Gender equality in science classrooms: Teacher perceptions and teaching-learning practices in government primary schools in Dhaka

By

Maisha Ahmed
19357062

A thesis submitted to the BRAC Institute of Educational Development in partial fulfillment of the requirements for the degree of
Master of Education Leadership & School Improvement

BRAC Institute of Educational Development
BRAC University
July 2021

Declaration

It is hereby declared that

1. The thesis submitted is my original work for the completion of my Master's degree at Brac University.
2. The thesis does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
3. The thesis does not contain material that has been accepted or submitted, for any other degree or diploma at a university or other institution.
4. I have acknowledged all main sources of literature and data used.

Maisha Ahmed

19357062

Approval

The thesis titled "Gender Equality in Science Classrooms: Teacher perceptions and teaching-learning practices in government primary schools in Dhaka" submitted by

1. Maisha Ahmed (19357062)

of Spring, 2021 has been accepted as satisfactory in partial and fulfillment of the requirement for the degree of Master of Education in Educational Leadership and School Improvement on 29 Jun 2021.

Examining Committee:

Supervisor:

____

Shamnaz Arifin Mim
Lecturer, BRAC Institute of Educational Development

Program Coordinator:

____

Dr. Mohammad Mahboob Morshed
Assistant Professor, BRAC Institute of Educational Development

External Expert Examiner:

____

Sabrina Ahmed
Research Associate, BRAC Institute of Educational Development

Head of Institute:

____

Dr. Erum Mariam
Executive Director, BRAC Institute of Educational Development

Ethics Statement

The thesis was completed by following ethical protocols at all stages of the research. An Ethics Application was submitted with the thesis proposal that was reviewed and accepted by an Ethics Committee. The interview questions were designed as such that do not elicit biased responses. For the interviews, the prospective participants were presented with a consent letter, outlining the research topic, interview duration and method, and privacy of their data. As an interviewer, I conducted the interviews from a neutral standpoint and reminded the participants they could withdraw from my research at any point in time. No minors were included in the research. All participants were adults who confirmed their participation by sending back signed consent letters. All data from the interview is only saved on my personal computer and discussed in the thesis result section and was not shared with any other body or institute for external use. Alias names of participants were used to sort and analyze the results from the interview. The final Ethics application was also submitted with the final thesis draft confirming the safeguarding of human rights of the research participants.

Abstract

This is a qualitative study exploring teachers' influences in gender equality in primary science classes in an urban context. Perceptions and attitudes of teachers in classes directly impact students' learning in science as early as in third grade. It is important to understand the gender-gap and under-representation of girls in science, both academics and career, in Bangladesh. The research is focussed on teachers' perceptions and teaching-learning practices that shape distinguished experiences for boys and girls in the classroom. By convenience sampling, eight teachers were selected from four government primary schools in Dhaka and interviewed using an interview-guided approach. Results found that although girls were seen as better students based on assessments and their completion of work, teachers perceived boys as naturally inclined to study in science due to having higher-cognitive abilities desired in science, being more exposed to the outdoors and making more interactions in class to question, participate, and ask for help.

Table of Contents

List of tables

List of Acronyms

UNESCO	The United Nations Educational, Scientific and Cultural Organization
IT	Information Technology
EFA	Education for All
MDG	Millennium Development Goals
CEDAW	Convention on the Elimination of all Forms of Discrimination Against Women
STEM	Science, Technology, Engineering, and Mathematics

1. Introduction and Background

1.1 Introduction

Gender equality in education has been of critical importance in the global arena to ensure an equal playing field for girls and boys alike by establishing equal access to resources, achievements, and occupational roles (UNESCO, 2000). The Education for All (EFA) goals urged the elimination of gender disparities in primary and secondary education in its Dakar Framework for Action in order to achieve a broader goal by 2015, which is to establish gender equality in education (UNESCO, 2000). This is also aligned with Goal 2 of Millennium Development Goals that accentuated the need to free primary and secondary classrooms of gender disparities by 2005 and attain gender equality in all levels of education by 2015 (Subrahmanian, 2005). Subrahmanian (2005) described gender inequality as men and women exercising unequal power. In reality, men start from a position of advantage in career, education, and society, as opposed to women. Subrahmanian explains that gender inequality in education is constructed by inequalities in other spheres, such as social norms and shared understandings. Therefore to obtain equality in education changes have to be made at the institutional and societal level too. Hence, in a broader context, to preserve the rights of people, gender equality in education has to be ensured since education is an "important life opportunity for women and men, and a vital social and economic resource for societies" (Subrahmanian, 2005, p. 401).

The education and field of science have long struggled to create an equalized platform for boys and girls, failing to inspire and utilize man and woman from an early stage in the education of science. In developing countries like Bangladesh where there are major advancements towards industrialization and service sector, demand for technically qualified staff across all sectors from agricultural to IT, and so quality science education is essential to create this supply of staff (Lewin, 1993). A multitude of studies exists explaining the challenges in a science classroom and the prevalent gender stereotypes that influence how boys and girls participate during science lessons, and how stereotypical notions are developed in the teaching of science both in teachers and students alike. A common theme from literature reviews have identified gender distinction in science, where physics and chemistry subjects showed visible domination of boys in classrooms and later in the field due to the requirement of "masculine" traits such as critical thinking and technical abilities; a numerical dominance in biology by girls is also evident, explained as due to biology's more feminine aspects in the nurturing and understanding of living things (Eddy et al., 2014; Hoferichter & Raufelder, 2019). However, it is argued that classroom dominance and the number of girls or boys attending are not sufficient measures to conclude an equal treatment of both genders in primary classrooms.

With both EFA and MDG influencing a nations' development of education systems, globally there has been a noticeable shift in improved policies and strategies to achieve gender parity through increased enrollment and attendance, especially of girls, and primary education completion rates (Aikman et al., 2011). However, whether countries have accomplished a gender-equal quality education cannot simply be determined from these statistics. Aikman et al. (2011) highlighted that quality of education should be evaluated based on its capacity to address gender equality via its curricula and the learning experience it creates for learners. This includes the gender dynamics within classrooms, participation and achievement gaps between boys and girls, and the extent to which stereotypes infiltrate the teaching-learning methods and outcomes.

In Bangladesh, classrooms already struggle to address gender equality in education due to preconceived biases of teachers. Ifegseban (2010) puts into perspective how teachers and schools play a key role in nurturing gender-sensitive future generations. The CEDAW treaty in 1981, adopted by United Nations, underlined that discrimination against women existed at home, schools, and the workplace. The emphasis on teachers' perceptions and role is particularly addressed in Article 10 of CEDAW 1981, which articulates the need to address gender equality in education by eliminating stereotypical concepts of the role of males and females by adapting teaching methods and school programs.

Particularly for science education, vast research exists in the exploration of the underrepresentation of girls in the STEM fields. However, there are very limited studies based on science classrooms at the primary level in Bangladesh's context. This study, therefore, is aimed to understand the gender gap in primary science education from the lenses of science teachers. By exploring the perspectives of science teachers and some of their teaching-learning practices that influence the severity of the gender gap in the primary stages of classroom experience, the research could help grasp a better understanding of how teachers contribute to this inequality in science from an early stage in a learner's education. Subrahmanian (2005) identified that both the curricula and attitude of teachers reinforced social norms that defined the capabilities of learners and assigned gender roles to occupations. My research demonstrates a qualitative approach to collect data by interviewing 8 government school science teachers from 4 schools in Dhanmondi and Lalbagh, to explore their perspectives and reflections based on the expectations set and observations made on how boys and girls perform in class.

1.2 Research Title

The research is titled "Gender equality in science classrooms: Teacher perceptions and teaching-learning practices in primary schools in Dhaka". It is set to explore:

a. science teachers' perceptions (their opinions and expectations) on student competencies, interests, and participation in primary science lessons.

b. how and if their perceptions influence their teaching-learning practices and student performance based on classroom observations.

These teacher attitudes and learning practices shape student experiences and learning in the classroom.

1.3 Problem Statement

In Bangladesh, science classrooms create different learning experiences for boys and girls, many of which are a product of the perceptions and practices of their science teachers. Schools and teachers create an environment that constructs values, morals, and beliefs in learners that they carry back to their homes and communities. It is necessary that teachers nurture a gender-equal classroom that is free of stereotyped concepts from the primary level so students have access to the same curricula, learning process, teacher support, and other educational and career opportunities (CEDAW, 1981). In Bangladesh, numerous interventions have been made to retain students and minimize dropouts, especially of girls. However, the focus has to go beyond stipend and food programs and consider micro-level inclusion strategies at the school and classroom level also to ensure students feel involved in their education. Studies suggest that gender biases in teacher attitudes and practices lead to low participation, staggering achievements, low self-esteem, morals, and drop-outs of students. There is existing evidence of low performance and inconsistent attendance among girls in government primary schools of Bangladesh due to limited contact hours with teachers and inadequate teaching-learning (Lee, 2018). Alan et al. (2018) stated, when in-classroom practices and beliefs do not tribute gender equality and inclusivity, they influence the innate capabilities and perspective of students in the long run.

There are few studies in the Bangladeshi context, specifically at the primary level, investigating gender inequality in science studies. It is also noted that gender difference perceptions about a student's ability in STEM can begin as early as in third grade (Stipek & Hoffman, 1980, as cited by Meece & Jones, 1996). There is evidence of adopted stereotypical concepts in secondary students demonstrating that both male and female students in secondary schools in Bangladesh perceived their ideal science teachers as male (Mim, 2020); this is similar to the findings of Chambers (1983, as cited by Makarova et al., 2019) from Draw A Scientist Test, feeding to the overall broader problem of categorizing science as 'masculine' while also devaluing the efforts and achievements of females in science. Huyer (2018) reported that even though countries like Bangladesh and Sri Lanka have made remarkable progress for women to achieve parity in science, in Bangladesh women are less likely to pursue research fields such as engineering, which is seen as a masculine field. The report clarifies that women made up about 17% of the research pool in Bangladesh as of 2018. This is discouraging to younger girls interested in pursuing science-related fields. Teachers, especially females, also express that stereotypes are learned when children are exposed to an unbalanced representation of gender in jobs and tasks (Gray & Leith, 2004); this is problematic because in Bangladesh there is an under-representation of girls in science which is also reflected in the abundance of male secondary school science teachers pursuing science as a career, as opposed to female teachers who lag behind due to the subject's time demands, family responsibilities and unassigned leadership in science (Mim, 2020).

Jones and Wheatley (1990) discussed that females were found to experience fear of success in science. The development of girls' interest and attitudes towards science is indispensable as these are important for course selection and choosing future career paths (Jones & Wheatley, 1990). Alexakos and Antoine (2003) emphasized that it is essential that all primary and secondary students have access to equal opportunities and resources to actively learn science. Unfortunately, countless research studies show the existence of a gender gap in science with boys having an advantage over girls. Girls exhibited less positive attitudes towards science, as early as in their elementary science classrooms, and were less likely to take advanced science classes in middle school (Oakes, 1990). By high school and university fewer women advanced taking math and science courses, feeding into the ever-growing gender gap in science.

1.4 Research Questions

The research sought to investigate the following questions in order to explore a probable presence of gender inequality stemming from teacher's perceptions and practices in primary level science classes. The following are the research questions of this study:

a) What perceptions do science teachers in primary schools have on how boys and girls perform in their class?
b) What are the teaching-learning practices in these science classes and do they encourage equal participation of both boys and girls?

1.5 Purpose of the Study

The purpose is to investigate gender discriminating factors in the classroom arising from the facilitation of science teachers in primary schools. The aim is to understand teacher perceptions (ie. their thoughts, opinions, etc.) on their students' abilities and participation, and what teaching-learning practices (classroom interactions, volunteer assignments, group works, etc.) influence student performance differently. The research collects data on participation and attitudes of boys and girls from teachers' classroom observations. By identifying these issues prevailing in primary classes, a probable correlation could be drawn to check carried-on impacts that lead to the underrepresentation of girls in science in higher classes and in the profession.

1.6 Significance of the study

The study is crucial to draw any correlation that teacher perceptions and practices may have in the distinctive participation of boys and girls in the classroom. The study helps achieve new knowledge on the matter by investigating:

- How government teachers in an urban context in Dhaka influence and create a gender gap in science for primary school-going children with their expectations and teaching methods,
- What differences in attitudes and participation of boys and girls already exist in science learning over various teaching methods,
- If students, based on their gender, experience segregation of 'hard' sciences from an early age,
- If teachers assign gender roles to specific science occupations,
- How boys perform in female-dominant classrooms and with female instructors- especially now when a multitude of government interventions are directed towards girls' attendance and learning.

Furthermore, the study can help at the policy level in planning professional teacher-training programs that offset mindsets and misconceptions of teachers against genders. A number of female and male teachers, as well as their qualifications and training, are deemed appropriate measurable indicators to examine gender equality within classrooms (Subrahmanian, 2005). Finally, the study is significant for schools and teachers to understand the responsibility and importance of their roles to safeguard classrooms from human biases and give access to equal opportunities for learners to pursue science regardless of their genders. The recommendations discussed at the end of the paper are practical and will help teachers practice inclusive teaching-learning of science.

2. Literature Review and Conceptual Framework

2.1 Literature Review

Gender disparities and gender stereotypes influence attitudes and perceptions of family, peers, and teachers that are then projected on learners (Eccles, 1989 as cited by Tatar & Emmanuel, 2001). How teachers treat students differently in science classes, especially based on their genders, critically affects the decision-making of students in choosing science for their future coursework and career pathways (Jones & Wheatley, 1990). Jegede & Okebukola (1992) highlighted teacher support as one of the influential variables that impact students' learning outcomes.

This research looked at various studies on gender inequality in science across many grade levels, from elementary to undergraduate classrooms. Teacher perceptions on male and female learners on overall performance in school and also specifically in science were taken into account to help develop themes to answer the research questions. A range of literature was studied that investigates the quality and execution of teaching-learning practices that are used by teachers. These included the type, length, and frequency of teacher-student interactions, quality of classroom discussions, design of activities in class and outdoors, and other voluntary or unconscious projections of gender biases to students in class that could possibly create gender gaps in science. Some common ideas that emerged from these reviews are categorized as (a) science teachers' perceptions of science and their students' capacity to perform in the subject (b) types and quality of teacher-student interactions during classes and (c) Design of classroom activities for teaching-learning.

2.1.1 Teacher perceptions:

Various research indicates that teachers' perceptions and attitudes are major factors, often having teachers display differing behavior towards boys and girls in the classroom, and allowing discrepancies in education by paving stereotypical gender roles for students. Ready and Wright (2011) emphasized that teachers' perceptions have powerful implications in building the educational experience for learners and creating future economic opportunities.

From a study on teachers' perceptions on teaching-learning approaches of science by Richardson et al. (2009) a common idea that emerged from the interviews is that teachers perceived that science involved abstract thinking, and as a result, required students to engage in high-level thinking like critical thinking and reasoning processes to fully grasp the scientific knowledge.

This knowledge and understanding of concepts, theories, and applications are further constructed through teacher-student interactions during teaching-learning. Richardson et al. (2009) suggested that perhaps acquiring science education depended on the quality of delivery of the knowledge and the construction of this knowledge in students.

At the elementary level, teachers held a general perception that boys are more skilled in mental and abstract abilities to analyze, question, evaluate, etc., whereas they perceived girls as silent observers and listeners, who set to complete tasks (Shepardson & Pizzini, 1992, as cited by, Tatar & Emmanuel, 2001). Stanworth (1981) and Walkerdine (1990), as cited by Gray and Leith (2004), explained that some teachers despised this diligent approach of girls during classroom learning. On the contrary, some studies show that teachers hold preconceived views that girls are more successful in the elementary stage due to their diligence and compliance as opposed to boys who require more direction and criticism from teachers (Fabregat et al., 1999). Regarding participation in classroom activities, results from the research of Gray and Leith (2004) showed that a majority of the teachers believed boys did not lead group activities or enjoy doing science experiments. The implications of these expectations can be reflected by Brophy (1983), explaining that when teacher bias positively favored students, they worked harder to compete and please the expectations of their teachers and peers. However, when this bias was negative, students battled with self-competence and self-worth issues when set against low expectations, consequently producing less output in class.

2.1.2 Gender inequality in Teaching-learning practices:

The following literature discusses some of the teaching-learning elements that influence gender gaps in science arising from unequal support and opportunities in the classroom. Crombie et al. (2003) defined active class participation by the frequency of questions and responses students engage in, the interruptions made during lessons, and quality involvement during discussions and activities.

2.1.2a Teacher-student interactions:

Leder (1990) in his study found a positive correlation between the quality of teacher-student interactions and the achievement of girls and boys in the mathematics classroom. During classroom teaching-learning, the types of engagement between teacher and student, its length and frequency, influenced how girls and boys felt involved in the learning process and how they performed in class.

Classroom Discourse:

Student-teacher interactions in the classroom discourse play a significant role in influencing a student's cognitive process (Chin, 2007). This study explains how the teacher raises questions for the students and manages their responses to stimulate a learning environment for the whole class to participate and make meaning of their scientific knowledge. Authoritative discourse in lessons demonstrates the transmission of knowledge from the teacher to the student, for example, during explanations of factual statements and giving instructions (Chin, 2007). Chin (2007) introduces another form of conduct, dialogic discourse where teachers invite students' opinions and challenge them to debate different views. The former, authoritative discourse, usually gives rise to short student responses, such as one-word answers, discussing right or wrong, and keeping limited to the discussion topic. In contrast, dialogic discourse encourages students to raise their questions, argue thoughts, and share new ideas. Chin argues that an amalgam of both types of discourses is necessary for teachers to help students construct scientific knowledge as both these interactions help students think about the what-why-how-when-where of their lessons.

Questions and Responses:

Based on literature to study student response, Leder (1990) in his research from sampling grade 3 students concluded that boys were more comfortable and frequently responded to teacher's questions and received more attention from their teachers compared to girls. Jones and Wheatley (1990) had similar claims that teacher-student interactions shaped female students' approach to STEM. In their research on a high school classroom, they tested how both genders participated differently across multiple variables such as the type of contact, quality of student response, teacher feedback, etc during teaching-learning. Through observation of 30 science classrooms, Jones and Wheatley (1990) discovered that both male and female teachers tend to ask questions, engage in discussions, and make various other contacts with boys during the class, and simultaneously had boys raise more questions in return. Marshall and Smith (1987, as cited by Gray & Leith, 2004) noted that teachers tend to give more detailed feedback to boys' to improve their performance while only marking 'correct' or 'incorrect' to the girls' works.

Classroom dynamics based on gender:

The influence of both peer and teacher interactions on the gender gap can be explained by the study of Oluwagbohunmi (2014) where teachers provided equal encouragement to boys and girls in a secondary social science class. In this class, boys were found to have higher achievement rates in the assessments compared to girls. In his research-based on 63 classrooms, the teachers asked students of both genders higher-order questions and involved them in various activities such as whole-class and small-group discussions. During their lessons, boys showed higher engagements too. Oluwagbohunmi (2014) interpreted this result, by citing Irvine (1986), that male student-initiated both positive and negative interactions with teachers. Irvine (1986, as cited by Oluwagbohunmi, 2014) argued that boys by nature are salient and active, and although the teachers encouraged girls to speak up too, more time was spent cold-calling boys to involve them in lessons and as a means to control classroom behavior. Consistent with Irvine, Younger, and Warrington (1996, as cited by Gray & Leith, 2004) claimed that most teachers believed they treated girls and boys equally, but from observation of a Year 11 classroom, boys occupied most of the teachers time and attention by getting reprimanded or frequently having questions directed towards them by their teacher. Oluwagbohunmi reasons his findings similarly, that boys achieved higher marks in social science due to this higher number of teacher-student interactions during which they had to actively engage in, recall lessons, and apply knowledge to solve questions with the teacher, and were more frequently corrected for wrong answers.

Results from the research by Jones and Wheatly (1990) showed that in a physics class, male students received more of every type of interaction with teachers. Crombie et al. (2003) also showed males rated higher in participation and they also perceived their facilitators with more positive impressions and allowed boys to engage in a personalizing manner to intervene, challenge and discuss in classrooms. Older male students are also considered as more active than male students in elementary school (Howard & Henney, 1998). They also cited Cooper (1979) who proposed that teachers tailored feedback and asked questions to control the behavior of students; therefore it suggested that the type and frequency of interactions between teachers and students were based on teacher's perception of the student, their behavior, and class performance. In another study of an undergraduate biology classroom, although girls occupied 60% of the class, their voices made up 40% of those engaging in discussions and responding to their teachers (Eddy et al., 2014). The study concluded from the data that male students contributed to more than 60% of voluntary responses and discussion time, in spite of being lesser in number present in class. Whyte's (1986, as cited by Eddy et al., 2014) research on these elementary science classrooms, has also shown that teachers had "passive unconscious bias". This is explained by one of the science teachers who reportedly felt that girls occupied 90% of his time during his teaching when actually he spent the same amount of time to make sure boys were caught up with his lesson. It was considered as his unconscious bias that females in his classroom were not as participative as boys and therefore he felt he was devoting too much time to engaging girls.

2.1.2b Peer works and lesson activities:

For teaching-learning activities that require group or peer work, boys in a secondary English-writing classroom were generally at a learning disadvantage and underachieving when grouped together with the same gender (Davies, 2003). Whereas girls in a group respected opinions, welcomed responses, and mirrored each other's experiences, boys were less cooperative, disruptive and had difficulty conveying their responses with cohesive language.

Davies (2003) stressed how designing lessons with such group-learning, interactive activities while harmonious for girls, created turbulence in male learning due to boys raising questions at each other, displaying macho behavior, and sometimes deviating from the actual task at hand.

During classroom experiments in science classes, boys tend to occupy science apparatus and physically dominate activities, whereas girls spend more time listening and watching (Barbieri & Light, 1992, as cited by Gray & Leith, 2004). Likely, Gray & Leith (2004) found from their study that more than half of the teachers noted that boys monopolized authoritative roles during practical activities and took charge of tasks, which inadvertently could create long-term consequences on girls. This is evidenced as per Tiedemann (2000) that when teachers allowed girls to be submissive it contributed to girls' low confidence. Alexakos & Antoine (2003) also illustrated that girls were especially sensitive to peer approval which then influenced their self-competency and self-esteem. Instead, when girls were able to work cooperatively with their peers it helped them create a positive experience on their learning (Alexakos & Antoine, 2003). This is similar to the results of an African science classroom where 90% of the girls felt their friends did not expect them to do well in science, however, the opposite was true for boys (Jegede & Okebukola, 1992). The research results of Crombie et al. (2003) also showed that female participation in the classroom was dependent on the male student size, gender of the instructor, and class design, that is whether participation in discussions and activities were mandatory.

2.2 Conceptual Framework

The conceptual framework is built upon the key aspects that the research questions set to explore: science teacher perceptions and teaching-learning practices in science. Based on the literature review, the following framework developed interview questions and sought theories and explanations from collected data.

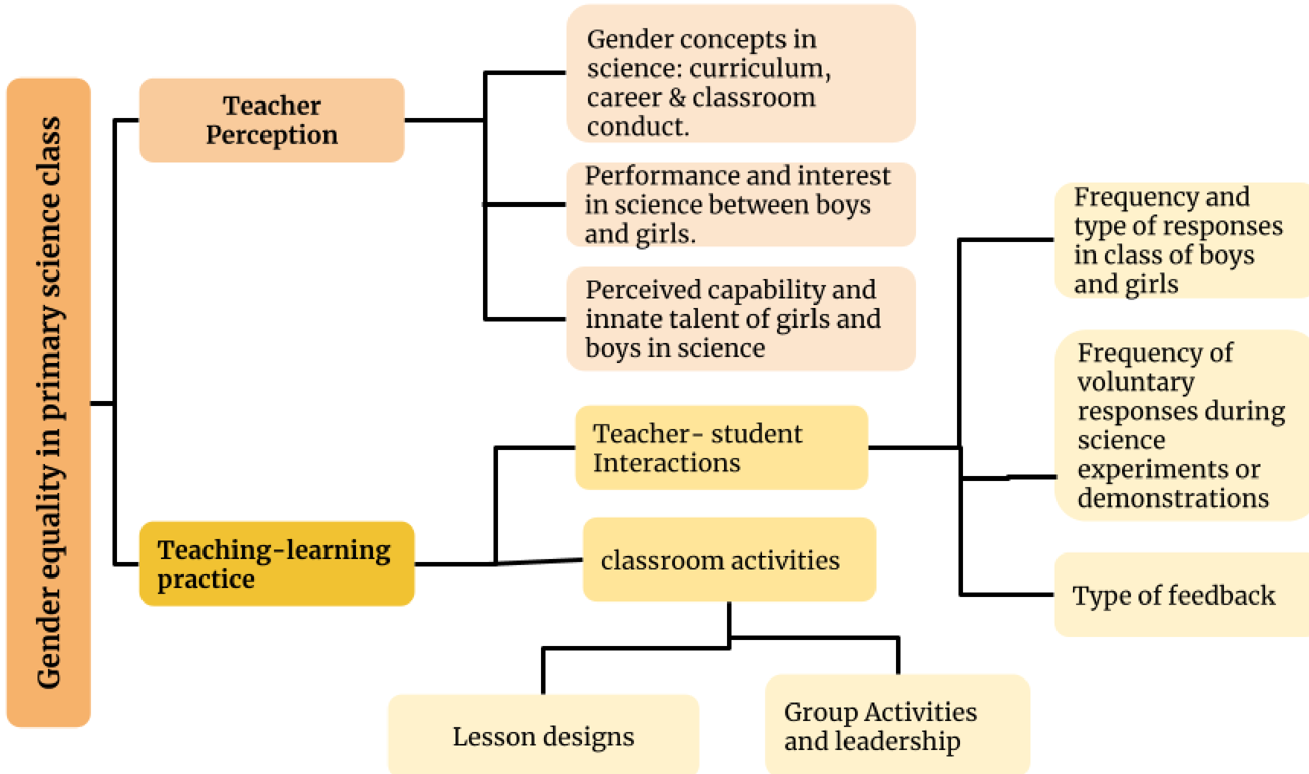

Figure 1: Conceptual framework map to explore science teacher perceptions and teaching-learning practices

3. Information and Methodology about the field research

3.1 Research Approach

The choice of research approach is Qualitative. The research is exploratory and aimed to investigate deeper human attitudes and practices arising from- how teachers viewed male and female students in their science classroom regarding their capabilities, traits, and performance in science, and if teacher's practices of teaching-learning methods are encouraging for both boys and girls to ensure equal participation and achievement. The research has the opportunity for inductive progression to build theories as there are limited studies and evidence in the context of Bangladesh where socio-cultural influences may vary regarding teachers' usage of inclusive practices in the classroom to create gender equality. The research is meant to support similar themes from related literature reviews but also allow open space to form new, relevant theories in the Bangladeshi primary education context.

3.2 Research site

The research sites are four government primary schools and specifically science classes from grades 3-5. The schools are located in Dhanmondi and Lalbagh for the feasibility of collecting data during the pandemic virtually or physically. All classrooms are co-ed to compare the performance and participation of girls and boys in science class and explore how teachers view their students. All classes have an average class size of 35-40 students. Primary schools provide an important foundation in shaping students and therefore, it is important to study how and which gender inequalities in these classes can affect students' performance. Only government schools were studied in this research because in Bangladesh the highest number of primary classrooms belong to government schools (more than 39,000 institutions) and with a maximum number of enrolled primary children (Ministry of Primary and Mass Education, 2019).

3.3 Research Participants and Sampling Procedures

The research participants are government teachers teaching science in grades 3 to 5. The science teachers are the direct target population to investigate their perceptions and practices as per the research topic. The respondents were selected by convenience sampling due to emphasis on easy accessibility, geographical proximity, and the willingness of teachers to participate in person or phone calls (Etikan et al., 2015) during the pandemic. The respondents were two male teachers and six female teachers. Initially, the participants were to be picked from each of the four institutions- one male and one female science teacher. Although it was not the primary objective, by having equal representation of male and female science teachers there would be an opportunity to paint a more vivid picture that accounts for teachers' perceptions and practices in relation to teacher gender. Eddy et al. (2014) discussed instructor gender to be a major factor in STEM classes for girls because they were able to participate better and identify with the subject matter. However, out of the four schools interviewed, only one school had male science teachers. The total respondents interviewed were 6 female and 2 male science teachers. From demographic details concerning male to female teacher ratio in school, it was noted that in the three schools with female science teachers, the entire staff was female. In the school, with 2 male teachers, the teacher ratio was 3 males and 4 females. Also noted that, in all-female staffed schools, science was also assigned to Teach for Bangladesh male fellows for some classes.

From the collected demographic information, the number of years of teaching experience for all eight participants had a mean average of 18 years (lowest= 15 years, highest= 25 years). None of the respondents had attended any government or private training or workshop on gender equality in education. 100% of the respondents, however, were consistent in recalling they had discussions on gender equality during other professional training. Gender equality was sometimes brought up in conversations linked to teaching-learning. Many teachers noted that there may not be any training designed specifically to address gender equality specifically for teacher training. Some teachers, however, acknowledged the significance of gender equality in education as a global “hot-topic”.

3.4 Data Collection Methods

Data were collected by conducting a 25-30 minute interview with 8 science teachers from the 4 schools. A one-on-one, in-depth interview was used to dive into sensitive aspects such as teacher's perceptions and teaching practices regarding stereotypes and make meaning of these attitudes (Gray & Leith, 2004). Other than collecting the data relating to the emerging themes from the literature review, the objective of the in-depth interview was to explore teacher’s views and allow teachers to frame and introduce their own insights to give fresh perspectives into their classroom context. This is essential since there is scarce research on our topic in Bangladesh’s context, so there is a need to welcome contextual lenses to understanding the research problem. Two teachers participated in an in-person interview on the school premises and the rest of the six teachers responded via zoom or phone interview lasting about 30 minutes. The interview questionnaire is open-ended and follows an “Interview Guide Approach” where questions were asked in the sequence suited best to extract valuable data through conversation with the respondent (Johnson & Christensen, 2004). There are 14-items in the questionnaire excluding general information on the respondent and their science classrooms, such as boys to girls ratio, staff gender ratio, number of teaching years, and training attended. The questions were developed with the help of the conceptual framework addressing teacher perceptions and teaching-learning practices. Few questions included on teacher perceptions on student’s capabilities in science and their participation are:

- From your classroom observation and academic results, who do you think better participates in science classes, girls or boys?
- In your opinion, what skills and practices are needed in learning science at the primary level and in the long run? Elaborate if you think both boys and girls have these traits in your classroom? Can these skills be developed or do you think they are inherent?

Some questions to learn about the teaching-learning approaches used by the teacher and how these methods incite distinguished motivation and involvement between both genders are also constructed:

- What materials do you use to teach science? Do you notice any differences in the way these materials interest girls and boys separately?

- When demonstrating science experiments, how do you select volunteers? Are boys or girls more likely to be selected?

- Who from your observation needs more feedback and teacher support in class, boys or girls? How do you provide this support and feedback? Is there space for support after class?

The interview questions also consisted of questions about the kind of interactions teachers were used to having with their students. Chin (2007) states that students made meaning of their knowledge from both teacher-directed lessons and teacher-student interactions. The kind of questions, how they are asked, and how the responses are managed can determine the stimulation of the cognitive process the students undergo to construct their scientific knowledge. The teachers were asked the following questions for this data:

- Do you ask questions during your lessons? What kind of questions?

- How do you manage responses by students? Do boys or girls give more voluntary responses? Why do you think so?

Research Approach	Qualitative Objective: ● Exploratory and inductive research ● Teacher's perspectives, attitudes, and practices
Research Sites	4 government primary schools Location: Dhanmondi and Lalbagh Grade 3-5 co-ed classrooms
Research Participants	Participants: Government teachers teaching Science Sampling Procedure: Convenience Sampling 2 males and 6 females Teaching experience: 15-25 years
Data Collection Method	Interview ● In-depth, open-ended ● Physical, phone, and zoom ● Audio-recorded ● 25- 30 minutes ● Interview-guided approach ● 13-items

Data Analysis	Thematic Analysis ● Transcribed and translated ● Color-coded and descriptive Theoretical thematic analysis and inductive approach to identify relevant themes.

Table 1. Summary of research methodology

3.5 Role of the Researcher

During the qualitative data collection, my role as a researcher was as an interviewer. Despite having been a teacher in one of the government schools, I approached the teachers with an unbiased, open mind to collect data regarding this sensitive topic that could bring about gender discriminating views of teachers. I built rapport with the teacher over the phone before scheduling the interview with them and notified them of my research topic, interview instructions, and the consent form.

I started the interview phase on 18th February 2021, and whether over the phone or in-person I had to constantly remind myself to not suggest ideas from my own classroom views as a former teacher. I made sure to let the respondents finish sharing and asked probing questions that allowed them to elaborate their answers instead of adding questions that could initiate biased thought processes.

3.6 Data Analysis

The collected data was analyzed by thematic analysis. Braun & Clarke (2006) described thematic analysis as a method to "identify, analyze and report data". The audio-recorded interviews were first transcribed and translated to English. By taking an active role to transcribe the data from zoom, call, and device audio recordings I was able to familiarize myself with the data before it was printed and read multiple times to color code relevant data, jot down recurring themes, and identify interesting new angles. Themes were filtered based on their importance to the research questions. While I dominantly took a 'theoretical' thematic approach, that is, to identify themes based on previous literature or the researcher's theoretical and analytical area of interest (Braun & Clarke, 2006), I was also open to identify new, emerging themes that are essential to understanding our local context better. Emerging theories from these descriptions were then organized in the result section and divided according to the two research questions.

3.8 Ethical Issues and Concerns

A consent form, both in English and Bangla, was printed. For the two in-person interview respondents the consent form was handed over for them to go through and ask questions if necessary. For respondents attending the interview virtually or over the phone, the form was emailed or sent through messaging apps one day before the scheduling of the interviews. The teachers signed, scanned, and sent back the form. For all the respondents, the consent form was read out again before beginning the interview to communicate transparency, data security, introduce the research topic, purpose of the study, and most importantly to encourage their dialogue. Participants were reminded again to have full freedom in accepting or rejecting participation in the study at any point during the data collection process. All data collected is strictly confidential to the researcher.

3.9 Credibility and Rigor

I have conducted quantitative and qualitative data collection as part of my previous academic coursework. I am familiar with the research topic and the school environment from prior professional experience as a primary classroom teacher.

3.10 Limitations of the Study

A few limitations of the study remain in understanding the entire state of gender equality in science in these classrooms.

- Firstly, due to the pandemic interviews had to be conducted mostly over phone and zoom calls. Technical failures, such as poor connectivity and noise disruptions were stressful and uncomfortable for both the interviewer and the respondent to go over answers and repeat questions. The virtual interview also lacked human connection and opportunity as the researcher to be aware of contextual and setting factors.

- Secondly, a lack of chance for classroom observations also omitted the scope to triangulate data given by teachers on their personal observation to actual objectively collected data from the researcher's classroom observations. As a result, data on students' participation and attitudes are all subjective considering teacher's perspectives and the articulation of their classroom experience. Any evidence of a gap between their conscious recollection of classroom data and the actual performance of students could not be cross-checked. Valuable data on teacher's gestures, posture, tone, verbal jigsaw, and cloze during teaching-learning could support the research in understanding teacher perceptions and their efforts in reality.

- During the interviews and data analysis stage, as a researcher, I felt my questionnaire had missing questions that addressed "why" teachers held certain perceptions to learn more about their past experiences and observations to give valuable data about the cultural context.

4. Results

4.1 Introduction

After the data collection period, the data was transcribed, translated, and analyzed. This section presents data organized under the two research questions by breaking them down into relevant themes emerging from the interviews.

The first research area is about perceptions of science teachers in government schools. The teachers were interviewed on their thoughts and opinions derived from classroom experiences and from introspective views. Firstly, when asked to define gender equality in education in their own words, all teachers acknowledged it as a ‘right’ of students, boys and girls alike, to have access to equal opportunities in resources and support. Next, data were collected on a range of factors- their opinions on the performance of boys and girls in science versus in overall academics in the grade, their perception of the acquired skills and innate abilities of the two genders, their thoughts on the participation and interest shown in science class between boys and girls based on students’ experiences and the classroom materials used. Following are relevant themes in the perceptions of teachers regarding gender in science in primary classrooms:

4.1.1 Performance and Participation in science class by gender:

Teachers were questioned on who, boys, girls, or both, they recognized as the better performer in science class based on participation in class, interest in science, as well as, academic results from assessments. Teachers had different opinions on how curiosity in science lessons varied between boys and girls:

4.1.1a. Curiosity in science learning: Task-based participation

Most teachers responded that there was equal participation from boys and girls depending on the type of activity or content of the lesson (63% teacher response). Teachers recalled student’s interest in the science lesson based on how eagerly and sincerely they attended the lesson. All of these teachers distinguished that boys were more involved in doing “practical” work and experiments both inside the class and outside school. Few teachers also pointed out boys were more confident and participative during chapters that taught about technology and invention. Girls participation was expressed by their ability to follow teacher instructions in class, perform well in written assessments and finish their homework:

> But overall, all boys and girls in my class show curiosity in science class. For boys, they are more responsive during experiments. In general, however, girls are active in making arrangements and helping to set up for class. In this case, boys are less active.
> (Interview #5, Date: 18-02-2021)

Few responses from teachers indicated that boys were more participative than girls in class and showed enthusiasm to learn (37% teacher response). This was measured by the teachers by student's involvement during practical works such as class experiments or by their ability to relate textbook theories to applications of these theories in their own lived experiences. One of the teachers elaborated that boys were able to connect classroom learnings to their personal interests and memory made outside of classrooms like learning from media:

> Sometimes they [boys] bring in new discussions or things they have seen on TV regarding a certain topic. They watch discovery channels and recall scientific facts.
> (Interview #8, Date: 22-02-2021)

No teachers responded saying only girls in the class were most participative.

4.1.1b Performance in science exams:

All teachers responded that girls usually scored the most marks in written science assessments, that is class tests or terminal exams. The ability to do well in these exams were also linked to showing more interest in the subject:

> I think girls are more interested in science. Especially, in the case of the exams, we take or the classwork we give in science class.
> (Interview #4, Date: 18-02-2021)

4.1.1c Performance in practical assessments and activities:

Most teachers perceived that boys were more involved during hands-on, outdoor science activities. Boys were thought to be enthusiastic in learning experiences that expanded beyond classroom teachings, unlike girls who were not as comfortable in outdoor spaces due to their obligations at home and for security reasons:

> The assessments we take outside our class, specifically the work I give to my students based on topics such as nature and the environment, boys enjoy going out and are eager to learn in outside class activities. When girls have to work outside, they tend to be

> reserved. They do not engage in many discussions or ask questions like you would want them to.
> (Interview #4, Date: 18-02-2021)

TAn interesting observation of the results also showed that teachers defined interest in science for girls and boys differently. All teachers who believed boys showed greater interest in science evaluated them against positive behavior towards practical experiences inside and outside class. On the contrary, teachers who agreed that girls had more interest in studying science understood interest as the ability to do better in assessments and classwork.

4.1.2. Comparing teacher perceptions of their students in science class to actual overall academic achievements:

Data was also collected from teachers who were among the top scorers in other subjects excluding science. Similar to answers for written assessments in science, a majority of the responses (75% of responses) specifically answered it was girls. Girls in most of the grades in these schools occupied the top student rankings during the terminal exams. Teachers shared this was mainly due to girls being obedient and hard-working by nature. Repeated use of the word “sincere” and “focussed” to describe girls’ attitude towards studies was noted in the interview transcripts, whereas, boys performances were excused due to their insincere efforts:

> They [girls] study more at home and focus on their work. Boys are less attentive to school studies. Boys are smart, they do well when they try, but they do not put much effort. Girls, however, give importance to the teacher's instructions to study at home, do their homework. They remember and attend to their tasks.
> (Interview #2, Date: 22-02-2021)

A few teachers also tried to rationalize their answers that girls were top students in class due to girls being more in number and in attendance, so teachers remembered mostly girls.

4.1.3. Teacher’s perspective on desired science skills and their acquisition by student gender:

4.1.3a Desired skills required to pursue science:

Next, teachers were asked to identify skills and requirements they believed were necessary to help students advance in the science field- in higher studies or profession. The three most commonly required abilities identified were invention or application, critical thinking, and mathematics skills.

The most frequently mentioned skill was the ability to apply, create or invent. More than 50% of teachers responded that students had to exercise the ability to create and invent, either by their own curiosity or through planned experiments. They accepted that studying science required higher-order thinking, the ability to transform their understanding to application and creation:

> Students need the skills to be able to connect them to reality. Just learning from the books, the facts and information is not enough. It can help them pass exams in school but to stay in the science field they need to constantly apply their learning and discover. Science is a subject where there is a need for high-order thinking. If students do not learn to think, do not learn to do, they will truly not understand even if I explain to them a thousand times.
> (Interview #5, Date: 18-02-2021)

Like the above-mentioned quote, most teachers put heavy emphasis on student's ability to apply the theory of scientific knowledge to solve real problems to be successful in the long-term. Few of these teachers also linked this ability to connect and create to the student's "intelligence". The responses indicated that students had to be meritorious and intelligent to keep up with the complexity of science knowledge. One of the teachers believed that a student's capacity to easily grasp the science learnings boosted their curiosity and confidence to learn more. They believed intelligent students were also interested in pursuing science.

Another skill highlighted was critical thinking that was often elaborated by the teachers with the ability to analyze, find deeper meanings and understanding mechanisms to reflect their learning beyond just memorizing.:

> In this case, interest is not enough, they may enjoy it but it's not enough to advance on the subject. I think students need to be thinkers. Science requires investigating and thinking, analyzing what is happening, how it is happening, and why it is happening.
> (Interview #3, Data: 25-02-2021)

Thirdly, some teachers emphasized that mathematics skills were a critical component for students to advance in the science field especially to study Physics and Chemistry in the long run. Biology was also viewed as a subject where remembering information was sufficient to advance. One of the male science teachers pointed out the importance of nurturing math solving skills from an early age:

> In the primary, students have to practice their skills in L.C.M, H.C.F, and fractions. These two chapters are critical at a young age. As for memory, unlike biology, in physics and chemistry, the first section of the question can be answered from memory. But section b and c require solving and math skills.
> (Interview #1, Date: 03-03-2021)

Therefore a combination and interdependence of math skills, critical thinking and application seems to be significant to learn science as perceived by the teachers.

The data was then intended to cross-check with data on teachers' perceptions on which of these skills belonged to boys and girls, and if differently.

4.1.3b Distinguishing acquired skills and innate traits by gender:

From the interviews it was evident that all respondents, although, believed that both boys and girls had the capability to learn and sharpen certain science skills, they also held certain beliefs that boys and girls had distinct, innate capabilities achieved from distinguished experiences or adopted "by nature" that gave one advantage over the other to perform well in science.

Opinions on male behavior, skills, and practices:
Boys were perceived as better at solving math problems than girls. A few of the teachers (37% of respondents) who identified quantitative math skills as a key component to studying science, all agreed that even if girls had an overall better performance in exams in all subjects including math, boys "by nature" were good at math. A teacher responded, 'In maths, boys are smarter and quicker than girls.'. According to these respondents, boys were also perceived to be better at solving creative or "unseen questions", whereas, girls were perceived as being more comfortable answering questions they had prepared for:

> But there are some differences too that we cannot neglect. Boys are better at solving more creative questions. Girls take a longer time. They are more comfortable in answering what they have read. This is why boys are good at maths.
> (Interview #6, Date: 19-02-2021)

This suggests teachers believe boys have a natural disposition for science and were simply "better" at solving creative or unseen questions. As mentioned earlier, 75% of respondents believed boys were more engaged in experiments, problem-solving, analyzing inside the class, and also in their daily lives. Few teachers specifically mentioned in their interviews that boys had more exposure to their community and through experiential learning could connect real-life applications of science to their textbook readings. Boys advantaged through their interactions in "mechanical shops, talking to rickshaw pullers, spending time in factories' '. Unlike boys, girls were understood to be limited to their homes and taking care of their families, thus limiting their knowledge and use of this knowledge. A few teachers also excused any lack of a boy's performance during exams or other assessments as their inattentive behavior but also confirming that they were naturally capable of approaching science beyond the syllabus. Interestingly, a repetitive example was used by three respondents to demonstrate how boys experienced science in their daily life as part of their development. They referred to playing with toy cars that boys experimented and analyzed from an early age and developed these key skills to understand mechanisms:

> When little boys get toy cars they have the tendency to break it and separate the parts. In these cases, boys are more curious.
> (Interview #1, Date: 03-03-2021)

Opinion on female behavior, skills, and practices:
Words such as "effort", "serious" and "sincere" were used frequently to describe how girls were compliant and focussed on following teachers' instructions to help arrange class activities, completing homework, and studying at home. 38% of respondents shared that girls were skilled in drawing and learned better through diagrams, "They easily remember labels and recall what the diagram is about.".When asked if girls experimented with their toys too, one teacher explained girls were not too interested in experimenting and that it was a trait developed by nature in boys who "grew up by breaking things, making things." and that "concepts of science came more naturally to boys". A few of the teachers also shared that girls were intimidated by science and believed it was a difficult subject. They perceived that girls did not usually practice higher-order thinking and were good at memorizing unlike the skills desired in science:

> Girls do not think too hard. They are good at memorizing. If you ask them questions from the book they will be quick to answer you. But it is difficult for them to give examples or analyze a situation.
> (Interview #8, Date: 22-02-2021)

The second research question focussed on what teaching-learning methods and materials were used to encourage equal participation of boys and girls in science. Data was collected on how science teachers facilitated science lessons, how they interacted with students, and what materials and activities could spike differentiated interests between the genders.

4.1.4 Distinguishing participation of boys and girls during various lesson activities:

100% teachers shared that they were mostly used to using textbooks to explain scientific theories and asking students questions directly from the textbook to check if they were following the lesson. Most teachers agreed this was because they had to cover many topics over a short time. But occasionally unconventional and engaging lesson designs would include classroom experiments, whole-class demonstration using materials, outdoor activities for observations, and collection of data.

4.1.4a Class experiments:

75% of teachers occasionally carried out lesson demonstrations using classroom experiments. The rest of the teachers only adhered to one-way knowledge transmission of textbook lessons. Teachers shared it was difficult to incorporate many activities due to limited class times and shortage of materials for all students. 4 out of 5 teachers, who shared their perception that boys were accustomed to performing practical experiments, proving theories, and linking to real-life applications at the beginning of the interview, shared in their observation of classroom experiments that in fact both boys and girls were eager to participate during practical tasks regardless of their academic potentials:

> I think both boys and girls are very attentive during experiments. For example, I once demonstrated an experiment showing that fire does not burn without oxygen. All boys and girls brought candles to class with great curiosity to do it themselves. I observed both boys and girls were enthusiastic about doing the experiments in class and had fun. (Interview #2, Date: 22-02-2021)

One teacher explained that this is because experiments were more intriguing than intimidating for students at a young age. She believed learning science and its knowledge of the world and its mechanisms were new and exciting for children. At the primary level, students enjoy science lessons and have more voluntary participation. In conducting classroom experiments, most teachers explained that they notified students to bring the materials before class due to the inability of the school to provide students with the necessary materials. In doing so, all students could participate. The rest of them would perform experiments in front of the entire class for students to see only. All students, boys, and girls tried their best to manage the items before class.

4.1.4b Group activities and Leadership:

7 out of 8 teachers planned occasional group activities during science lessons. One of the science teachers occasionally planned group activities which required students to go to the roof or the playground to make observations from nature and the environment for certain lessons. Her observation was similar to the majority of responses that said, unlike boys, girls seemed more comfortable to participate inside than in groups or activities outside classrooms. Boys, on the other hand, "generate good discussion, they are active, run around the space to collect information.". Girls were observed to be more reserved. One of the teachers shared that girls in her class hesitated in taking part in group activities that required them to go outside of their classrooms and consequently missed out in developing crucial experiences to develop scientific knowledge:

> When outside the classroom I have to divide them in groups, boys and girls usually mixed together in each group, and I ask them to take certain notes and write on their observations, girls do not even want to go near the gate. They do not want to write their observations or do the task outside the classroom.
> (Interview #4, Date: 18-02-2021)

When asked who were assigned, and if not, voluntarily stepped up to take a leadership role during group projects, more than 50% of the teachers responded they always mixed boys and girls when creating groups but did not assign group leaders. It was boys who were more likely to volunteer to be leaders. They often quickly assigned themselves as the leader asking the teacher to be handed the authority without mutual discussion within their groups, regardless of how much they could contribute to the task with knowledge support. One of the teachers explained it was the "extrovertedness" of boys that made them claim authority. Sometimes teachers deliberately put quiet and introverted students in groups to motivate leadership among themselves, even in these cases, it was mostly boys or older students who stepped up to take the lead due to their more "extroverted" and confident nature. Sometimes girls who felt confident in their abilities or were naturally outgoing stepped up:

> In introverted groups it is seen that after a while some students decide to be outspoken. Even then it is usually the boys interested in the leadership roles and sometimes girls who are good students or naughty in general.
> (Interview #4, Date: 18-02-2021)

Only a few teachers responded that it was girls who were more likely to claim leadership and do better work collectively. These teachers also stated that they created separate groups of boys and girls. However, one of the teachers quickly rationalised the circumstance, that it was usually because they were among girls and felt more comfortable in raising their voices, sharing their opinions when they worked with their friends. These teachers also believed girls were better leaders:

> Girls are also better leaders. They're work is smoother and sincere. So they perform better.
> (Interview #5, Date: 18-02-2021)

4.1.5 Differentiating teacher-student interactions by gender of students:

To assess how student participation may be influenced by how teachers and students interact in the class, information was collected from teachers on how boys and girls responded to questions, engaged in discussions or asked for teacher support in class. This question received mixed responses.

4.1.5a Response type and frequency during lessons by gender:

75% of teachers mentioned in a regular class they picked students during questions and discussion from those who knew the answers and raised their hands voluntarily, or students who were seen to be inattentive or disturbing the class. To find out more about voluntary responses, 50% of the responses favored that boys were more comfortable and confident in responding voluntarily to teachers' questions or contributing in classroom discussions. These teachers all agreed that girls were calm and quiet in nature. One of the respondents believed boys were not afraid in classroom discussions and activities because they were not scared to make mistakes. Girls on the other hand were cautious of their image and did not want to risk making mistakes:

> They [girls] are tensed whether they are making mistakes, if they will be scolded. And for boys getting scolded is not a matter. If they make a mistake, they will be corrected and they will move on.
> (Interview #1, Date: 03-03-2021)

Only one teacher responded that she experienced more voluntary responses from girls when she asked questions to the class because girls usually studied and did their homework. The rest of the teachers (38% of the respondents) said responses varied depending on the type of student, their level of confidence or the designed class activity. Students who knew the answer to the questions, regardless of gender, or when competing in a scored group activity, were more likely to respond to the teacher more spontaneously. For one teacher who shared that she received more voluntary responses from girls, she also expressed that due to the higher number of girls in her class, they were more confident among other girls.

100% of the responses also indicated that boys took up most of the teachers' time in class while girls were serious and usually busy with their class work. Compared to girls, boys were more disruptive in class and required more supervision and teacher intervention to get them to pay attention. Teachers usually helped boys pay attention to the lesson by calling on them to answer questions to the entire class and repeat what they missed, or asking them to read a paragraph from the book, or allowing them to share their thoughts in a discussion to motivate them and feel included. Teachers also agreed that boys needed more supervision than girls who did not usually interrupt the teacher:

> I ask them to repeat what I taught them, ask questions or have them read from the book. Even though they do their tasks during class, they are slow and I lose a lot of time behind them. I have to supervise them more. But for girls, there are those who are focused on their work and some [girls] who do not understand the instructions or do not know how to do the task, they just sit quietly. They do not waste my time.
> (Interview #4, Date: 18-02-2021)

As a result of this, most teachers admitted to overlooking girls who were quiet in class but still struggling during the lessons. Some teachers were too busy rectifying and engaging the boys and some teachers deliberately did not waste further time to help "quiet" girls.

4.1.5b Extent of teacher support to students by gender:

Regarding holding teacher support or individual feedback, none of the teachers held extra hours to help students with their problems relating to lessons. However, all teachers said they were available in the teacher' rooms if any student had questions. None of the teachers gave thorough feedback to students after assessments. Teachers were only used to helping students finish class work. However, when asked to elaborate which students were more likely to ask for teacher support during or after class, 38% of the responses indicated that teachers thought both boys and girls were shy to ask for help, but concluded boys were more "open to speak up and share their thoughts. They raised their hands and asked questions." Girls hesitated to question but slowly would find the courage to do so after a while. 50% of the respondents said:

> girls do not ask for help. They stick with whatever and how much the teacher taught in class. But boys come for support when they do not understand something. This is very common in boys.
> (Interview #1, Date: 03-03-2021)

Two of the teachers responded that she had more girls asking for teacher's help in her class to understand their lessons due to external circumstances. Most girls in their class did not have a private tutor due to financial issues and disinterest of guardians to invest in girl's education. They explained boys had private tutors in most cases, but girls tried to learn as much as they could by clarifying their confusions and taking support from their teachers at school.

Additional data on teacher expectations from their students to support our research data was collected. 100% of the responses favored that boys were more likely to choose science for higher studies and work in a science field, in spite 5 of them admitted to believing both boys and girls had the capability to excel in the field. These teachers shared that girls were at a disadvantage due to social constraints. The respondents believed girls were more likely to drop out due to responsibilities at home, forced child marriages and inability of parents to invest in their education. One teacher pointed out that studying science required private help from tutors and is also an expensive subject in higher classes. Two of his female students were forced to choose arts by their parents due to their parents unwilling to invest in their education, especially since they are expected to take care of their homes soon onwards.

4.2 Major findings

Some major findings from the research are as follows:

- Although 6 out of 8 science teachers were female, they came from schools with all-female staff, suggesting that primary school teaching is a feminine profession (Ullah, 2016) even though science was “masculine” and more favoured to be taught by men.

- Teachers defined the “interest” of students in science differently based on their gender. Girls’ interest was defined by their ability to score more in written exams, carry out teacher’s instructions and help teachers make arrangements for class, whereas boys interest was believed to be due to their active nature during practical activities, exposure to the outdoors and natural disposition through their development, personal hobbies and lifestyle.

- Girls scored more marks during written assessments in all classrooms and were described as sincere, hard-working and compliant. Boys were commonly observed as inattentive and disobedient.

- Boys were perceived as developing or naturally gifted with the desired traits in science- such as creativity, applicability, critical thinking and reasoning, analyzing, and math skills. Some teachers believe girls do well because they memorize.

- The most common teaching method for teachers is by an authoritative discourse due to a shortage of time with a one-way transmission of scientific knowledge from teacher to the student. Occasionally there are whole-class demonstrations of classroom experiments and with instruction, beforehand, to students to bring their own materials. Teachers also hosted outdoor activities for observation or data collection in rooftops and playgrounds.

- All teachers carried out group activities by creating either mixed and homogenous groups with no assignment of leaders. Students were free to choose their leaders.

- During group activities boys were more likely to claim authoritative roles to lead the team, whereas, when girls led all girl groups during activities they worked better collaboratively and harmoniously.

- All students, boys and girls showed equal excitement and curiosity during experiments, even though most teachers perceived that boys were more curious and practiced class experiments, in reality, the majority of the classrooms saw that both girls and boys showed equal enthusiasm in carrying out experiments. This is because for primary school children science is a new subject and they are excited to make meaning of their world.

- Boys enjoyed practical, hands-on activities more. They are active during outdoor learning and generated good discussion, whereas, girls were reserved and hesitant outside classrooms.

- Boys were more likely to make voluntary responses to engage with the teacher in the lessons. They are more confident as opposed to girls who are worried about making mistakes, and would only speak up when they felt confident among peers or if they knew the answer to a raised question.

- Boys occupied most of the teacher’s time to manage disruptive behavior. Subsequently, boys also received more attention from the teachers to engage in the learning by being asked more questions, receiving more feedback and being praised for their efforts.

- Teachers believed both boys and girls had the ability to pursue science in their futures but more number of boys were able to achieve this in reality than girls due to lack of family support, inconfidence and financial investment in girl’s education.

5. Discussion and Conclusion

5.1 Discussion

In this section, the results are presented for boys and girls separately discussing their performance and interest from teachers' perspectives and their behavioral patterns during participation over various learning activities from teachers' observation. The findings from this research have also been compared to existing literature reviews.

5.1.1 Teacher Knowledge and Training on Gender Equality:

In my sample of government school teachers in Dhanmondi and Lalbagh, I was initially determined to interview one male and one female science teacher from each school to further explore if perspectives and student achievements varied with teacher's gender as claimed by Crombie et al. (2003), as well as, Beilock et al. (2010) whose research finding suggested female teacher's anxiety and beliefs on subjects influence girls' achievements. However, only one school had male science teachers from my sample and the total respondents interviewed were 6 female and 2 male science teachers. It was also noted that in the three schools with female science teachers, the entire teaching staff was female and science was usually assigned to Teach for Bangladesh male fellows in some of the classes. This information might suggest that when the staff consisted of male and female teachers, male teachers were more likely to be assigned to teach science in these schools. The data collected hence was more representative of female teachers' opinions and observations. All their classes were co-ed with all classrooms accommodating a greater number of girls than boys. The study found that none of the teachers in their years of experience had received any professional training from the government or private institutions to learn about the history and significance of gender equality. However, all teachers were able to define gender equality in education as a student's "right" and defined it as equal access to opportunities, resources, and social support for boys and girls in education.

5.1.2 Comparing boys and girls in science: Interest, Performance, and Skills from Teachers Perspective

5.1.2a Boys' curiosity and social lifestyle:

In my findings, most respondents shared their thoughts on boys having equal or more participation than girls during science lessons in their classrooms. Boys were perceived to show interest in science applications demonstrated during classroom experiments and also in real-life implementation. Some teachers thought what raised this curiosity during lessons in class is boys' abilities to connect their classroom lessons to their learnings outside class, such as linking their textbook lessons to what they learned watching scientific docu-series in National Geographic channel, or from their experiences outdoors in the community visiting mechanical shops, helping in factories and being in nature. Lind (1999), as cited by, Ting and Siew (2014) explained that children applied science concepts when they explored the outdoors. Outdoor activities such as outdoor lesson activities, field trips, science fairs, etc., are crucial to developing an interest in STEM. especially for girls, as stated by Cooper and Heaverlo (2013). Although there is limited scope for teachers in these primary schools to accommodate outdoor opportunities due to time, limited staff, and finance, most of the teachers shared their opinions that boys performed better during classwork and assessments when lessons included experiments, outdoor learning activities, and other hands-on experiential learning efforts. According to the UK's National Foundation of Education research (2004), as cited by Ting and Siew (2014) outdoor activities had a positive impact on children's science process skills. This perception is contradictory to Gray and Leith (2004) research findings where teachers from their observation stated boys did not actually enjoy science experiments. However, this is inconclusive because from teachers' perceptions it is difficult to presume if it is the inattentive nature of boys or an actual lack of interest. However, boys lagged behind girls during written science assessments in terminal exams where teachers believed girls scored higher and were mostly among the top students in the class. Some teachers regarded this as boys, in general, being less attentive in studies and putting in a low effort. Ahslund and Bostrom (2018) set a similar lens in observing how boys and girls approached their schoolwork in the early stages of school. They mentioned that girls in Sweden and Finland had an orientation for self-improvement by working out how to learn and make progress. Boys, however, were performance-oriented and inclined to putting minimal effort and doing just enough to finish their work.

5.1.2b Boys' high-order cognitive abilities and aptitudes for science:

Regardless of their performance in terminal exams, it was found that the perceived aptitude and acquired skills in male students matched all the most common and desired skills to develop scientific knowledge and capability as per teachers' perspectives. The most commonly identified skills by more than 50% of the teachers were the ability to apply the scientific knowledge through the creation and/or invention, and the critical thinking abilities to observe, investigate and reflect in pursuit to find deeper meanings and inspire curiosity. This is similar to the findings of Richardson et al. (2009) that science teachers believed science was a subject involving abstract thinking to fully grasp scientific knowledge. Shepardson and Pizzini (1992), as cited by Tatar and Emmanuel (2001), stated that teachers viewed boys as being skilled in abstract cognitive abilities such as reasoning and analyzing, likewise most teachers in my study viewed boys as having a natural edge in science. Boys were “by nature” better at applying their learned knowledge to real-life situations because of their experience outdoors and exposure to various scopes for experiential learning. Ting and Siew (2014) explained using various existing literature that young children who explored the outdoors stimulated curiosity which is crucial for science lessons as children are able to learn and retain longer using all their senses investigating events and objects. This was proven in their experiment with year 5 students in Malaysia who showed the most growth in their science process skills over the school year who participated in multiple outdoor school lessons compared to the controlled group. Like so, boys in my study were perceived to be naturally curious to investigate and experiment to find out the ‘how’ and ‘why’ of mechanisms in their surroundings.

Creativity, design, and innovation are also listed as essential skills for students’ STEM development (Cooper & Heaverlo, 2013). A common example the teachers repeatedly used to interpret boys’ innate ability of in-depth thinking, problem-solving, and curiosity to create was explained by how boys from an early age had the tendency to play with toys and most often break apart the parts of their toys and then rebuild them or make a completely new object. Teachers in the study of Murphy et al. (2017) also shared these attributes- questioning, curiosity, and engaging the senses were habits of mind to make complete meaning of science. Another important skill to excel in the science field especially in studying Physics and Chemistry, mentioned by a few of the teachers, was proficiency in Math and likely quant skills. Boys were seen as smarter and quicker in solving various math problems and required application skills to work out unseen or creative questions.

Evagorou and Dillon (2009) defined these abilities to analyze interrelationships between scientific concepts and objects, investigating properties, solve problems and anticipate consequences as ‘systematic thinking’, a high-order reasoning skill that helped develop the understanding of systems. In science education, systematic thinking aids the solving of complex systems of scientific phenomena, such as energy transfer and ecosystem (Evagorou & Dillon, 2009). Based on this definition it can be interpreted that teachers in our study believe boys acquired similar attributes to achieve systematic thinking. Grotzer and Basca (2003), as cited by Evagorou and Dillon (2009) emphasized the significance of developing systematic thinking skills in science as a requisite for conceptual understanding. Suggested modes of developing systematic skills were case studies for students to solve the best outcome and the practice of forming criticism, challenging opinions, and raising questions (Evagorou & Dillon, 2009).

5.1.2c Girls: Rule followers, compliant behavior, and learning by the book:

As for girls, close to Miller et al. (2006) that high-school girls thought science was uninteresting and difficult, none of the responses by teachers in this research favored that girls were interested in science lessons. This could either suggest girls showed disinterest in science from an early age or that teachers based their perceptions on high school experiences. However, all teachers stated that girls excelled in written exams and scored more marks than boys. More girls were among the top students in all of the four schools as the study of Fabregat et al. (1999) found that teachers believed it was the girls' sincere and diligent efforts that resulted in more achievements than their male counterparts in the elementary level. Ashlund and Bostrom (2018) mentioned that teachers perceived that girls provided more quality work and were more independent and organized in their learning. Similar to our research, in the study of Ashlund and Bostrom (2018) teachers also perceived girls were more likely to successfully manage their academic goals and requirements better than boys. From a different point of view, Stevenson et al. (2021), mentions that even though numerous studies suggested that in the US, girls at the elementary stage outperformed boys in the classroom, girls still struggled with self-efficacy and assumed science and technical fields were not for them (Nation et al. (2019), as cited by Stevenson et al (2021)). Like our teacher respondents, the teachers from the study of Stevenson et al. also presumed girls had a lower probability to pursue science fields outside life sciences or psychology due to poor self-efficacy and self-concept.

Some characteristics outlined by the teachers for girls are that they are more sincere and naturally hard-working than boys. The majority of the teachers were also able to point out that girls were motivated to follow the teacher's instructions and complete given tasks. So girls turned in homework, did their classwork according to the instructions, and prepared for tests just as suggested by Shepardson & Pizzini (1992), as cited by Tatar and Emmanuel (2001) that girls were set to complete tasks. This finding can be explained by the cultural context of Bangladesh. Hossen (2020) reported Bangladesh's society and institutions as patriarchal. Bangladesh, like its conservative neighbouring countries, has institutionalised patriarchy at all aspects of society, starting from within households where boys are taught to be assertive and girls to be submissive (Hossen, 2020). Stanworth (1981) and Walkerdine (1990), as cited by Gray and Leith (2004) said some teachers did not appreciate this diligent attitude and pleasing approach of girls. Skill-wise, girls were seen as better at drawing diagrams, learning from labels.

As mentioned, few teachers also believed girls were not naturally as skilled in math as boys either. Beilock et al. (2010) concluded from their research study that girls who held traditional gender beliefs on the masculinity of STEM areas had poor achievement in math in elementary school that was transmitted from their female teachers with math anxiety who grew up believing the same. AAUW (2010), as cited by Beilock et al (2010) stated how girls felt about math impacted their interest in pursuing science fields. Teachers in my study also perceived girls did not practice much high-order thinking and were more accustomed to memorizing their lessons than seeking further meaning in their learning. Ridley and Novak (1983) explained rote learning as verbatim and lack of intent from the learner's part to make meaningful learning by relating new knowledge to prior knowledge. Ridley and Novak (1983) further explained this tendency to please the teachers whereas, boys were usually risk-takers and challenged teacher's expectations. The findings in my research are aligned with this that the teachers viewed that girls were more compliant and task-focused than boys who were confident, responsive, and comfortable to engage with teachers whether in discussions, asking for help, or being disobedient in class. However, data from the study of Meece and Jones (1996) showed contrasting evidence that girls in the same ability scale as boys were among those who used more meaningful learning and construction of knowledge to learn science.

Teachers in my study also believed that girls are intimidated by science subjects and less likely to select science fields for future studies and professions due to low confidence, financial and social restraints. A study on grade 5 and 6 students by Meece and Jones (1996) found that girls were less confident in science but no gender difference was noted in exam scores. They suggested it could be the masculine image of STEM subjects that leads girls to undermine their abilities even though they performed as well as boys. Stevenson et al. (2021) recommend science teaching should involve teaching practices that praise students for their efforts and persistence rather than innate abilities. This is to develop self-efficacy in science and encourage further engagement in the subject. This is especially necessary for girls as they perceive science as one of the fields that require innate talents (Donovan et al. (2019), as cited by Stevenson et al. (2021)).

5.1.3 Gender stereotyped Science topics

The majority of the teachers did not find a distinguishable interest of boys and girls in separate topics. It is because science was a relatively new subject and all students were eager to understand science and its prevalence in our everyday life.

5.1.4 Comparing student involvement by gender during learning activities

In primary classrooms teachers mostly used traditional methods, adhering to textbook teaching and one-way transmission of knowledge from teacher to student. However, most teachers were also used to carrying out activities in class to elevate learning using demonstrations and practical work. Boys and girls were also observed to have contrasting involvement during these activities.

5.1.4a Class experiments:

Most teachers occasionally planned lessons with a demonstration of science theories through class experiments so students had the opportunity to learn real-life applications of science. It was noted here that maximum teachers who initially expressed their perception that boys, in general, took more curiosity in science practical experiments, also in their observation found that in fact both boys and girls were equally enthusiastic during these practical lessons and actively took part in performing experiments in a class by preparing materials and participating in experiments. This was explained as usual behavior of young children eager to show interest in learning new things and understanding the world. Murphy et al. (2017) also shared teachers' belief from their classroom observation of elementary students that 'doing science' required visualization and active engagement of the senses to truly understand scientific concepts. Peacock et al. (2021), in their study on fourth graders also found a positive correlation between physical hands-on learning in their natural environment and improved academic outcome.

5.1.4b Outdoor science education, group activities, and leadership:

Outdoor group activities are also a common teaching method used by the majority of the teachers who have students work together in the roof or school playgrounds to note observations from nature and the environment to develop a deeper understanding of their lessons. Based on teachers' observations, in most of their cases, boys were more active and eager during these activities, discussing their findings with the groups and running to gather information. On the contrary, girls were noted as being reserved and hesitant to work comfortably during these outdoor activities. This could be extrapolated from the information that boys were more used to being outside of their homes, roaming in their communities whereas, girls were socially limited to their homes attending to family responsibilities. Hossen (2020) highlighted the cultural norm of Bangladeshi women to have monitored or restricted mobility and freedom outdoors to do chores, work, interact, etc. This is a common culture practiced in the indian subcontinent, where society placed emphasis on girls' subordination and "protection" under a a male relative or authority outdoors to upload family's reputation and conservativeness (Gilbert et al., 2004). Stevenson et al. (2021) describe outdoor science education as an important tool for students to learn from an authentic context through social interactions, as well as, exploration of scientific content. Such lesson practices in the outdoor setting give all students, mostly girls and introverts, the opportunity to connect with the social and natural world and engage in scientific practices (Stevenson et al., 2021). Outdoor education also aids the learning of students who do not fit into the traditional instructions of teaching inside classrooms (Carrier et al., 2014).

Carrier et al. (2013) presented that students with minimal outdoor experience were prone to "developing fears of the outdoors." (p. 2061). Stevenson et al. (2021) also emphasized this to be true for students who experienced strict parental supervision and increased indoor activities. This could explain why some teachers found girls in our research to be hesitant in exploring outdoors during lessons. The majority of the teachers shared that girls in their class had to attend to chores and obligations at home while boys were used to roaming the outdoors. Carrier et al. (2013)

study on outdoor teaching of fifth-grade students in science showed that students of a facilitator who made them comfortable and expressed enthusiasm had a positive effect on student’s outdoor learning than for students under a facilitator who relied heavily on instructions and little feedback. Similarly, the experiment on fifth graders under the outdoor science program lessons by Stevenson et al. (2021) also suggested that teachers need to play a supporting role instead of an instructor to foster students’ skills to explore, observe, and evaluate in the outdoors.

Collaboration is also seen as an integral part of exploring scientific knowledge (Carrier et al. (2014) and Murphy et al. (2017)). Students recall their lessons from collaborative work in their playgrounds not only because they had fun but also because they had the option to ask their friends for clarity or help (Carrier et al., 2014). Teachers also shared that they did not normally assign group leaders during these activities encouraging voluntary participation. As found in Gray and Leith (2004) in most cases when each group had both boys and girls, boys responded to take an authoritative role and lead the team without mutually discussing ahead with their teams. This was regardless of boys’ confidence to support the team with the task outcome. This behavior is acknowledged as their extroverted nature especially observed in strategically created groups of introverts where it was most often boys who opened up to lead. A contrasting scenario for a few teachers who always created separate groups for boys and girls for lesson activities saw that girls showed equal enthusiasm to be assigned as leaders and believed in a collective spirit. Likewise, Davies (2003) reported in his study that girls worked harmoniously together, respecting each other's opinions and focussed on the task. The teachers in my study also commended that when girls were leaders and working in same-gender groups their work was smoother and more sincere compared to boys who became more disruptive. Girls felt more at ease when grouped with same-gendered peers similar to the findings of Liem and Martin (2011), as cited by Rabenberg (2013) that same-gendered peer groups had a more positive influence on girls’ engagement. In their study, Meece and Jone (1996) found that in grades 5 and 6, students had a stronger desire to study in small group activities than whole group settings where teachers had more control. This was true across students of all abilities and gender because they felt more involved in their learning process. However, this study also reported that small groups led some students to use effort-minimizing strategies if not monitored carefully by the teacher. In whole-class discussions, students feel accountable for their own learning. However, small group activities and communal methods of ‘doing science’ are still a necessary teaching practice that more teachers should incorporate in their lesson design regardless of time bounds and other complexities. Murphy et al. (2017) study on teacher notions on science as an experience and exploration found that most of the teachers recalled from their childhood science lessons that they participated in with their friends. They also shared observations from their classrooms that students enjoyed and remembered ‘hands-on’ lessons that they did in groups.

5.1.5 Comparing teacher-student interactions by student gender:

Teachers are mostly accustomed to an authoritative discourse due to short lesson time and heavy syllabus. For most days teachers transmit lesson theories to explain the topics and ask simple follow-up questions on the lesson or on previous knowledge. Only a few teachers tried to involve all students to share their thoughts and experiences but faced difficulty in encouraging students due to shyness. Chin (2006), as cited by Chin (2007), suggests that in classroom settings where students struggle to verbalize their ideas teachers need to practice ‘responsive questioning and feedback’. This is a scaffolding technique to help students bring out their thoughts, add probing questions, guide student thinking, and fill in knowledge gaps among different student’s ideas. The more common authoritative instructional discourse in our study could also be interpreted as teachers’ strategy to manage classroom behavior (Ahslund & Bostrom, 2018). Teachers used this method as they found better results managing boys’ performance in the classroom through entire class discussions or one-on-one teacher interactions rather than engaging them in any activities that could push boys to go off-topic.

In interactions with students during lessons, teachers admitted to engaging more with students who willingly participated during discussions. These were usually the academically competitive and “smart” students. When asked about this voluntary participation half of the responses shared from their classroom experience that boys were mostly confident to speak up and engage with the teacher in discussions, often sharing their thoughts and opinions. This resonated with the research findings from a grade 3 classroom of Leder (1990) that boys in classrooms felt more comfortable to vocalize their understandings and confusions, and were willing to respond to the teacher while also receiving more attention from the teacher. This finding is in alignment with the findings of elementary science classrooms where boys were eight times more likely to volunteer for answers as opposed to girls (Sadker & Sadker, 1994, as cited by, Eddy et al., 2014). Another half of the teachers shared that girls gave more voluntary responses to answer teachers’ questions or help draw a diagram on the board. Other than that, teachers also put effort to involve disruptive, inattentive students who interrupted the class. Even though boys were said to be more responsive to the teacher in the classroom, all teachers during the interview agreed that it was mostly male students who took a significant focus off the lesson urging the teachers to intervene and have them refocus, spending more time to make sure they were caught up with the class lesson. Similar to the classroom studies of Jones and Wheatley (1990) and Leder (1990) teachers paid more attention to boys by asking them more questions, providing feedback and praise as they did their classwork, and encouraging their involvement by helping the teacher to prepare materials or read from the textbook. Boys’ behavior to argue, respond and interact with teachers during a lesson could also be reflected as an opportunity that was allowing boys to develop critical thinking skills (Evagorou & Dillon, 2009). Girls were seen as quiet, conforming, and reserved and most of the time overlooked by the teacher when they needed help but did not voice their concern as they tend to be shy to ask for teacher support and ask further questions. This scenario can be interpreted as that by Irvine (1986, as cited by Oluwagbohunmi, 2014) and Ahslund and Bostrom (2018) that teachers had more frequent and elaborated interactions with boys than girls as a means of controlling classroom behavior. This is deemed concerning to Ahslund and Bostrom (2018) for teachers who perceive boys' behavior as negative. In their study teachers thought boys were demotivated and avoided school work also showed that teachers had lower expectations from boys' academic achievements which in turn affected boys' grades in exams due to negligence of teacher efforts. For example, from teachers' lowered expectations boys in the classroom may believe there is no need to put in extra effort and thus creating an endless loop for poor performance, as also mentioned by Brophy (1983). Ashlund and Bostrom explained that teachers in these elementary classrooms placed the responsibility to utilize learning opportunities on students instead of adjusting their teaching-learning methods and classroom management.

On the other hand, none of the teachers held extra hours for student support and feedback to allow space for students needing help. However, half of the responses indicated boys were vocal about their confusion and asked for the teacher's guidance. For some of the girls who were proactive in their learning were said to be because they could not afford private tutors and therefore had to get all the help from school teachers.

5.2 Conclusion

This research was aimed at exploring how teachers in government primary schools in Dhaka could impact a gender gap in STEM for children from an early age. Teachers' perceptions and student performance data were collected across four schools in Dhanmondi and Lalbagh area. Teachers although not receiving specific learning on gender equality were still up to date about its significance today. Although teachers believed both boys and girls could pave their way in future science fields given they were both socially, financially, and emotionally supported equally, it was found that teachers held certain concepts on gender abilities and interest in science that were reflective of some biased interpretations, such as boys showing more interest in science and experiments, boys having greater math and science process skills- creation, application, critical thinking and analyzing. While girls were commended for their sincerity and diligence in their efforts they were held against stereotypical opinions regarding their abilities in science. Moreover, this perception of teachers was influenced by teachers' observations of class performance too. Girls fell behind during certain teaching-learning activities such as group works and outdoor activities where girls showed resistance to work outside classrooms and out of their comfort zone in mixed groups with male leads. This is also reflective of how girls are socially brought up within their homes as opposed to boys who have more exposure to learning from their surroundings. While this research is not conclusive it gives little insight on a few of the views science teachers have that can make way to further research with a larger sample size with an equal number of male and female science teachers to investigate possibilities of distinguished perceptions on the topic. Additionally, student's perceptions of their performance, feelings towards science and class activities could be obtained for greater understanding. This study has allowed me to see that traditional gender views still exist to some extent in teachers in primary schools and children's development outside of schools also impacts how they function within lessons. Teaching-learning practices need to be designed and monitored to ensure students have an equal chance to be engaged and motivated in their learning of science.

5.3 Recommendations:

It is difficult to alter teacher perceptions as they are formed from personal experiences, social mindsets, and biases. However, adequate awareness and training on how they conduct learning for both boys and girls in the classroom can be helped. Teachers have to diversify their lesson plans to go beyond authoritative discourse and implement a mix of science activities to allow students, boys and girls alike, to make meaning of their scientific knowledge by active participation and enhanced cognitive processes. Keeping in mind the limitations of time, resources, administration and outdoor opportunities in a government primary school in Dhaka the bellow recommendations may help teachers create and inclusive science learning environment for students:

i. Acquire dialogic discourse to elicit student responses: Allow thinking time after questions for students to gather their thoughts, encourage different point-of-views from students, ask probing questions to guide discussions and create a more complete learning. .

ii. Develop systematic thinking: Design classroom lessons that incorporate activities to build higher-order thinking for students to analyse and apply their textbook learnings from theory to solve real-life issues. This can be done by solving case studies and hosting debates.

iii. Accommodate more outdoor activities: Use available and accessible outdoor spaces, such as school rooftops and playgrounds, to give students, especially girls, the opportunity to interact in nature and socialise. Teachers should remember to act as facilitators instead of instructors and share enthusiasm with students to enjoy the learning experience.

iv. Create smaller groups for student activities: Have students pair up in small groups to keep them engaged in the activity, especially boys, also a way to manage classroom behavior by 'keeping students busy'. Same-gendered groups will also help girls to feel more comfortable and confident to work among their peers. Teachers should assign leaders in mixed groups so both girls and boys get turns over different lessons to practice leadership and building confidence.

v. Practice self-awareness: Mention female role models in science during lessons to avoid gender stereotyping of science. Teachers should also be aware during classroom conduct to not make gender-biased or gender-stereotyped comments that discredit student's abilities based on their gender.

vi. Give feedback and support: Identify students who may be struggling to keep up with the lesson. Hold spaces during breaks or before shifts to help students share their questions and catch up with the lesson. Correction classes once a week could also be helpful to address common misconceptions and difficult topics.

Lastly, the research could benefit from studying math classes and math teacher perceptions too. Alexakos and Antoine (2003) suggested that math was also a "gatekeeper" to physical sciences and engineering professions and also influenced how students enjoyed or feared pursuing science. Further research is recommended to study students on both their math and science performance and find any possible patterns in their achievements and behavior.

References

Ahslund, A. & Bostrom, L. (2018). Teachers' perceptions of gender differences- What about boys and girls in the classroom? International Journal of Learning, Teaching and Educational Research, 17(4), 28-44. https://doi.org/10.26803/ijlter.17.4.2

Aikman, S., Halai, A., & Rubagiza, J. (2011). Conceptualizing gender equality in research on education quality. *Comparative Education, 47*(1), 45-60. https://doi.org/10.1080/03050068.2011.541675

Alan, S., Ertac, S., & Mumcu, I. (2018). Gender stereotypes in the classroom and effects on achievement. *Review of Economics and Statistics, 100*(5), 876-890. https://doi.org/10.1162/rest_a_00756

Alexakos, K. & Antoine, W. (2003). The gender gap in science education. *The Science Teacher (Normal, lll)*, 30-33.

Beilock, S. L., Gunderson, E. A., Ramirez, G. & Levine, S. C. (2010). Female teachers' math anxiety affects girls' math achievement. Proceedings of the National Academy of Sciences of the United States of America, 107(5), 1860-1863. https://doi.org/10.1073/pnas.0910967107

Braun, V. & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in Psychology, 3*(2), 77-101. http://dx.doi.org/10.1191/1478088706qp063oa

Brophy, J. E. (1983). Research on the self-fulfilling prophecy and teacher expectations. *Journal of Educational Psychology, 75*, 631-661. https://doi.org/10.1037/0022-0663.75.5.631

Carrier, S. J., Tugurian, L. P. & Thomson, M. M. (2013). Elementary science indoors and out: Teachers, time, and testing. *Research in Science Education, 43,* 2059-2083. https://doi.org/10.1007/s11165-012-9347-5

Carrier, S. J., Thomson, M. M., Tugurian, L. P. & Stevenson, K. T. (2014). Elementary science education in classrooms and outdoors: Stakeholder views, gender, ethnicity, and testing. *International Journal of Science Education, 36*(13), 2195-2220. https://doi.org/10.1080/09500693.2014.917342

CEDAW (1981). *Convention on the Elimination of all Forms of Discrimination against women.* Retrieved from https://www.ohchr.org/en/professionalinterest/pages/cedaw.aspx

Chin, C. (2007). Teacher questioning in science classrooms: Approaches that stimulate productive thinking. *Journal of Research in Science Teaching. 44* (6), 815-843. https://doi.org/10.1002/tea.20171

Cooper, R. & Heaverlo, C. (2013). Problem Solving and Creativity and Design: What influence do they have on girl's interest in STEM subject areas? *American Journal of Engineering Education*, 4(1), 27-38. https://doi.org/10.19030/ajee.v4i1.7856

Crombie, G., Pyke, S. W., Silverthorn, N., Jones, A., & Piccinin, S. (2003). Students' perceptions of their classroom participation and instructors as a function of gender and context. *The Journal of Higher Education, 74*(1), 51-76. https://doi.org/10.1080/00221546.2003.11777187

Davies, J. (2003). Expressions of gender: an Analysis of pupils' gendered discourse styles in small group classroom discussions. *Discourse and Society, 14*(2), 115-132. https://doi.org/10.1177/0957926503014002853

Eddy, S. L., Brownell, S. E., & Wenderoth, M. P. (2014). Gender gaps in achievement and participation in multiple introductory biology classrooms. *CBE- Life Sciences Education, 13*, 478-492. https://doi.org/10.1187/cbe.13-10-0204

Etican, I., Musa, S. A., & Alkassim, R. S. (2015). Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics,* 5(1), 1-4. https://doi.org/10.11648/j.ajtas.20160501.11

Evagorou, M. & Dillon, J. (2009). Infusing thinking skills in the science classroom: System thinking and argumentation as a means to engage students in the process reasoning. In M. Saleh & M. S. Khine (Eds), *Fostering scientific habits of mind: Pedagogical knowledge and best practices in science education* (pp. 107-124). Sense Publishers. https://doi.org/10.1163/9789087909239_007

Fabregat, A. A, Almacellas, J. B, & Beltri, R. T. (1999). Self-reported personality and school achievement as predictors of teacher perceptions of their students. *Personality and Individual Differences, 27*, 743-753. https://doi.org/10.1016/S0191-8869(98)00276-1

Gilbert, P., Gilbert, J. & Sanghera, J. (2004). A focus group exploration of the impact of izzat, shame, subordination and entrapment on mental health and service use in South Asian women living in Derby. *Mental Health, Religion and Culture*, 7(20), 109-130. https://doi.org/10.1080/13674670310001602418

Gray, C., & Leith, H. (2004). Perpetuating gender stereotypes in the classroom: A teacher's perspective. *Educational Studies, 30*(1), 3-17. https://doi.org/10.1080/0305569032000159705

Hoferichter, F., & Raufelder, D. (2019). Mothers and fathers- who matters for STEM performance? Gender-specific associations between STEM performance, parental pressure, and support during adolescence. *Frontiers in Education, 4*(14). https://doi.org/10.3389/feduc.2019.00014

Hossen, M. S. (2020). Patriarchy practice and women's subordination in the society of Bangladesh: An analytical review. *Electronic Research Journal of Social Sciences and Humanities*, 2(3), 51-60.

Howard, J. R., & Henney, A. L. (1998). Student participation and instructor gender in the mixed-age college classroom. *Journal of Higher Education, 69*, 384-405. https://doi.org/10.1080/00221546.1998.11775141

Huyer, S. (2018). Is the gender gap narrowing in science and engineering? *UNESCO Science Report: Towards 2030.* Luxembourg: UNESCO, 84-103.

Ifegbesan, A. (2010). Gender-stereotypes belief and practices in the classroom: the Nigerian post-primary school teachers. *Global Journal of Human Social Science, 10* (4), 29-38.

Jegede, O. J. & Okebukola, P. A. (1992). Differences in sociocultural environment perceptions associated with gender in science classrooms. *Journal of Research in Science Teaching, 29 (*7), 637-647. https://doi.org/10.1002/tea.3660290703

Johnson, B. & Christensen, L. (2004). *Educational research: Quantitative, qualitative, and mixed approaches* (pp. 299-311). Boston: Pearson

Jones, M. G. & Wheatley, J. (1990). Gender differences in teacher-student interactions in science classrooms. *Journal of Research in Science Teaching, 27* (9), 861-874. https://doi.org/10.1002/tea.3660270906

Leder, G. C (1990). Gender and Classroom Practice. In Burton, L. (Ed). *Gender and Mathematics: An International Perspective* (pp. 21-31). London, England: Cassell Education Limited

Lee, R. (2018, June 11). Girl's education in Bangladesh. *The Borgen Project.* Retrieved from https://borgenproject.org/girls-education-in-bangladesh/

Lewin, K. M. (1993). Planning policy on science education in developing countries. *International Journal of Science Education, 15*(1), 1-15. https://doi.org/10.1080/0950069930150101

Makarova, E., Aeschlimann, B., & Herzog, W. (2019). The Gender gap in STEM fields: The impact of the gender stereotypes of Math and Science on secondary students' career Aspirations. *Frontiers in Education, 4*(60). https://doi.org/10.3389/feduc.2019.00060

Meece, J. L. & Jones, M. G. (1996). Gender differences in motivation and strategy use in science: Are girls rote learners? *Journal of Research in Science Teaching, 33*(4), 393-406. https://psycnet.apa.org/doi/10.1002/(SICI)1098-2736(199604)33:4%3C393::AID-TEA3%3E3.0.CO;2-N

Miller, P. H., Bessing, J. S & Shwartz, S. (2006). Gender differences in highschool students' views of science. *International Journal of Science Education, 28*(4), 362-381. https://doi.org/10.1080/09500690500277664

Mim, S. A. (2020). Masculinity of science: unveiling gendered challenges of female science teachers in Bangladesh. *Gender and Education*. Article https://doi.org/10.1080/09540253.2020.1866170

Ministry of Primary and Mass Education (2019). *Annual Primary School Census.*

Murphy, A. N., Luna, M. J. & Bernstein, M. B. (2017). Science as experience, exploration and experiments: elementary teachers' notions of 'doing science'. *International Journal of Science Education, 39(*17) 2283-2303. https://doi.org/10.1080/09500693.2017.1374578

Oakes, J. (1990). Lost Talent: *The under participation of women, minorities, and disabled persons in science.* Santa Monica: Rand Corporation. file:///Users/user/Downloads/R3774.pdf

Oluwagbohunmi, M. F. (2014). Gender issues in classroom interaction and student's achievement in social studies. International Journal of Innovative Research and Development. 3(5), 742-745. Article http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.930.8778&rep=rep1&type=pdf

Peacock, J., Bowling, A., Finn, K. & Mclnnis, K. (2021). Use of outdoor education to increase physical activity and science learning among low-income children from urban schools. *American Journal of Health Education, 52*(2), 92-100. https://doi.org/10.1080/19325037.2021.1877222

Rabenberg, T. A. (2013). *Middle school girl's STEM education: Using teacher influences, parent encouragement, peer influences, and self efficacy to predict confidence and interest in math and science* [Unpublished doctoral dissertation] Drake University. Retrieved from http://hdl.handle.net/2092/2020

Ready, D. D. & Wright, D. L. (2011). Accuracy and inaccuracy in teachers'perceptions of young children's cognitive abilities: The role of child background and classroom context. *American Educational Research Journal, 48*(2), 335-360. https://doi.org/10.3102/0002831210374874

Richardson, C. H., Christodoulou, A., Osborne, J., Richardson, K., & Simon, S. (2009, September 2-5). Exploring science teachers' perceptions of teaching and learning. *British Educational Research Association Annual Conference*, Manchester, England, UK.

Ridley, D. R. & Novak, J. D. (1983). Sex-related differences in highschool science and mathematic enrollments: Do they give males a critical headstaart toward science- and math- related careers? *Alberta Journal of Educational Research, 29(*4), 308-318

Stevenson, K. T, Szcytko, R. E., Carrier, S. J. & Peterson, M. N. (2021). How outdoor science education can help girls stay engaged with science. *International Journal of Science Education*. https://doi.org/10.1080/09500693.2021.1900948

Subrahmanian, R. (2005). Gender equality in education: Definitions and measurements. *International Journal of Educational Development, 25*, 395-407. https://doi.org/10.1016/j.ijedudev.2005.04.003

Tatar, M. & Emmanuel, G. (2001). Teachers' perceptions of their student's gender roles. *The Journal of Educational Research, 94* (4), 215-224. https://doi.org/10.1080/00220670109598755

Tiedemann, J. (2000) Parents' gender stereotypes and teachers' beliefs as predictors of children's concept of their mathematical ability in elementary school, *Journal of Educational Psychology, 92*(1), 144–151. https://doi.org/10.1037/0022-0663.92.1.144

Ting, K. L. & Siew, N. M. (2014). Effects of outdoor school ground lessons on student's science process skills and scientific curiosity. *Journal of Education and Learning*. 3(4), 96-107. http://dx.doi.org/10.5539/jel.v3n4p96

Ullah, H. (2016). School teaching as a feminine profession: The legitimization and naturalization discourses in Pakistani context. *In Papers from the Educational Doctoral Research Conference 2015* (pp 122-130). University of Birmingham, Birmingham. Retrieved from http://epapers.bham.ac.uk/2151/

UNESCO (2000, April 26-28). *The Dakar Framework for Action: Education for All: Meeting our collective commitments. World Forum on Education*, Dakar, Senegal.
https://sustainabledevelopment.un.org/content/documents/1681Dakar%20Framework%20for%20Action.pdf

Appendices

Appendix A: Consent Letter for Interview

Dear Mr/Miss ____

I am a student of BRAC Institute of Educational Development where I am currently enrolled for my Masters in Education Leadership and School Improvement. As part of my master thesis I am required to conduct a research study of the title 'Gender Equality in Science Classrooms: Teacher perceptions and teaching-learning practices in government primary schools in Dhaka'. I seek your assistance to participate in my research.

The research is intended to explore teachers' perceptions and teaching-learning practices concerning gender equality in their classroom in terms of attitudes and practices. No students will directly participate in the research.

Your participation as a teacher in this research will entail one personal interview requiring 30 minutes of your time. The interview will be tape-recorded and cover items about teacher's opinions, perceptions, teaching-learning practices.

All data collected will be held confidentially and identities of you and other participants will be protected through the use of pseudonyms for this research and for any future publications or presentations. Participants should understand that they may be quoted directly but will not be named in any part of the report. Please understand that you may withdraw from the study at any time without prejudice.

I appreciate your willingness to support me in conducting this research. If you have any questions please feel free to contact me at +8801730263148 or maisha.ahmed@teachforbangladesh.org

Sincerely,
Maisha Ahmed

I have read the above and discussed it with the researcher. I understand the study and I agree to participate in the research.

Signature ________________________________ Date ___________________

Appendix B: Interview Guide

This interview is being conducted as part of the data collection for the study titled 'Bangladeshi primary school teacher perceptions on gender equality and its influence on classroom practices and student achievements'. The study intends to explore teacher perceptions, behavior and practices in primary classrooms in regards to ensuring gender equality and how they influence participation among girls and boys. The interview will take 20-30 minutes.

Participant Gender: Male / Female

Grade teacher:
Student number:
Girl to Boy ratio:

Training received on Gender Equality: Yes / No

If yes, training name:

1. What do you understand by gender equality in education?

2. From your classroom observation and academic results, who do you think better participates in science classes, girls or boys?

3. Academically and from assessment results, are the best students in your class mostly girls or boys?

4. Do you think boys and girls are equally interested in science?

5. What materials do you use to teach science? Do you notice any differences in the way these materials interest girls and boys separately?

6. When demonstrating science experiments, how do you select volunteers? Are boys or girls more likely to be selected?

7. Do you ask questions during your lessons? What kind of questions?

8. How do you manage responses by students? Do boys or girls give more voluntary responses? Why do you think so?

9. Who from your observation needs more feedback and teacher support in class, boys or girls? How do you provide these support and feedback? Is their space for support after class?

10. Overall, do girls or boys take most of your lesson time in engaging in discussions or giving responses?

11. Have you carried out any peer or group activities as part of a teaching-learning method in class or for projects? How are groups created? Who is more likely to take the lead in groups? How are these authoritative roles carried out in the groups?

12. Are there specific topics that girls and boys have distinguished interest and performance in? What are your thoughts on these differences?

13. In your opinion, what skills and practices are needed in learning science in the primary level and in the long-run? Elaborate if you think both boys and girls have these traits in your classroom? Can these skills be developed or do you think they are inherent?

14. Between girls and boys who do you think has better chances of taking advanced science for higher studies and subsequently work in the science field?

Appendix C: Interview Transcript

1. What do you understand about gender equality in education?

I think it is about involving both boys and girls to the same degree. It is about having them participate in all areas equally, and giving them the same opportunities inside and outside home, at school or at any work.

2. From your classroom observation and academic results, who do you think better participates in science classes, girls or boys?

To me, from what I have seen girls. Especially, in the case of the exams we take or the class work we give in science class. Girls show more interest in their learning. However boys show more interest and involvement in the assessments we carry out outside the class. In class girls are more active in participation because they usually help set up the learning materials or equipment. They do more.

3. Academically and from assessment results, are the best students in your class mostly girls or boys?

It depends. In some subjects boys are clearly better, in some subjects girls have better results. But I am unable to say specifically who does better in what.

4. Do you think boys and girls are equally interested in science?

The assessments we take outside our class, specifically the work I give to my students based on topics such as nature and the environment, boys enjoy going out and eager to learn in outside class activities. When girls have to work outside, they tend to be shy, reserved. They do not engage in many discussions or ask questions like you would want them to.

5. What materials do you use to teach science? Do you notice any differences in the way these materials interest girls and boys separately?

For classes 4 and 5, I have students go to the roof for observation or to carry out group activities where they need access to nature or a good space for discussion with their friends. From these activities I have observed boys generate good discussion, they are active, run around the space to collect information. But girls are reserved. There are only a handful of girls who are more involved but not to the extent you want them to. But they do come forward during in-classroom chores or science work. When showing experiments, there are a few girls who are willing to go find a glass or a ruler so I can make demonstrations. Sometimes they get sand and stone on their