finally how they motivate their daughter to study and focused in STEM.

Table 6: Awareness, and challenges of parents towards girl child

Particulars	Education					Main job		
	Post-graduate	Graduate	Higher secondary	Secondary	Sub total	Service holder	Businessman	Housewife
Awareness Urban areas								
Very high		2			2(10 %)			2
High	4		6	4	14(70 %)	8	2	4
Neutral			2	2	4(20 %)	2	2	
Low								
Very low								
Total					20	10	4	6
Challenges Urban areas								
Gender bias			2	2	4(20 %)			4
Lack of female role models			2	2	4(20 %)	4		
Insufficient resources	4	2	2		8(40 %)	4	2	2

Lack of encouragement from teachers			2	2	4(20 %)	2	2	
Difficulty of subjects								
others								
Total					20	10	4	6
Awareness rural areas								
Very high								
High		2			2(10 %)	2		
Neutral			4	8	12(60 %)	4	2	8
Low			3	3	6(30 %)		2	2
Very low								
Total					20	6	4	10
Challenges rural areas								
Gender bias								
Lack of female role models								
Insufficient resources		2	4	4	10(50 %)	2	2	6
Lack of encouragement from teachers			2	2	4(20 %)	2		2
Difficulty of subjects			1	5	6(30 %)	2	2	2
others								
Total					20	6	4	10

Several questions have been asked to find out how parents feel about their knowledge, thoughts, and plans for their daughter's future in STEM disciplines. 10 civil services, 4 business owners, and 6 housewives make up the 20 parents in metropolitan regions. At 70%, the largest number of them are well aware of STEM. 2 women with graduate degrees are extremely concerned about their daughters in STEM. About 20% of parents hold no opinion about STEM awareness. Two of them are service members, and two of them are businessman. 10 housewives, 4 business owners, and 6 service holders make up the 20 parents in remote locations. 2 parents who are service holder responded highly conscious while the highest number of them are in neutral positions. From every profession, they responded their positions in neutral about STEM. It is clear from the data that in both urban and rural areas from every profession and every

education level, everyone told that lack of sufficient resources is the main challenges for girls in STEM subjects. In urban and rural areas the percentages are 40% and 50% respectively. So it is clear that in schools, there is no sufficient resources like equipment, materials, and qualified teachers to adequately serve their children. In urban, gender biases, lack of female role models and encouragement from teachers showed the similar amount of challenges around 20%. Difficulty of subjects is another main challenges in rural areas account for around 30% of the total while no parents responded this option in urban areas. It may be, in urban, parents and teachers are quite conscious about girls education compare to rural areas.

Table 7: Encouragement of parents towards girl child

Particulars	Education					Main job		
	Post-graduate	Graduate	Higher secondary	Secondary	Sub Total	Service holder	Business	Housewife
How to encourage girls interest in STEM urban areas								
Discuss Stem topics at home	2	4		2	8(40%)	6		2
Provide Stem related toys and games			2		2(10%)		2	
Enroll her in Stem extracurricular activities		2			2(10%)	2		
Encourage her to take advanced courses	2	2	2		6(30%)	2	2	2
Introduced her to female role models				2	2(10%)			2
Doing nothing								
Total					20	10	4	6
How to encourage girls interest in STEM rural areas								

Discuss Stem topics at home		2			2(10%)	2		
Provide Stem related toys and games				2	2(10%)		1	1
Enroll her to take advanced courses			2		2(10%)	2		
Encourage her in Stem extracurricular activities			4	6	10(50%)	2	2	6
Introduced her to female role models			1	1	2(10%)		1	1
Doing nothing				2	2(10%)			2
Total					20	6	4	10

In response to the question of how to encourage girl's interest in STEM, around 40% of parents consists of 6 service holder and 2 housewife in urban areas encourage girl's interest in STEM by having conversations about the subject at home. Only 2 businessmen of higher secondary education level provided STEM related toys and games to their child to encourage in this field. More interestingly, parents from every profession support their daughters' enrollment in advanced courses and the percentage is 30%. Only two housewives who completed higher secondary, they tried to introduce female role models to their girls so that they can be encouraged. In rural areas, most of the parents across all profession around 50% responded that they encourage girl's child to join in STEM extracurricular activities. Only 2 graduate of service holder discuss different Stem related topics with their child at home. 1 housewife and 1 businessman of higher secondary and secondary believe that introduce girls with female role models encourage them to be interest in STEM. It is shocking that 2 housewives of secondary education level told that they don't take any action to support their child's interest in STEM. They might not be fully aware of topics connected to science and technology.

Part 2:

Focused Group Discussion: Based on the FGD of urban and rural teachers, this section will analyses how they perceive the importance of STEM, their techniques in class room and also the challenges they face and finally suggest how to improve the present scenario of STEM education for girls.

Awareness and Perceptions: Teachers in urban areas from all levels are highly concious about the importance of STEM education for girls despite their teaching experiences. They believe that STEM education is equally important for girls as it is for boys. One of the teachers named Zakia Sultana told that

"In today's world STEM education for girls benefits them not only better career opportunities but also increases their creativity and innovation."

It's even more intriguing to note teachers from rural areas are really sincere about the importance of STEM education for girls. A math teacher of primary with 2 years' experience of teaching told that STEM education ensure higher earning potentials among girls. Similarly, Rimi Khatun a college teacher from urban areas of 10 years teaching experience stated that "STEM education helps girls to improve problem solving skills and enhance critical thinking."

Teaching practices and support: Nearly all urban teachers have employed certain strategies to get girls interested in STEM topics in the classroom. A high school teacher of 2 years experienced told that "I have used some inclusive teaching materials, providing hands-on activities and also encouraging them to participate in STEM extracurricular activities. In addition, I constantly incorporate real-world STEM applications into my lessons to help students relate to the material.

There are certain differences in perception in rural places. Teachers expressed that schools don't provide adequate support for girls in pursuing STEM education. "I don't find any support from school to engage girls however I always offered additional support and highlight female role models in STEM to encourage them. I think we should need more STEM resources for girls" said Nigar Sultan Bithi a 10 years' experience of secondary science and math teacher. According to Md. Ashraf Ali, another college teacher of science told that "we don't get adequate support from school in pursuing stem education for girls. We need proper training on STEM education for girls."

Challenges and Barriers: Teachers at urban school expressed that they face some difficulties in classroom. Physics teacher of 9 years experienced told that "There are some students in my class are very much callous. They do not pay heed to their teachers." A biology teacher from high school told that "school doesn't have sufficient resources in pursuing STEM education. Lack of encouragement from teachers and family members may responsible in acquiring sufficient knowledge of STEM. Girls feel difficulty of subjects specially mathematical and related terms for our poor students. That's why they are indifferent to those subjects."

Every teachers in rural areas from every teaching level observed that they encounter some difficulties in the classroom. The most frequent issue is that there aren't enough STEM resources available in the classroom. A teacher of ICT from high school told that "There is not any arrangement of special multimedia classroom. We have not any computer club where girls can easily engage." They also expressed that lack of encouragement from parents in rural areas is the another major barriers for girls STEM education.

Out of ten rural instructors, only three were trained to promote STEM education for girls. They claimed that it works really well, particularly when it comes to learning how to use STEM materials and technologies in the classroom. The fact that all of the urban instructors were trained in advanced ICT, artificial intelligence, digital content creation, and office applications.

Suggestions and Feedback: Rimi Khatun, Lecturer in Biology in Nobokumar Institution and Dr. Shahidullah College suggest that "Take some important steps among the students and guardians to encourage all of the female students to acquire sufficient STEM knowledge and skills." According to Ismat Zakia one of the biggest obstacles to females' education is poverty. So, providing financial support and resources can help girls stay in school/college. She adds that the majority of students admitted here have low GPAs. Furthermore, they don't care about further education. "Social awareness plays a vital role to develop STEM education," stated biology teacher Jinnat Rahena. According to Israfill Hossain "I would

like to suggest increasing opportunities and congenial environment for enhancing STEM education for girls in my school."

"We have to create all girls STEM clubs where girls can explore STEM topics in a supportive environment," suggests Md. Shakhawat Hossain, a primary school teacher. Participation and awareness of STEM education should be promoted. "Having access to technology tools, equipment, and STEM resources can level the playing field to explore their interest in STEM," stated another secondary science teacher. According to a high school ICT teacher, "highlighting women's contributions in STEM history can help girls in this field." I firmly believe that instructors should support girls' STEM opportunities and parents should be sincere about this.

"I think we should make supportive and inclusive school culture where girls feel encouraged to participate without judgment," stated Md. Israfil Mia, a secondary math teacher. The majority of them recommend raising community and parent awareness through campaigns and seminars. According to secondary science instructor, parents' and girls' knowledge is crucial for STEM education. We must set up some STEM education seminars. We need to plan some activities that can encourage teamwork, creativity, and skill development, as well as boost girls' confidence in STEM, according to the high school ICT instructor. "Offer opportunities for hands-on learning experiences and experiment to spark girl's interest in STEM," advises Nilufar Yasmin, a college teacher. We must appropriately include our community in this initiative.

Part 3:

In-depth Interview: Based on the interviewees from the education planner in the Directorate of Secondary & Higher Secondary, this paper will analyze how their perception about girl's participation in Stem is.

Table 10: Coding of 5 interviewed Officials

Interviewee code	Positions
Participant 1	Assistant Director (Planning & Development),
Participant 2	Assistant Director, (Finance and Procurement wing)
Participant 3	Research Officer (Planning & Development)
Participant 4	Research Officer (Planning & Development)
Participant 5	Research Officer (Planning & Development)

Source: Author's own table

Importance of STEM: Participant 1, as an education planner his major work is to develop new project and study proposal on new idea and assist to implement government perspective plan. He expressed that as per demographic structure in Bangladesh it is vital to address girl's education because they are more than half of the population. So there is no space to avoid the girls from STEM education. To fostering the STEM education in a balance way gender equity movement needs to be address in all sphere of national life.

Participant 5 is working as a research officer in Directorate of Secondary & Higher Secondary expressed that girls can facilitate the rising skills gap while contributing to higher productivity activities and economy wide competitiveness through STEM education.

Participant 3 expreesed that STEM education can help girls to develop skills to cope and succeed in a changing, competitive job environment.

Participant 2 viewed that STEM education is very crucial for girls of Bangladesh because it can help in empowering them, bridge gender gap in the workforce and ultimately they can be the part of the economic development of the country.

Participant 4 through STEM education from the very early stages, girls will be more conscious about modern world and technology and they can contribute in economic growth, personal empowerment and finally can minimize gender gap STEM job sectors.

Current state of STEM: In Bangladesh, there is still a social stigma that girls are week in STEM education. However, Participant 1 told that this is already breakthrough in Bangladesh on the field of Medical education where almost 60% girl's student accommodate in this area from last one and half decade.

In case of participation in STEM worldwide, Participant 5 is quite depressed in the present scenario. She told that "Participation in Stem education for girls is one of the lowest in South Asia. Despite the consistently superior results of girls, the percentage of girls enrolling in STEM subjects is relatively low." The similar view came from the Participant 4 and she told that "the underrepresentation of women in STEM fields remains a significant challenge in Bangladesh, with only 14% female participation in such roles. This disparity reflects broader gender inequalities in education and workplace." However, Participant 5 hoped that now a days girls enrollments increased in STEM subjects at both secondary and tertiary level.

Policies: National Education Policy 2010 is the major supportive policy for girl's student enrollment in STEM education. This policy has made notable strides in improving education- increased enrollment, focus on gender equality, curriculum and infrastructure development.

In this case Participant 1 told that this is effective so far but positive mind set are changing day by day to accelerate girls in STEM education. There is no major gaps exist in the policy rather girls students have free access to study in STEM subjects or courses.

Participant 2 said that there are some gaps in policy like focus on pedagogical method, teacher training and industry collaboration. These can be addressed by innovative pedagogical methods-like project based learning, hands on experiments, curriculum integration, provide teacher trained, strength industry and academic partnerships

Stipend programs are in exist to promote STEM education for girls in Bangladesh. These are successful to some extent. Participant 4 and 5 both expressed that there are some gaps in current policies such as less focus on gender issues and lack of access to quality resources. These can be solved by integrating gender-sensitive awareness program and increasing investment in STEM resources for girls.

Barriers: Everyone believe that financial insolvency, family pressure, lack of career guidance and also cultural and societal norms, societal expectations, lack of self-confidence make barrier in STEM study and career.

According to Participant 1 **i**n case of barriers, she told that societal norms, gender stereotypes and economic hindrance are prevalent in STEM fields which can create obstacles for the attraction, retention and progression of girls and women in Stem studies and career.

Challenges for policy makers: It is quite surprising that two respondents opinioned that they don't face any challenges to make specific policy for girls. Participant 1 argued that only for girls there is no necessary to allocate resources but it is important for all in the era of 4iR. However, it should be allocated equitably, strategically and sustainably.

An opposite opinion came from Participant 5 and she said that "as an education planner limited budget and resource allocations are the main challenges for them to make an effort for girls in Stem education. Resource allocation should be gender sensitive to ensure the success of STEM education programs for girls".

Suggestion: Finally, Participant 1 suggests that, it is important to find out the real gaps in the field of STEM education and then make the implementation plan to address. There is necessary to analyses the data on present trend and can be made a projection for future.

Participant 5 proposed that educational institutions at all grade levels could create opportunities for families and students to engage in STEM activities by organizing events such as science fairs or math Olympiads. Governments, NGOs, private sectors etc can strengthen women in STEM via advocacy, joint scholarship, mentorship programs, public awareness campaign, improving STEM education access, conducting research, international cooperation, creating technological motivation platform. Such programs can link female students with women professionals in STEM, offering them valuable guidance and insights. These initiatives can help bridge the gap between academic learning and real-world experience.

Discussion:

This paper mainly focuses on the role of Science, Technology, Engineering and Math (STEM) education for girls from the very early stages. It has tried to understand the perception of girls, parents, and teachers and also the policy makers towards STEM education of girls. The previous studies found that in spite of girl's confidence and interest in STEM subjects, teacher's quality and infrastructure challenges and socio-cultural barriers keep them out of STEM. It is also found that university girls have lack of confidence in technological skills in modern world. Finally, previous study suggest that demanding curriculum, teaching techniques of STEM education program can attract more girls in this field.

Girls perception about STEM: From the perception of girls interest and their access to schools STEM related extra curriculum activities, opposite scenario has been shown between urban and rural areas. More than 80% girls are highly interested and they have access to extra curriculum activities in urban areas while 87% respondents claim that they have no access in schools STEM activities in rural areas. All of the girls in rural areas faced challenges and difficulty understanding the materials showed highest number of challenges. In urban areas, 47% of females reported having difficulties, a lack of resources and trouble understanding the STEM content equally make up the highest challenges which account for 86%. In case of role model, girls from urban schools and college mostly followed female scientist while in rural areas they followed their teachers. This may be they don't have enough knowledge about female scientist. It is

interesting that all of the girls from rural regions expressed a desire to pursue a career in STEM due to job opportunities and the percentage is 47%. In metropolitan locations, about 47% of females are passionate about STEM topics and want to pursue careers in the field. It indicates that urban females genuinely enjoy and are passionate about STEM disciplines. According to the recommendations made by females in both rural and urban regions, parental and teacher support ranks highest (33% and 53%, respectively). Improved facilities and resources as well as awareness campaigns, financial aid and scholarships are the other suggestions from girls.

Parent's perceptions about STEM: Several questions have been asked to find out how parents feel about their knowledge, thoughts, and plans for their daughter's future in STEM disciplines. In urban areas parents of different profession are concern about their girl's education in STEM subjects while rural most of the parents showed less concern about STEM. It is clear from the findings that in both urban and rural areas from every profession and every education level, everyone told that lack of sufficient resources is the main challenges for girls in STEM subjects. In urban and rural areas the percentages are 40% and 50% respectively. Parents use some techniques to encourage them in STEM. Urban parents are more educated and they usually discuss about STEM related topics and role models at home. 50% of rural parents of higher secondary and secondary degree encouraged their girl's child to join in STEM extracurricular activities.

Teacher's thoughts and suggestions about STEM: Teachers from rural and urban areas are conscious about the importance of STEM despite their teaching experience. They have expressed that STEM related education improve girls creativity, problem solving skills, critical thinking thus they will get better jobs. Teachers in urban have used some inclusive teaching materials, providing hands-on activities and also encouraging them to participate in STEM extracurricular activities. Rural teachers claimed that they don't get enough support from schools however, they individually have offered additional support and highlight female role models in STEM to encourage them. Teachers from both sides claimed that school doesn't have sufficient resources in pursuing STEM education. Teachers from urban were trained in advanced ICT, artificial intelligence, digital content creation, and office applications while rural teachers are not trained on STEM related topics. They suggested that providing financial support and resources, raising community and parent awareness through campaigns and seminars play a vital role to develop STEM education.

Policy maker's thoughts and suggestions about STEM: Officials from Directorate of Secondary & Higher Secondary expressed that STEM education from the very early stages can help girls to be more conscious about modern world and technology and they can contribute in economic growth, personal empowerment and finally can minimize gender gap STEM job sectors. They said that despite the consistently superior results of girls, the percentage of girls enrolling in STEM subjects is relatively low. National Education Policy 2010 is the major supportive policy for girl's student enrollment in STEM education. However, there are some gaps in policy like focus on pedagogical method, teacher training and industry collaboration. These can be addressed by innovative pedagogical methods-like project based learning, hands on experiments, curriculum integration, provide teacher trained, strength industry and academic partnerships. As like teachers, policy makers believe that financial insolvency, family pressure, lack of career guidance and also cultural and societal norms, societal expectations, lack of self-confidence make barrier in STEM study and career. Moreover, as an education planner limited budget and resource allocations are the main challenges for them to make an effort for girls in Stem education. Resource allocation should be gender sensitive to ensure the success of STEM education programs for girls. Finally

they suggest that Governments, NGOs, private sectors etc can strengthen women in STEM via advocacy, joint scholarship, mentorship programs, public awareness campaign, improving STEM education access, conducting research, international cooperation, creating technological motivation platform.

Conclusions:

A country's total development is not possible without the participations of its half of the population. Though girl's education is progressing rapidly in Bangladesh. But still they stay far away from the current STEM wave. Lack of family support, school dropout, lack of infrastructure facilities, lack of qualified teachers, lack of motivation and encouragement are the biggest challenges of girls in Bangladesh pulling into STEM education. With the support of family to the policy maker of the country upon solving this issue, more girls and women will involve in STEM areas. It enables them in these areas and set their carrier in STEM field. In a modern digitalized world, girls cannot make progress if she has not equipped herself with scientific and technological knowledge. A well-organized STEM program for girls from primary education level may help them to boost their career in ICT sector and contribute Bangladesh to improve its economic growth. So the country urgently needs to take substantial steps if it wants to develop herself.

References:

1. 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.
2. Aberšek, B., Aberšek, M. K., & Dolenc, K. (2016). Modernization, Optimization and Development of STEM Education. *DIVAI 2016*.
3. Ahmed, N., Urmi, T., & Tasmin, M. (2020, December). Challenges and opportunities for young female learners in STEM from the perspective of Bangladesh. In *2020 IEEE International Conference on Teaching, Assessment, and Learning for Engineering (TALE)* (pp. 39-46). IEEE.
4. Bangladeshi scholar wins int'l award. (2018, February 19). *The Daily Star,* Retrieved from https://www.thedailystar.net/city/bangladeshi-scholar-wins-intl-award-1536748
5. Blickonstaff, C. J. (2005). Women & Science Career: Leaky Pipeline on Gender Filter? *Journal of Gender & Education, Western Washington University*,7(4), 369-386
6. Choudhury, S.K. (2014). Women in Science and Engineering in Bangladesh- Status and Future. Final ASSAA report, Panmun Education Co., Ltd, Korea, 51-66
7. Chowdhury, S.A., Arefin, S. ASM. & Ahmed, F. (2019). Factors behind the implementation of STEM education in Bangladesh, *Journal of Physics: Conference Series, IOP Publishing,* Pg.: 1-6 Devi, K.J. (2017). Women empowerment Through Education. *Journal, of English Studies International Research*, 5(1), 127-130
8. Farhana, Z., Sultana, T., Al-Amin, M., & Hoque, S. (2023). Integrating STEM Approach at Primary Education in Bangladesh: Perception and Challenges of the Teachers.
9. Kimber, S.A. (2014). *Women in STEM: Underrepresentation & Equity in Professional Research Organization*. Washington State University, 1-15.
10. McCullough, L. (2011). The Women's Leadership in Science, Technology, Engineering and Mathematics: Barriers to Participation, Pg: 1-11 *Oxford Round Table. 406 West Florida Avenue, Urbana, IL 61801. Tel: 217-344-0237; Fax: 217-344-6963; e-mail: editor@forumonpublicpolicy.com; Web site: http://www.forumonpublicpolicy.com*
11. Munir, Q. T., & Shams, J. Integrated Stem Education: Bangladesh Perspective.

12. Nath. R.V., Sireesha M., & Manjunatha. H. (2020). Education and Research for Women Empowerment, Pg: 51-58, uploaded in Researchgate on 03 April 2020, Available at: https://www.researchgate.net/publication/340413533.
13. Nowshin, N. (2017 March 08). Women in science- why are we still surprised? *The Daily Star*.Retrieved from https://www.thedailystar.net/opinion/interviews/women-science-why-are-we-still-surprised-1372321.
14. 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 ScientificJournal, ESJ*, 11(4).
15. Smart, S., & Rahman, J. (2009). Bangladeshi girls choosing science, technology, engineering and maths. *Report by London East Thames Gateway Aimhigher and CfBT Education Trust*.
16. Sulai, M. E., & Sulai, E. I. (2020). Science, technology, engineering and mathematics (STEM) education: A tool for national development. *International Journal of Educational Research*, *8*(1), 117-126.
17. Siddiqa, N. (2019). Barriers to STEM Education for Rural Girls: A Missing Link to Innovation for a Better Bangladesh. Echidna Global Scholars Program, Policy Paper. *Center for Universal Education at The Brookings Institution*.
18. Women in STEM. (2018, January 11). *Bangladesh Open Source Network*, Retrieved from https://www.bdosn.org/news/149-round-table-discussion-on-women-in-stem-perspectives-challenges-prospects-held-successfully.