

Students' Perceptions about Climate Change and Pedagogical Approach in the National Curriculum Framework-2021 of Bangladesh: An Exploratory Study

By

ZEBA SAJIDA SARAF
ID: 22357039

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

BRAC Institute of Educational Development
BRAC University
January 2025

© 2025. Zeba Sajida Saraf

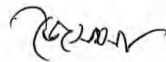
All rights reserved.

Declaration

It is hereby declared that

1. The thesis submitted is my own original work while completing my M.Ed. 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 any other institution.
4. I have given credit to all main sources of assistance.

Student's Full Name & Signature:



Zeba Sajida Saraf

ID: 22357039

Approval

The thesis titled “Students’ Perceptions about Climate Change and Pedagogical Approach in the National Curriculum Framework-2021 of Bangladesh: An Exploratory Study” submitted by Zeba Sajida Saraf; Student ID: 22357039 of Spring, 2024 has been accepted as satisfactory in partial fulfillment of the requirement for the degree of Master of Education in Educational Leadership and School Improvement on January 22, 2025

Examining Committee:

Supervisor:
(Member)

Ms. Nazmin Sultana
Lecturer, BRAC Institute of Educational Development,
BRAC University

Program Coordinator:
(Member)

Dr. Manjuma Akhtar Mousumi
Assistant Professor, BRAC Institute of Educational Development,
BRAC University

External Expert Examiner:
(Member)

Md. Mamunur Rashid
Senior Lecturer, BRAC Institute of Educational Development,
BRAC University

Head of the Institute:

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

Ethics Statement

I, Zeba Sajida Saraf, hereby consciously assure that the manuscript “Students’ Perceptions about Climate Change and Pedagogical Approach in the National Curriculum Framework-2021 of Bangladesh: An Exploratory Study” the following is fulfilled.

- This material is my own work, and it has never been published before
- All sources used in this manuscript are appropriately identified and cited. Text that has been verbatim copied must be marked as such with quotation marks and appropriate citation.
- All the participants in this study willingly participated in this research.
- The participants’ identities are confidential, protected and will not be revealed at any point.
- The findings are suitably contextualized in relation to previous and present research.

Abstract

Bangladesh is one of the most climate-vulnerable countries in the world, with children and youth from urban low-income communities particularly at a risk due to climate change impacts. Climate change education can play an important role in preparing them to adapt to such impacts. This study contains an exploration of the current state of climate change education as implemented across Bangladeshi secondary schools. The aim of this research is to explore secondary students' perceptions of climate change, how climate change education is integrated into the National Curriculum Framework-2021 and how teachers incorporate climate change content into their lessons. A qualitative research approach was used to conduct this study. The participants were 8th grader secondary students and their teachers from two low-income marginalized urban communities in Dhaka. Data collection methods included semi-structured in-depth interviews, a Focus Group Discussion, class observations and content analysis of subject-specific textbooks, curriculum and Teacher's Guide documents. The key findings indicate that secondary students from low-income urban communities perceived climate change as an existential threat, yet many hold misconceptions and limited understanding of its causes, global consequences and climate action. Most students believed climate change happened due to anthropogenic activities only and expressed dissatisfaction with the way they were being taught about climate change. Teachers, facing various contextual constraints, were not implementing the curriculum framework's project-based learning methods. Moreover, the National Curriculum Framework and its teaching-learning materials contained fragmented and insufficient content relevant to climate change. This study has implications for policymakers and curriculum developers to address these gaps and employ better climate change education for Bangladeshi children.

Key Words: Climate change education; secondary students; pedagogy; National Curriculum Framework-2021; Bangladesh.

Dedication

I humbly dedicate this thesis to the children and young people whose precious lives were sacrificed, and to those who endured loss of limbs and vision, in the noble struggle for a new Bangladesh in 2024. May their bravery and thirst for freedom continue to inspire the nation for centuries to come.

I would also like to dedicate this thesis to my parents, Yasmin Ahmed and Faruk Ahmed, my sibling Mashrur Hossain Shurid, my sister-in-law Mahjabin Sabnam Dolon, my aunt Shilpi Rahman and my uncle Khondker Rezaur Rahman. Their unwavering support and guidance have been my greatest source of strength throughout this journey.

Acknowledgement

I would like to express my gratitude to my Supervisor Ms. Nazmin Sultana for her consistent guidance and support during my thesis journey. My sincere gratitude to the entire team of Faculty members of BRAC IED as well for contributing meaningfully to my journey at the institute and for teaching me.

Table of Content

Declaration	ii
Approval	iii
Ethics Statement.....	iv
Abstract	v
Dedication	vi
Acknowledgement	vii
Table of Content	viii
List of Tables	xii
List of Figures	xiii
List of Acronyms	xiv
Chapter 1	1
Introduction and Background	1
1.1 Introduction	1
1.2 Research Topic	3
1.3 Statement of the Problem	3
1.4 Research Questions	4
1.5 Purpose of the Study	5
1.6 Significance of the Study	5
1.7 Summary	6
Chapter 2	7
Literature Review and Conceptual Framework	7

2.1 Overview	7
2.2 Climate Change as a Threat to Bangladeshi Low-income Urban Communities.....	7
2.3 Importance of Climate Change Education in the Global South	9
2.4 Climate Change Education in National Curriculums Across the World.....	12
2.5 State of Climate Change Education in Bangladesh.....	15
2.6 Secondary school students' perceptions about climate change.....	18
2.7 Secondary School Teachers' Pedagogical Approaches for Teaching Climate Change	22
2.7.1 Emotional Engagement as a Pedagogical Approach	23
2.7.2 Project-based pedagogical approach	25
2.7.3 Interdisciplinary and Transdisciplinary approach	25
Conceptual Framework of the Study.....	27
2.8 Summary	30
Chapter 3	31
Methodology	31
3.1 Introduction	31
3.2 Research Approach and Design	31
3.3 Research Site	32
3.4 Research Participants and Participant Selection Procedure	32
3.5 Data Collection Method	33
3.6 Data Collection Procedure	34
3.7 Data Analysis Procedure	35
3.8 Trustworthiness and Rigor of the Research	39
3.9 Ethical Issues.....	40
3.10 Limitations of the Study	41
3.11 Summary	42
Chapter 4.....	43
Results and Analysis	43
4.1 Overview	43
4.2 Students' Perception towards Climate Change	44
4.2.1 Students' Awareness of Environmental Changes Around Them	44

4.2.2 Students’ Understanding of the Causes of Climate Change	47
4.2.3 Students’ Knowledge of Local and Global Climate Impacts	49
4.2.4 Sources of Information Related to Climate Change	50
4.3 Theme 2: Students’ Emotional Perception towards Climate Change	52
4.3.1 Perceived Threat to Self From Climate Impact	52
4.3.2 Perceived Threat to Family or Community	55
4.3.3 Emotional Responses to Climate Change.....	56
4.3.4 Students’ Thoughts and Reactions to How Climate Change was Being Taught at School Under the New Curriculum	59
4.4 Theme 3: Students’ Applied Perception towards Climate Change	63
4.4.1 Frequency of Climate Thoughts and Situations That Prompt These Thoughts in Students	63
4.4.2 Individual Actions and Personal Responsibility Against Climate Change	64
4.4.3 Collective and Community-Based Actions Against Climate as Youth Leaders of the Community	65
4.4.4 Perceived Barriers to Personal and Collective Action.....	67
4.5 How Teachers Integrate Climate Change in their Lessons and the Challenges they face in teaching climate change	68
4.5.1 Teachers’ Views on Climate Change Education, its Relevance to the School Community and Climate Impacts Affecting the School Community.....	68
4.5.2 Teachers’ Integration of Climate Change in Regular Subject-Based Lessons and Climate Assessments	69
4.5.3 Teachers’ Opinions on Whether the NCTB Textbooks Cultivated Climate Change Awareness and a Sense of Responsibility Towards the Environment Among Their Students	74
4.5.4 Textbooks as Teachers’ Sources of Information on Climate Change	75
4.5.5 Resource Limitations Teachers Face in Teaching Climate Change	77
4.5.6 Unspoken Emotions: How Teachers Avoid Addressing Students’ Emotions and Feelings on Climate Change.....	78
Climate change education in the National Curriculum Framework 2021	79
4.6.1 Content analysis of the National Curriculum Framework-2021	79
4.6.2 The Gaps in the Curriculum Framework.....	83
4.7 Climate change content in the 8 th grade textbooks and pedagogical instructions in the Teacher’s Guides.....	84
4.7.1 Content analysis of the 8 th grade textbooks and Teacher’s Guides	84

4.7.2 Pedagogical Instructions for Teaching Climate Change in the Teachers Guides	103
The History and Social Science (HSS) Teachers' Guide	103
The Science Teachers' Guide	105
4.8 Summary	106
Chapter 5	107
Discussion and Conclusion	107
5.1 Overview	107
5.2 Discussion	107
5.2.1 How Bangladeshi secondary students perceive climate change.....	107
5.2.2 Students' Misconceptions about Climate Change	116
5.2.3 Climate Change Education in the National Curriculum Framework 2021 and NCTB textbooks.....	119
5.2.4 How secondary school teachers incorporate Climate Change into their regular lessons	120
5.2.5 Applying the Bicycle Model to interpret the findings	129
5.3 Conclusion.....	132
5.4 Recommendations for Policymakers.....	133
5.5 Recommendations for Further Research	135
References	137
Appendices.....	163
Appendix A. Consent Letter for Parents	163
Appendix B. Permission Letter for School Authority	165
Appendix C. Consent Form for Teachers	166
Appendix D. Interview Guide for Teachers	168
Appendix E. Interview Guide for Students	170
Appendix F. FGD Guideline	171
Appendix G. Class Observation Protocol	172

List of Tables

Table 1: List of research participants.....	32
Table 2: Generating initial codes and search for sub-themes	37
Table 3: Reviewing the sub-themes and defining the themes.....	38
Table 4: Generating codes and themes from the textbooks	39
Table 5: A sampling of the documents used for doing content analysis	85
Table 6: Climate change misconceptions students held	116

List of Figures

Figure 1: CONCEPTUAL FRAMEWORK	28
--------------------------------------	----

List of Acronyms

CCE: Climate Change Education

EE: Environmental Education

ESD: Education for Sustainable Development

FGD: Focus Group Discussion

GED: General Economic Division

IDI: In-Depth Interview

IPCC: Intergovernmental Panel on Climate Change

MOEFC: Ministry of Environment, Forestry and Climate Change

NEP: National Education Policy

NDC: Nationally Determined Contribution

NCTB: National Curriculum and Textbook Board

NCCLS: National Climate Change Learning Strategy

PCK: Pedagogical Content Knowledge

UNFCCC: United Nations Framework Convention on Climate Change

UNDP: United Nations Development Programme

UNICEF: United Nations International Children's Emergency Fund

UNESCO: United Nations Educational, Scientific and Cultural Organization

Chapter 1

Introduction and Background

1.1 Introduction

Climate change, a profound global phenomenon, disproportionately impacts marginalized and vulnerable populations, exacerbating existing socio-economic inequalities. While privileged groups in society may adapt with minor lifestyle changes, disadvantaged and marginalized communities bear the brunt of its effects: displacement, loss of livelihoods, and long-term socio-economic instability. Global climate change disproportionately affects those least responsible for its causes, increasing the vulnerabilities of already marginalized and disadvantaged groups in society (Intergovernmental Panel on Climate Change [IPCC], 2023). Climate change impacts also worsen existing educational inequalities in climate-vulnerable countries and disproportionately affect children and adolescents from low socio-economic backgrounds, particularly secondary students since education becomes more expensive and resources become scarcer (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2020). Bangladesh is particularly vulnerable to the impacts of climate change due to its geographical position, low-lying topography, and socio-economic conditions (General Economic Division [GED], 2015). The country frequently experiences extreme weather events such as cyclones, floods, and heatwaves, which not only devastate infrastructure but also disrupt education, particularly for secondary students from low-income urban communities. These disruptions exacerbate educational inequities, leaving vulnerable children and adolescents at a disadvantage in acquiring the skills and knowledge needed to respond to climate challenges (Ahmed et al., 2022).

Education is widely acknowledged as a powerful tool in combating climate change. The United Nations Framework Convention on Climate Change (UNFCCC) emphasizes the role of education in raising awareness and fostering action on climate change in its Article 6. Similarly, the Paris Climate Agreement (2015) highlights the importance of education in promoting climate action through its Article 12. In the context of Bangladesh, where youth make up a significant proportion of the population, educating young people about climate change is important for building a resilient

and adaptive society (United Nations International Children's Emergency Fund [UNICEF], 2021). The National Curriculum-2012, based on the National Education Policy-2010, sought to integrate environmental awareness and climate-related topics at both primary and secondary levels (National Curriculum and Textbook Board [NCTB], 2012). The updated version of the National Curriculum-2012 of Bangladesh was based on the National Education Policy-2010 (Riad & Podder, 2015). One of the aims and objectives of the National Education Policy-2010 was to build students as skilled human resources to fight the challenges of the world threatened by climate change and other natural disasters and to instill social awareness in them about environment (NCTB, 2012). However, that curriculum's reliance on rote learning and limited integration of practical, competency-based approaches hindered its effectiveness in preparing students to address the multidimensional challenges of climate change (Kagawa, 2022). A 2021 UNICEF survey revealed that while 77% of Bangladeshi youth reported learning about climate change in school, only 50% could explain it effectively, and 70% expressed anxiety about its impacts, highlighting the gaps in current educational approaches (UNICEF, 2021). The National Curriculum Framework-2021 represents a significant shift towards a competency-based curriculum in Bangladesh, emphasizing experiential and collaborative learning over the usual examination-centric and rote-learning practices. These pedagogical approaches are recent additions to the country's educational process reportedly inspired by the curriculums of Finland, Japan, and Singapore (Das, 2023; Ali, 2024). However, the formal school curriculums of Finland, Japan and Singapore have integrated climate change education (UNESCO, 2022; Fang, 2022). It is important to explore whether the National Curriculum Framework-2021 of Bangladesh also makes climate change education a priority and integrates it in its textbooks and Teacher's Guides. While the Framework aims to prepare students for a knowledge-based economy and foster adaptive capacities, it remains essential to also critically evaluate how it integrates climate change education and whether the students in low-income urban communities who possess specific vulnerabilities faced by climate change, benefit from it (Hasan & MacDonald, 2021).

This study explores the extent to which the National Curriculum Framework-2021 addresses climate change education and how effectively it is implemented by secondary teachers in underserved urban communities in Dhaka. By focusing on the perceptions of students and examining teachers' pedagogical approaches, this research aims to provide insights into the gaps and opportunities in climate change education in Bangladesh.

1.2 Research Topic

The title of my research is “Students’ Perceptions about Climate Change and Pedagogical Approach in the National Curriculum Framework 2021 of Bangladesh: An Exploratory Study”. Climate change poses an existential threat to Bangladesh, disproportionately affecting children and youth of underserved communities, who are among the most vulnerable to its impacts (UNICEF, 2020). Exploring the perceptions of secondary students from low-income urban communities in Dhaka is particularly important, as these students often experience the combined effects of climate change and urban poverty. Understanding how students from urban poor communities perceive climate change is crucial, as their insights reveal how they interpret and respond to its impacts, while their limited access to resources and infrastructure heightens their vulnerability to risks like flooding, heatwaves, and water scarcity (Ahmed et al., 2022; Haque et al., 2021). In addition, this study also looks at how climate change education is addressed in the National Curriculum Framework-2021 of Bangladesh. Assessing how a national curriculum addresses climate change education can identify its strengths and gaps in preparing students to face the realities of a changing world (Monroe et al., 2019). Furthermore, exploring how teachers address climate change in these communities offers an opportunity to identify potential gaps in pedagogical approaches and curriculum implementation, which are critical for fostering meaningful climate change education. In this study, I therefore, set out to explore the secondary students’ perceptions of climate change, the representation of climate change education in the National Curriculum Framework-2021, and how secondary teachers incorporate climate-related topics into their subject-based lesson.

1.3 Statement of the Problem

Climate change poses an existential threat worldwide, with Bangladesh being particularly vulnerable due to its geographic location and socio-economic conditions (Huq & Rabbani, 2011). The urban poor in megacities like Dhaka are among the most affected, facing increased exposure to flooding, heatwaves, and water scarcity (Alam et al., 2018). Children and youth in these underserved urban communities are especially at risk, given their limited adaptive capacity and the combined effects of climate change and urban poverty (Ahmed et al., 2022). Despite this, there is limited research on how 8th grader secondary students from these vulnerable populations perceive climate change. Existing literature on perceptions of climate change in Bangladesh in recent years mostly focuses on rural and coastal communities, young adult university students or

adult populations, but the perceptions of secondary students from urban low-income communities adapting to the realities of climate change remain underrepresented (Hasan & MacDonald, 2021). Education plays an important role in equipping young people with the knowledge and skills to adapt to and mitigate the impacts of climate change (Monroe et al., 2019). The National Curriculum Framework-2021 of Bangladesh represents a shift toward competency-based education, aiming to prepare students for a rapidly changing environment (Haque et al., 2021). However, very little is known about how it addresses climate change education in secondary level. Teachers, as key implementers of this new curriculum, are essential in translating its ambitious visions into competencies and knowledge for students. Yet, there is limited understanding of the pedagogical approaches' secondary teachers in low-income urban communities are employing to incorporate climate change into their regular subject-based lessons and preparing these students for the difficult challenges that lay ahead, leaving a critical gap in the literature.

The consequences of neglecting the voice of the students from urban low-income communities are significant. Without effective climate change education, these secondary students may remain ill-prepared to understand and address the climate impacts they face, exacerbating their vulnerability and limiting their potential to contribute to climate action. In the broader context, this knowledge gap undermines efforts to build resilience among future generations in Bangladesh, a country on the frontline of climate change impacts (UNICEF, 2020). My study aims to address these significant gaps by exploring the perceptions of 8th grade secondary students from low-income urban communities in Dhaka regarding climate change. It also critically analyzes how climate change education is represented in the National Curriculum Framework-2021 and explores how secondary teachers incorporate climate change topics into their lessons. By focusing on these aspects, my research contributes to a deeper understanding of the strengths and gaps in the current practice of climate change education in Bangladesh, offering evidence-based recommendations to policymakers and curriculum designers for improving curriculum design and pedagogical practices.

1.4 Research Questions

1. How do Bangladeshi secondary students perceive climate change?
2. How does the National Curriculum Framework-2021 of Bangladesh address climate change education?

3. How do secondary school teachers incorporate climate change into their regular lessons?

1.5 Purpose of the Study

The purpose of this study is to explore the perceptions of climate change among 8th grader secondary school students in Bangladesh, specifically those from low socio-economic backgrounds in two underserved urban communities of Dhaka city, who have been educated under the National Curriculum Framework-2021, which was introduced in 2023 for first grade in the primary level and grades six and seven in the secondary level. This exploratory study also aims to find out how the recently implemented competency-based National Curriculum Framework-2021, along with its associated textbooks, teacher's guides, and pedagogical practices, addresses climate change. Additionally, the study aims to explore how secondary school teachers embedded in these underserved communities, particularly those teaching 'Science' and 'History and Social Science' subjects, teach climate change relevant topics in their regular subject-based lessons.

1.6 Significance of the Study

This study addresses a critical gap in understanding how 8th grader Bangladeshi secondary students from low-income urban communities perceive climate change. While some research exists on rural Bangladeshi secondary students' and university students' awareness of climate change, no study has specifically focused on this urban demographic's perceptions in recent years, which remains a disproportionately vulnerable group to climate impacts due to these communities limited adaptive capacity and heightened exposure to environmental risks (Huq & Rabbani, 2011; Alam et al., 2018). By focusing on students' perceptions, my study sheds light on their understanding, awareness, misconceptions, emotional responses and ideas on climate action, which are particularly important to be studied in a country where the youth demographic plays a key role in future climate action. Its findings will reveal gaps in current practice of climate change education in Bangladesh, which will help policymakers to develop targeted pedagogical interventions that address such gaps by correcting students' misconceptions, emotionally engage students and provide a solid foundation in climate understanding. A solid foundation in understanding climate change will be an essential knowledge for youth in the upcoming years as impacts of climate change will further increase (Hasan & MacDonald, 2021). By exploring these students' perceptions, analyzing how climate change education is addressed in the National Curriculum Framework-2021, and probing how secondary teachers incorporate climate change into their

regular lessons, this research fulfills an important gap in the climate change education literature and provides useful insights from the global South. This study will also fill a significant gap in the literature through its analysis of how the National Curriculum Framework-2021 addresses climate change education, the Framework being a recent effort by the Government of Bangladesh to transform the traditional exam-centric education system to develop a competency-based continuous curriculum from pre-primary to grade 12, an area that remains unexplored in existing research. These findings thus will be crucial for understanding whether the Framework manages to adequately equip Bangladeshi secondary students with the knowledge and skills necessary to navigate the complex realities of climate change in their lives. Furthermore, my study highlights the ground realities of teaching climate change in secondary schools within low-income urban communities in Bangladesh. Policymakers and curriculum developers will benefit from the findings and evidence-based recommendations I suggest based on the findings to refine the curriculum, making it more feasible and contextually relevant for implementation. As an exploratory study, it also lays the groundwork for further research into the practice of climate change education in Bangladesh and similar developing countries in the global South, emphasizing the importance of relevant climate change education in urban vulnerable communities that are underrepresented in academic research.

1.7 Summary

This research is guided by three research questions: to explore how secondary students from underserved communities in Dhaka perceive climate change; to analyze how the National Curriculum Framework-2021 addresses climate change education; and to find how the secondary teachers are teaching climate change relevant topics in their regular subject-based lessons. This study highlights the unique vulnerabilities of Bangladeshi urban secondary students to climate impacts and emphasizes the role formal education plays in shaping their perspectives. The findings will provide insights into secondary students' perceptions of climate change, pedagogical approaches undertaken and explore the integration of climate change education in the new curriculum framework.

Chapter 2

Literature Review and Conceptual Framework

2.1 Overview

In this section, I reviewed relevant literature such as journal articles, books and documents related to climate change education. The literature was reviewed based on a few themes such as secondary school students' perceptions of climate change, climate change education in national curriculums and secondary teachers' pedagogical approaches and classroom practices of teaching climate change in Bangladesh and beyond. I have organized the literature review in this chapter under the following aspects: 1) Climate change as a threat to Bangladeshi low-income urban communities, 2) Importance of Climate Change Education in the global South, 3) Climate Change Education in national curriculums across the world, 4) State of Climate change education in Bangladesh, 5) Secondary students' perceptions of climate change and 6) Secondary School Teachers' Pedagogical Approaches for Teaching climate change.

2.2 Climate Change as a Threat to Bangladeshi Low-income Urban Communities

United Nation's International Children's Emergency Fund (UNICEF) had declared climate change a "*Child's rights crisis*" (UNICEF, 2021). According to the Children's Climate Risk Index (CCRI) report published by it, Bangladesh scored a 7.6 in the index, which officially classifies it as an "Extremely high risk" country. It is estimated that the lives of nearly 20 million children in Bangladesh are threatened by climate change impacts (UNICEF, 2021). An international survey of 10,000 young people aged 16-25, found that 84% were at least moderately worried about climate change and 59% were very or extremely worried, while 75% said that they think the future is "*frightening*" and 83% said that they think people have "*failed to take care of the planet*" (Hickman et al., 2021). Climate change impacts numerous sectors of the global economy, such as public health, agriculture and forestry, energy, transportation, tourism, infrastructure, water resources, ecosystem and biodiversity (Kumar, 2017). Coastal communities from the Southern part of the country, farmers and agricultural-worker communities, women and children from poor and

marginalized communities are the demographics most exposed to and vulnerable to climate change impacts (Huq & Akhtar, 2003; IPCC, 2014). Yet, Haque (2021) found that low-income urban communities in Dhaka often lack basic services, which heightens their exposure to climate risks. According to a national Climate Vulnerability Assessment report published by the Ministry of Environment, Forest and Climate Change of Bangladesh (MoEFCC), Dhaka city, the capital of Bangladesh, also faces a risky combination of climate impacts such as flooding, heat waves, diseases, storm surges, and intensifying cyclones (MoEFCC, 2023). Although there is no city-level data available for Dhaka's climate risk projection yet; by analyzing the National Adaptation Plan (NAP) for Bangladesh (2023-2050) and the Bangladesh Delta Plan for 2100, an overall Climate Change Risk Assessment (CCRA) of both Dhaka North and Dhaka South was incorporated in the Climate Action Plan (CAP) for the Dhaka South City Corporation published in May 2024. The CCRA's projected climate hazards for Dhaka city included erratic rainfall and urban flooding, storm surges from cyclones, rising temperature and heat waves (DSCC, 2024). Due to climate change, Dhaka also faces severe water insecurity with scientists projecting worsening conditions under various carbon emission scenarios (Tahsin & Murshed, 2023). 'Urban Heat Island' effects with land surface temperatures increasing by nearly 6°C compared to Dhaka's surrounding areas has also been observed by scientists (Rahman, Islam, & Shampa, 2024). While flooding has a long history in the city, climate change is projected to exacerbate flooding through more erratic rainfall patterns and overflowing of the rivers, thus posing a direct threat to the inhabitants of Dhaka (Dasgupta, et al., 2015; Haque, 2021). A 2016 study revealed that 70% of the Greater Dhaka district falls within 'moderate to very high hazard zone' for flood inundation (Sayed & Haruyama, 2016). Cyclones and storm surges are also climate-induced threats to the city (Rabbani, Rahman, & Islam, 2011). Diseases such as Dengue, Malaria, diarrhea, heat stroke, allergies, respiratory and cardiovascular diseases are considered as key climate impacts on human health in Bangladesh, particularly affecting children and vulnerable urban poor communities (WHO, 2018; WHO, 2015; UNICEF, 2016; Kabir et al., 2016). The urban poor of Dhaka are predominantly noted as a vulnerable group to these multiple climate impacts due to various factors such as the city's fragile, mostly unplanned infrastructure, lack of sanitation and lack of employment security (Khan, 2010). For densely populated countries like Bangladesh, climate change also threatens democratic stability since it can worsen already existing issues such as poverty and internal and intrastate conflicts. Researchers conclude that climate change impacts can provoke migration, sending

millions of Bangladeshis to seek shelter in neighboring South Asian nations, disrupting peace and security in the region (Hasan & MacDonald, 2021).

2.3 Importance of Climate Change Education in the Global South

In this study, by the term ‘Global South’, I refer to the countries that are the members of the G-77, a group of developing countries from Asia and Oceania, Africa, South and Central America established in 1964 that refers to itself as the ‘Global South’. Today, 134 countries are members of the G-77 and Bangladesh is amongst them (UN, n.d.; Brooke-Holland, 2024). Even though the way children and youth learn about climate change expands beyond classrooms, they are also influenced by media, communities, local environment and other institutions via alternative education. But for the purpose of the study, the literature reviewed for CCE has been narrowed down to formal education setting only.

The Intergovernmental Panel on Climate Change has highlighted the urgency of climate change as the “*defining challenge of our time*” (IPCC, 2023). Climate change is considered by academic scholars as a ‘*super wicked problem*’ created by humans (Levin et al., 2012). Ever since climate change had entered the global political agenda, the potential of the education sector in dealing with the crisis has been recognized and referred to as CCE for sustainable development (Mochizuki & Bryan, 2015; UNESCO, 2016). In fact, CCE can be one of the most effective means to shape and influence people’s collective engagement in creating a climate-friendly society (Lee et al., 2015). Climate change has also been identified as a ‘multifaceted justice issue’, due to its disproportionate impact on those who have contributed least to the creation of the crisis, such as people of color, the economically disadvantaged, indigenous people, the rural poor, especially in the Global South, immigrants, including ‘climate refugees,’ and the youth (Levy & Patz, 2015; Weston, 2008). Currently, a trend has been observed by researchers that children and young people are being positioned as future leaders whom the public expects to overcome the older generation’s legacies of environmental inaction (Lee, 2013). Yet today’s children and youth have very limited opportunities to develop, voice, and express their understandings, concerns, and imaginings about climate change within their local environments and communities (Hill, 2006). It is thus widely acknowledged that innovative forms of CCE are needed for children and young people worldwide, who will be forced to grapple with the uncertain effects of climate change brought forth by previous generations (Dalelo, 2011; Kagawa and Selby 2012; Pruneau et al. 2003; UNESCO,

2009). Young people, despite not having lived long enough to contribute much to climate change, are expected to bear a disproportionate share of its consequences, especially if they also belong to marginalized groups. Unfortunately, young people's education in primary as well as secondary levels are unlikely to have prepared them for the challenges posed by climate change, partially because of the many systemic barriers that mainstream or formal education systems are plagued by (Kwauk, C., 2020).

While the discipline of CCE is still emerging, research suggests that “good” CCE should involve all areas of institutional activity and focus on the cognitive, socio-emotional, and behavioral or ‘action’ dimensions of learning as well as be concerned with climate justice (Bieler et al., 2018; Gaudiano & Meira-Cartea, 2010; UNESCO, 2015; UNESCO, 2019). However, some researchers are of the opinion that CCE is not entirely different or new since it is intricately connected to similar disciplines such as Environmental Education (EE), Education for Sustainability (EfS), and Education for Sustainable Development (ESD) (Bourn and Hatley, 2022; Jorgenson et al., 2019; Kapranov, 2022). Article 14 of the Paris Agreement of the United Nations Framework Convention on Climate Change (UNCCC) called for all parties to improve CCE as a means of limiting global warming to 1.5 degrees Celsius (United Nations, 2015). Beginning from the early 2010s, the idea that climate change is a threat to the mankind had expanded to the education sector, which responded to it by proposing the concept of ‘Climate Change Education’ (Busch et al., 2019; Reid, 2019; Stevenson et al., 2017; Tang, 2024). Broadly, it had been defined as a holistic approach by previous researchers, an approach that involves “*content knowledge on climate change, environmental and social issues, disaster risk reduction and sustainable consumption and lifestyles*” (Anderson, 2012).

Very little research on CCE had actually been done throughout the 1990s and early 2000s, but this changed when researchers from beyond Europe and North America started publishing their work since 2009 (Rousell & Cutter-Mackenzie-Knowles, 2019). Brownlee et al. (2013) concluded that CCE needs to move beyond cognitive and scientific-knowledge based pedagogies to engage students. Rousell and Cutter-Mackenzie-Knowles (2019) suggested CCE and its research need to extend beyond investigations on children and young people's knowledge of climate change science, to empower them for climate change mitigation through more meaningful, engaging and participatory approaches. In the prominent *Environmental Education Research* journal, a

concerning lack of diversity was noted as majority of Environmental Education (EE) and CCE related research published in it were conducted in North America and Europe (Busch, Henderson & Stevenson, 2018). Additionally, other researchers had also noted a significant lack of geographical diversity in the distribution of CCE research for 1993-2014, with North America, particularly the USA, and European Union countries dominating (Rousell & Cutter-Mackenzie-Knowles, 2019). Similar trend of disparity in CCE research was also observed by a systematic literature review done by Nepraš et al. (2022) found 84% of the CCE literature for 2009-2020 on both primary and secondary education consisted of researchers focusing on developed countries, particularly European and North American youth. This study will therefore contribute to adding valuable insights from the global South into CCE implemented in secondary education.

Education plays an important role in strengthening human capacity to mitigate against and adapt to climate change (Feinstein & Mach, 2019). Climate change education (CCE) is a crucial aspect of addressing the challenges posed by climate change, particularly in the global south and countries like Bangladesh. Stapleton (2015) emphasizes the importance of environmental identity development through social interactions, action, and recognition, highlighting how participation in global education programs focused on climate change impacts can facilitate this process. He also argues for framing climate change education around social justice, specifically intragenerational climate justice, to mobilize youth in industrialized nations like the United States to become climate-engaged individuals (Stapleton, 2019). Mall et. al., (2018) have discussed the challenges and ways forward for disaster risk reduction including climate change adaptation in South Asia, emphasizing the need for effective deliberation among regional policymakers. Narain (2019) further explores the challenges of mainstreaming disaster risk reduction in education from a urban perspective, underscoring the unique vulnerabilities and resilience factors in such contexts. The importance of integrating climate change education within the education systems of South Asia is highlighted by (Jamil et. al., 2019), emphasizing the need for a comprehensive approach to address climate change challenges in the region. Additionally, Rocha et. al. (2020) presented a case study of climate change education in a Brazilian public school, underscoring the importance of training teachers and integrating climate change themes into the curriculum to promote knowledge, attitude, and behavior change among students. Furthermore, (Glazebrook et. al., 2020) shed light on the gender bias and climate change impacts on women farmers in the global south and north, emphasizing the need to challenge traditional agricultural development models and

recognize the unique challenges faced by women in farming practices. Overall, these studies underscore the importance of climate change education in the global south and countries like Bangladesh to build resilience, promote sustainability, and address the social justice dimensions of climate change.

CCE is crucial in the global south, particularly in countries like Bangladesh, where the impacts of climate change are already being felt. Chowdhury et. al. (2021) examined university teachers' perceptions of climate change in Bangladesh, highlighting differences in awareness and understanding between teachers in public and private universities. These studies collectively underscore the importance of climate change education in Bangladesh, to address the challenges posed by climate change and promote sustainable development. Shoeb-Ur-Rahman et. al. (2013) emphasized the integration of 'Education in Emergency' in climate change adaptation efforts to safeguard the country's education sector during disasters. This approach requires collaboration among government departments, upgrading courses on sustainable development and environmental protection, and utilizing information technology. (Datta, 2024) explores Indigenous perspectives on climate change education in the Chittagong Hill Tracts, focusing on themes such as Indigenous land rights and intergenerational knowledge. (Suza et. al., 2024) delve into the dynamics linking climate change and conflict on Hatiya Island, Bangladesh, examining perceptions and responses to climate-induced stress and insecurity. Siddique et. al. (2024) investigated the relationship between climate change knowledge, perceptions of the Dengue-climate link, and associated factors among Bangladeshi youth, emphasizing the importance of climate consciousness. Jurek et. al. (2022) emphasized the importance of providing students with knowledge beyond factual information to enable a deeper understanding of the complexity of climate change. Overall, these studies underscore the importance of climate change education in secondary schools of the Global South to equip students with the knowledge and skills needed to address environmental challenges in the future.

2.4 Climate Change Education in National Curriculums Across the World

Researchers found that targeted educational curriculums and programs can enable students to participate in climate change discussions in an informed manner (Chang & Pascua, 2017). It is therefore crucially important to include climate change education (CCE) into school curriculum. The main goal of any national curriculum is to develop an educational experience that will enable

students to succeed in society (Henderson, 2015). Considering the complexities and uncertainties of a changing world, children who are unable to engage with climate change issues will likely miss the benefits of CCE. Climate change education models and practices are gradually emerging worldwide, accompanied by a growing body of research outlining the framework (Chang & Pascua, 2017; Henderson et al., 2017; Öhman & Öhman, 2013). Researchers and policymakers emphasize that incorporating climate change topics into school curricula is essential for empowering youth to effectively navigate the pressing realities of global climate change and its impacts, both in practical terms and psychological resilience (Salinas et al., 2022).

In several countries across both the developed and developing parts of the world, climate change is typically addressed in national curricula in two distinct ways: either as an integrated aspect of a cross-curricular approach or by establishing a non-disciplinary or cross-disciplinary framework within the curriculum (Eilam, 2022). Countries have also accepted and recognized that climate change must be included in national curricula through interdisciplinary frameworks to prepare children for the future (Kate et al., 2019). The ‘Climate Change Education Report Card’ by UNESCO showed that some countries were making progress towards promoting CCE in their national education systems, among whom Singapore, China, Italy, Cambodia and Argentina were mentioned (UNESCO, 2021). Content analysis of Chile’s primary and secondary school curriculums done by Salinas et al. (2022) found that they contained less than 5% learning goals relevant to CCE. Dalelo (2011) found through a content analysis of Ethiopian secondary schools’ curriculum guides and textbooks that even though causes and consequences of climate change were covered adequately, the ‘politics of global climate change’ remained missing. Actions against climate change, as well as impact of human actions that contribute to global climate change were not articulated properly. Chile’s upper secondary grades (grade 9-10), on the other hand, did include climate action as part of the Science curriculum. Among Southern African countries, researchers have found that Zambian and Zimbabwean curriculum frameworks for secondary education (2013-2016) had emphasized integration of CCE but did not specify ways of inter or transdisciplinary CCE across the curriculum and offered no specific guidelines about how school teachers should handle CCE (Gwekwerere and Shumba, 2021). In the Zambian curriculum framework, climate change is mentioned in only two subjects: Science and Geography. Teachers across Africa also reported lacking updated resources to teach climate change and secondary students mentioned learning about climate change mostly from the media (Shumba, 2017). Apollo

and Mbah (2021) also observed that although CCE is being implemented in national curricula in East African countries to some extent, there is a lack of coherent approaches to leverage CCE as a tool in their adaptation and mitigation strategies. Several researchers have also looked at policies and classroom practices regarding CCE in South Asia, a region disproportionately affected by climate change impacts, and found that there was a large gap between the educational policies for CCE and the implementation of such policies in reality (Mbah, Shingruf, & Molthan-Hill, 2022). Mbah et al. (2022) recommended inclusion of CCE into school curricula in South Asian countries for mitigating and adapting to negative impacts of climate change in the region. In China, several CCE policies and initiatives were undertaken though researchers noted some challenges regarding their implementation (Han, 2015). In Singapore, climate change is incorporated into school curricula but in a fragmented manner and without clear pedagogical guidelines (Chang & Pascua, 2017). Canadian and English researchers also have found shallow and inconsistent representation of CCE into national and regional levels (Bieler et al., 2017; Greer et al., 2023; Rushton et al., 2022). In case of subject-specific curricula, Trædal et al. (2022) found South African and Norwegian schools' geography textbooks discussed climate change topics in adequate manner.

However, the question of how much CCE related policies, regardless of how interdisciplinary or innovative they are, can teachers actually implement in the classrooms at secondary level, when they themselves are not adequately trained, is a topic worth studying in the CCE literature from a global South perspective. Even though climate change education patterns are emerging globally, these are considered to be fragmented at best by some researchers (Lee et al., 2015). Kwauk (2020) argued that the current formal education sector incorporates climate change and Education for Sustainable Development (ESD) in a 'compartmentalized' manner, restricting them to just climate 'science'. This system fails to engage students about climate justice and excludes the discussions surrounding the politics of climate change. While climate justice remained underrepresented in school curriculums around the world, children and youth have expressed significant interest in it, as visible from today's climate activism movements (United Nations Development Programme [UNDP], 2023; Neas et al., 2022). Researchers conducting content analysis on 377 National Adaptation Plans, Nationally Determined Contributions and other relevant policies found that countries overall focused more on 'content knowledge' instead of action-oriented teaching-learning approaches to teach climate change (McKenzie, 2021). Ronald et al. (2017) argued that

the presence of CCE content in curriculums alone may not imply that it is successfully taught to students because if teachers use inappropriate teaching strategies, students cannot learn properly (Ronald et al., 2017).

The most common channel through which to deliver and research CCE so far has been science education, but researchers emphasize that CCE should be holistic and included in cross-curricular projects (Schreiner et al., 2005). Much of the existing literature in CCE has also emerged within science education research and environmental education research (Shepardson et al., 2017). However, evidence of extended practice of holistic CCE remains lacking. It is considered important to equip students with knowledge that is personally relevant and meaningful (Monroe et al. 2017). Approaching climate education through social studies promotes student engagement, climate literacy, and action, and highlights the human connection to climate change (Climate Generation, 2018). In this context, practice of CCE still remains dominated by science educators to this date. Some studies have concluded that curricular frameworks worldwide have failed in large to incorporate climate change adequately, leaving the majority of non-science teachers around the world unsure of how to teach the topic and without time or resources to connect their subject area to it, even though they may want to teach it (Field & Schwartzberg, 2018; Kamanetz, 2019; Taylor, 2019).

2.5 State of Climate Change Education in Bangladesh

CCE can be defined as the “*process of learning in the face of climate change-related risks and uncertainty*” (Stevenson et al., 2017). CCE targets to increase awareness of children and youth about climate change and its consequences (Tang, 2024). A UNICEF report found that nearly one in every three children in Bangladesh are at risk from flooding, cyclones and other climate change-related disasters (UNICEF, 2019), thus undermining children’s education across Bangladesh, particularly in coastal areas. According to the 2021 report from UNESCO’s Global Education Monitoring (GEM), climate education can help the public understand the impact of climate change, to develop new skills and to increase resilience of vulnerable communities. The Climate Change Education Ambition Report Card that studied all the Nationally Determined Contributions (NDC) shows a distinct trend: while more countries are prioritizing CCE today than ever before, only four countries have mentioned teaching CCE across all subject areas and levels of education on a compulsory basis (Kwauk, 2022). Climate change is part of Bangladesh's everyday politics and

public consensus, quite unlike the prevailing skepticism in some Western high-income countries such as the US. Bangladesh's experiences with the climate impacts and natural disasters have allowed the country to recognize the undeniable necessity of taking climate change seriously. When the Parliament of Bangladesh declared climate change to be a "*planetary emergency*" in 2019, it proved itself to be the very first developing country in the world to do so (Huq S. , 2019). Yet, Bangladesh, was not among those four countries incorporating CCE in its NDC. Bangladesh has also been a signatory of the United Nations Framework Conventions on Climate Change (UNFCCC) since 1992, yet Bangladesh's revised NDC submitted for the Paris Agreement did not include an education policy that allows provision for CCE or evaluation and monitoring of CCE (MoEFCC, 2021). Bangladesh's NDC also did not include any reference to the inclusion of key stakeholders such as indigenous groups, students with disabilities and excluded reference of climate justice. It also lacked declaration of protection of children's right to education, especially in climate-related disasters and did not call for a systematic strengthening of the Bangladeshi education system to address climate change. Moreover, only ten countries around the world as of 2022 have publicly declared their National Climate Change Learning Strategies (NCCLSs), and Bangladesh was not one of them (Kwauk, 2022). It is in this context that the need for a brief look at the state of CCE in formal education, particularly secondary education in Bangladesh arises.

The National Curriculum 2012 of Bangladesh was developed in light of the National Education Policy (NEP)-2010 by the National Curriculum and Textbook Board (NCTB) under the Ministry of Education, and officially published in 2012, beginning implementation nationwide from 2013. The goal of the National Curriculum 2012 was to create "*scientific-minded, rational, work-oriented, skilled human resources*" (NCTB, 2012). Based on the 'Objective learning outcome' model, it included 18 objectives in the secondary curriculum, among which making students productive and creative in using ICT, increasing their interest in technology and developing their leadership, collaboration and communication skills were included (NCTB, 2012). Previously pioneering research done by Chowdhury (2014) demonstrated that the curricular content as supported by the NCTB textbooks under this National Curriculum-2012, included brief, "fragmented" and incomplete components of Environmental Education (EE) at secondary level; lacking "*continuity and logical progression*". Most of the EE-relevant content were broadly distributed among two subjects: General Science and Social Science in secondary level (grade 6-10). There were also no established criteria for assessing students' environmental literacy

(Chowdhury, 2014). While the textbooks included some EE content, most of those only focused on the geographical aspects of the country's environment and natural disasters faced by different areas. Core topics relevant to both EE and CCE (e.g., Climate change, biodiversity loss) were not well represented in the textbooks created in accordance with the National Curriculum-2012. Furthermore, research done by Shohel et al. (2021) on both primary and secondary level school education confirmed such finding and recommended that school curriculum be expanded to include more topics, ensuring students truly understand the local and global consequences of climate change. The National Curriculum 2012 thus was found lacking in terms of preparing Bangladeshi secondary students sufficiently and equipping them with knowledge about climate change.

Later on, the NCTB published the new National Curriculum Framework-2021 on October 21, 2021, as an effort to bring much needed transformative reform to the education system. The National Curriculum Framework-2021 was the result of an effort to develop a competency-based continuous, seamless curriculum from pre-primary to grade 12, for children aged between 4 and 18 years in the context of the national goal to become a developed country by 2041 and global challenges in order to equip students in Bangladesh with the knowledge and skills to address 21st century challenges, including climate change, poverty, hunger and pandemics. In this new Curriculum Framework, the “spirit” of Bangladesh's historical movements such as the Liberation War of 1971 provided the background from which the concept of competency was generated and established close interrelatedness among four elements: knowledge, skills, values, and attitudes (National Curriculum Framework, 2021). Competency-Based Curriculum (CBC) was implemented in various educational systems around the world with the aim of improving the quality of education and preparing students for the demands of the 21st century (Timothy & Hollan, 2024). Competency was defined by the National Curriculum Framework-2021 as a combination of four elements: ‘knowledge, skills, behaviors, and attitudes’. Combining these four elements, a total of 10 “core competencies” were created and integrated across all subjects and grades. Taking local and global needs as well as future perspectives of higher education into consideration, 10 ‘Learning Areas’ were developed for acquiring the core competencies. These Learning Areas are the same for all students from pre-primary to grade 10 in secondary level. Among those 10 ‘Learning Areas’, only the 7th one is dedicated to ‘*Environment and Climate*’ (National Curriculum Framework, 2021). As this Framework focused on experiential, hands-on learning rather than the

traditional rote memorization, students were supposed to get out of the classroom environment and get practical experience with the people of the society through the learning process of group work, project work, fieldtrips and problem-solving based formative assessments. While the Directorate of Primary Education and Directorate of Secondary and Higher Education (DSHE) oversees implementing the new National Curriculum Framework-2021, and the NCTB supervises creating the secondary level curriculum and textbooks in Bangladesh. Unlike the past approach of adopting curriculums nationwide across all grades and subjects simultaneously, the new framework was planned to have been executed gradually from 2023 to 2027. The first stage of the partial implementation saw light of the day when the curriculum was officially launched in January 2023, starting with primary students of grade 1 and secondary students of grade 6 and 7 across Bangladesh. However, the framework implementation was put on pause in September, 2024 following the regime change in Bangladesh after the July-August Uprising.

Overall, the goal of this Framework was to give the younger generation of Bangladeshis the 21st century skills and competencies they need, to reduce their dependence on rote memorization of textbooks, coaching centers and private tutors to pass exams without learning. The textbooks for secondary students focused on project-based learning, and a more modern multidimensional assessment approach that included activities like group poster presentations, debates, drama performances, storytelling, creating models and other project-based learning activities that encouraged teamwork among students (National Curriculum Framework, 2021). Even though there has been some research on the previous curriculum of 2012 and its inclusion of EE related content in secondary education, there had not been any research done exploring how CCE is incorporated into the Curriculum Framework-2021 in Bangladesh since the Framework's official implementation in 2023. Some researchers have recently examined the National Curriculum Framework-2021 through a gender education lens (Barua et al., 2024). This study, therefore, aims to fulfill an important gap in CCE research and provide insights into how the Curriculum Framework-2021, its textbooks and Teacher's Guides incorporated CCE in Bangladesh.

2.6 Secondary school students' perceptions about climate change

Perception involves recognizing 'environmental stimuli' and then interpreting the information to act accordingly. It can be explained as sensory experience and is considered important for survival (Cherry, 2020). To put it simply, perception is an individual's or group's exclusive way of

observing a phenomenon that involves processing of stimuli, inclusion of memories and experiences in the process of understanding (McDonald, 2012). In this study, the term is defined as the understanding, knowledge and viewpoint of lower-secondary level (age 13-16) 8th grader students about climate change.

People need to know about the consequences of anthropogenic activities and the impact those consequences have on the world's climate. When people are aware of environmental issues and their impact on the climate, their attitude towards such issues also change and they tend to become more concerned, showing pro-environmental behaviors (Marquart-Pyatt et al., 2011). Previous research work shows that developing knowledge and positive attitudes towards environmental issues from an early age can help to create 'environmentally conscious citizens' (Bas, Teksoz, & and Ertepinar, 2011). Researchers of environmental behavior studies found evidence for positive relation between environmental knowledge and creation of positive environmental attitudes (Barraza & and Walford, 2002). Since today's young people are not just the leaders of tomorrow but also remain at the forefront of bearing the brunt of climate change impacts, more and more studies are being done to understand their perception of the global crisis itself. The focus on anthropogenic climate change as one of the core emerging environmental issues has also been observed in existing educational literature.

Starting from the early 1990s, a lot of North American and European studies and surveys have explored how secondary school students perceived climate change. Among literature dated from the early 2000s, Shepardson et al. (2009) investigated 7th grader students from the US about climate change and global warming. Rye et al. (2011) investigated 6th and 7th grader students from US; whereas even earlier, Boyes and Stanisstreet (1992) studied Canadian secondary school students' perceptions towards climate change. One of the most important work in CCE research was the systematic literature review done by Lee et al. (2020), which revealed that knowledge of climate change generally increases with age. In a much recent study of secondary school students in the UK, researchers found that students often perceived climate change as a global and distant issue, which made individual climate actions feel meaningless when compared to the massive scale of the problem (O'Neill & Nicholson-Cole, 2022). Alvaro et al. (2024) studied the knowledge and perception of 1328 Spanish school students and found 75% perceived climate change to be real and happening in real-time. Bodzin et al. (2014) studied 8th grader students in an urban school

community in the US and found several deficiencies in students' understanding about basic climate change concepts. Feldbacher et al. (2023) observed that Austrian secondary school students were knowledgeable of climate change but lacked deeper understanding of more intricate relationships and long-term interactions of climate change effects on people and ecosystems.

Several studies had also been done to explore secondary school students' perceptions from the global South, even though they have been comparatively much fewer than research done on Europe and North American students (Lee et al., 2020). A 2011 UNICEF survey focused on South African children's (aged 14-17) perception of climate change and revealed that their perceptions and understanding of climate change were somewhat distorted. Vujovic (2013) confirmed this finding and linked this as a result of the school teachers' own misconceptions about climate change and gaps in knowledge and perception. Earlier studies done to explore school students' perceptions, knowledge and understanding about climate change in Europe, particularly the UK and Greece, observed a rural-urban dichotomy as urban students with better education and access to electronic media were better informed about climate change than their rural counterparts (Boyes & Stanisstreet, 2001; Liarakou et al., 2011). However, a 2015 study on South African students found no confirmatory evidence for this rural-urban dichotomy and observed that more than 60% of all the participant secondary school students held misconceptions about climate change (Lekgeu & Davis, 2015). Furthermore, research done on Malaysian secondary school students' found that students held different ideas, while some portrayed a higher level of understanding, others had several misconceptions about climate change (Maisuna et al., 2024). Climate change understanding of senior high school students from Indonesia also were found to be low, inconsistent and in need of improvement (Sulistyawati et al., 2018). But this finding contradicted the results of a recent study that found Indonesian school students to be highly aware of climate change and its health impacts (Deshiana et al., 2022).

Recent research from Afghanistan found that Afghan school students demonstrated a high understanding of climate change and its local impacts, showing concern regarding negative climate impacts but there was a clear need for further formal education on climate change (Dildar et al., 2024). Many students from the global South perceived climate change caused them and their families or communities several severe health issues, as found by Malaysian and Indonesian researchers (Hamid et al., 2021; Deshiana et al., 2022). Gautam et al. (2021) also found Nepalese

secondary school students to hold similar ideas about health impacts of climate change. Study done on Kenyan high school students revealed that students associated climate change with mental health concerns and suicidality (David et al., 2024). In such scenarios, the common challenge for educators lies in finding a proper way to balance teaching about climate change while also nurturing the hopeful sense that something can be done and that individuals, communities, and societies can all make a difference, turning young people from ‘Climate worriers’ to ‘Eco warriors’ (Birdsall, 2020).

Among the existing literature on climate change perception of Bangladeshi youth, a 2021 UNICEF survey carried out among almost 5,500 15-24 year old urban and rural youth found 50% could explain what ‘climate change’, 77% reported they learned about it in school and 70% felt anxious about climate change (UNICEF, 2021). Some studies have been carried out focusing on the perceptions of adult participants towards climate change and its impacts in Bangladesh. For instance, Haq and Ahmed (2020) studied adult university students’ perceptions of climate change. Chowdhury et al. (2021) conducted a study on the perceptions of university teachers of Bangladesh towards climate change. Among much earlier and older research works, Rahman et al. (2014) studied climate change awareness among 270 secondary students aged 10-16 years from Chittagong from varying demographic profiles and schools found that curriculum content on climate change was less than adequate but overall students’ awareness increased gradually from lower to higher grades. Lower efficacy of the curriculum in 6th and 7th grades were noted. This data is consistent with a 2021 study done on more than 700 Indian students studying in 8th to 12th grades showed significantly less awareness and knowledge about climate change compared to their higher-secondary counterparts (Zeeshan et al., 2020). Moreover, it was evident that level of environmental education (EE) and students’ awareness of the environmental issues overall were inadequate in Bangladesh (Uddin, 2023). However, there is a huge gap in studies that focused entirely on the climate change perceptions of secondary students after the introduction of the new National Curriculum Framework in Bangladesh in 2023. A thorough literature review of existing studies proves that Bangladeshi students from low socio-economic urban communities whose ages range from 14 to 16 (8th graders) perceive climate change has not been studied in-depth in recent studies. Since the new curriculum was introduced for secondary students from 6th and 7th grades in limited scale from the academic year of 2023 across Bangladeshi schools, scope for research

exploring the new curriculum's impacts is huge and this study might be able to carve out a pathway for further research on the topic.

It must be noted that even though there is scientific consensus about the causes and impacts of anthropogenic climate change, misconceptions about climate change among the children and youth have continued to persist around the world for the last two decades. Misconceptions about climate change, particularly climate science, among youth have been well-documented in international CCE research. Several researchers have done a comprehensive review of such misconceptions (Shepardson et al, 2011; Niebert and Gropengiesser, 2013). Students around the world wrongly perceiving air pollution and ozone depletion to cause climate change, confusion between climate change and the ozone hole problem, greenhouse effect causing skin cancer, not understanding the greenhouse effect as a natural process, not knowing what all the greenhouse gases were or what the differences between weather and climate, not knowing the natural causes behind climate change, perceiving global warming to be happening solely due to human activity, mistakenly perceive generally pro-environmental behaviors and actions as the appropriate solution for solving any environmental issue-- were some of the most commonly found misconceptions that have been repeatedly found by many researchers across the world (Boyes & Stanisstreet, 1992; Boyes et al., 1993; Gowda et al., 1997; Boyes & Stanisstreet, 2001; Liarakou et al., 2011; Sherpadson et al., 2009; Shepardson et al, 2011; Niebert and Gropengiesser, 2013; Leiserowitz et al., 2010; Pruneau et al., 2003; Henriques, 2010; Choi et al., 2010; Dawson, 2015; Cartwright et al., 2021).

2.7 Secondary School Teachers' Pedagogical Approaches for Teaching Climate Change

Climate change education, if properly done, could serve as a strategy for climate adaptation and mitigation (Borde et al., 2022; Iyengar, 2020). Despite the growing recognition of the need to teach climate change worldwide, the field of climate pedagogy is relatively new, and faces several challenges. Teachers need content-specific pedagogical approaches to confidently incorporate climate change in their lessons (Kunkle & Monroe, 2018; Hestness et al., 2017; Shea et al., 2017). Existing research indicates the professional development programs teachers need to effectively teach climate change should increase their pedagogical content knowledge (PCK), because pedagogy changes across content areas (Van Driel et al., 2012). Some of the recommended

pedagogical strategies for CCE include: projects, fieldtrips, experiments, case study, action learning and whole school approach. Existing research does not agree on a particular pedagogical approach for teaching climate change to secondary level students. But the following few approaches, as discussed below, were commonly found while reviewing the literature.

2.7.1 Emotional Engagement as a Pedagogical Approach

Climate change represents the biggest threat humanity faces (Calvin et al., 2023; World Health Organization, 2023). If the formal educational frameworks do not properly prepare the youth about the future they face, it will cause considerable anxiety or distress among them when they realize they were not adequately prepared equipped for the challenging future they face (Diffey et al., 2022; British Science Association, 2023). Emotional engagement is therefore an important pedagogical approach for teaching climate change, as it enables students to connect with the issue on a personal level, creating a deeper understanding and motivation to take action (Lenzen et al., 2002). Human actions are often driven by emotions (Kretz, 2020). Emotions can work as a lens for understanding how students perceive climate change and influence students' perceptions and judgements (Hufnagel, 2015; Lombardi et al., 2013). Some researchers found conclusive evidence that emotions play a significant role in how students relate to climate issues, and addressing these emotions can improve their learning experience and motivate them to take action. Ojala (2023) found that while feelings of worry and anxiety about climate change can negatively affect students' well-being, they can also serve as motivating forces for learning and engagement. This perspective is supported by findings from a case study in France, where secondary school students discussed their emotional reactions to climate change and engaged in collaborative problem-solving, demonstrating that emotional engagement can lead to proactive measures (Monitoring and Evaluating Climate Communications and Education Project [MECCE], 2023).

Some researchers have suggested that teachers should develop “Critical Emotional Awareness (CEA)” to help their students cope with feelings of anxiety and worry related to climate change (Ojala, 2023; Ojala, 2021; Vay et al., 2024). This involves understanding how emotions can be both a barrier and a motivator for learning (Carter & Thompson, 2019). When teachers are aware of the emotional elements of learning, they can create more effective instructional strategies that resonate with students' experiences and feelings (Carter & Thompson, 2019). Ojala (2-15) urges

teachers to take students' negative emotions on climate change seriously. By addressing both positive and negative emotions students have, teachers can facilitate a more comprehensive understanding of climate change that goes beyond cognitive understanding of climate change. Studies suggest that when teachers incorporate socio-emotional aspects into teaching climate change through activities like group projects or discussions about emotions, it can encourage students to engage with the material more deeply and develop a sense of shared responsibility (Smith & Brown, 2020). Furthermore, research highlights that educational settings often magnify feelings of powerlessness and fear among students, but when educators incorporate emotional aspects into climate education, it fosters a deeper understanding and encourages positive action (Ojala, 2023). Also, a 'hope-inspired' pedagogy that emphasizes the importance of hope, agency, and resilience, helps students to see their potential impact on climate change mitigation rather than feeling overwhelmed by it (Geiger et al., 2023; Johnson & Lee, 2021).

Research done by Willox et al. (2012) found that creating space for emotional discourse helps students to integrate their feelings with cognitive understanding, fostering a holistic approach to climate literacy. This integration is particularly relevant in contexts like Bangladesh, where school education must balance global awareness about climate change with local relevance. Researchers recommend that teachers should connect climate change topics to students' lives, increasing their relevance and emotional investment to the topics (Godin & Johanson, 2024). Ojala (2012) argued that ignoring students' emotions regarding climate change can lead to increased climate anxiety and a sense of helplessness, particularly among young people. Discussing and engaging with students' feelings might be particularly important for students in urban low-income communities in Bangladesh, since these communities often experience direct impacts of climate change such as flooding, heat stress, and economic instability, making the students' emotional responses to climate change deeply tied to their "*lived realities*" (Islam & Winkel, 2017). Rushton et al. (2023) explored climate change education in British secondary schools and observed that teachers were emphasizing 'content knowledge' over emotional engagement. They found that students expressed mostly negative emotions towards climate change (e.g., fear) and noted that teacher professional development is desperately needed to address these emotional responses. They recommended emotional support in climate change education by encouraging teachers to address students' emotions related to climate change, promoting constructive hope and resilience. Some Canadian

researchers have suggested a new kind of framework for teaching climate change that integrates climate emotion coping strategies (Levesque & Rocque, 2024). Teachers have an important role in promoting ‘constructive hope’ by demonstrating a caring attitude, and manifesting caring in practice (Pihkala, 2017). Elizabeth et al. (2023) highlighted the need for targeted teacher professional development which enables them to respond to the emotions young people experience in the context of climate change education. Teachers' beliefs about emotions also play a role, with varying views on how to handle emotional reactions in the classroom (Ojala, 2021).

2.7.2 Project-based pedagogical approach

Project-based pedagogy has emerged as an effective approach for teaching climate change to secondary school students worldwide. This method engages students in hands-on, inquiry-based projects that deepen their understanding of climate science, its societal impact, fosters critical thinking and problem-solving. Some researchers have recommended project-based teaching as an important strategy for implementing CCE at secondary level education (Larue et al., 2016; Siegner, 2018). It is based on John Dewey’s principle of ‘learning through practice’ and such projects can include community outreach programs, waste management, recycling, tree plantations etc. Such project-based pedagogy has been implemented across secondary schools by teachers of Canada and Seychelles (Monroe et al., 2021; Larue et al., 2016). This project-based approach of teaching secondary students about climate change was observed in limited scale in some provincial schools of Zambia, where teachers led students to do waste management projects (Makisa, 2016). When teachers used project-based educational modules to teach climate change to middle and high school students in several US classrooms, students achieved significant climate literacy gains (DeWaters et al., 2014). Arranging fieldwork and trips is another strategy that some secondary school teachers have used when teaching the CCE content in school curricula (Lotz-Sisitka et al., 2017). This is the method of teaching that provides opportunities for students to learn through direct and concrete experiences (UNESCO, 2020).

2.7.3 Interdisciplinary and Transdisciplinary approach

Climate change as a phenomenon itself is located at the intersection of several disciplines such as physics, chemistry, biology, economics, sociology, psychology and so on. Some researchers

conclude that the present compartmentalized education system does not make it easy to allow space for an inter/transdisciplinary approach to teaching about climate change (Singh V. , 2023). Disciplines have developed specific vocabulary and frameworks that may not be easily translatable; thus transdisciplinary pedagogy is a relatively new field (Brown et al., 2010; Leavy, 2011). Some researchers observed that well-known approaches such as Project-Based Learning, Problem-Based Learning, Case-Study- Based learning and Social-Emotional Learning can also contribute to the development of a transdisciplinary framework (English & Kitsantas, 2013; Weissberg et al., 2015). Many researchers have recommended an interdisciplinary educational framework that develops scientific knowledge and civic skills as the best curriculum for teaching climate change to youth (Ho & Seow, 2017; National Oceanic and Atmospheric Administration, 2007; Chang, 2012; Dalelo, 2011; Milér et al., 2012). Pitt (2009) suggested that one way to enhance environmental education in schools is to integrate a sustainability-inspired approach across subjects and different disciplines, breaking down barriers between different learning areas. Integrating various disciplines, (e.g., humanities and social sciences) thus allows a multidimensional exploration of climate change which promotes critical thinking and creativity in students (Houghton et al., 2023).

Among other alternative pedagogical strategies and approaches than the above-discussed ones, some researchers have also suggested that African Ubuntu-philosophy inspired pedagogy could also promote climate literacy (Gwekwerere & Shumba, 2021). Finnegan (2023) also explored creative pedagogies such as digital storytelling about climate futures, as a means of encouraging hope among students through “positive reappraisal”. ‘Pedagogy of hope’ is also another much-appraised approach as part of informal education that some researchers argued as capable of protecting student well-being while also empowering them as agents of change and collective action (Finnegan & d’Abreu, 2024). Place-responsive pedagogy, Eco-pedagogy, Critical Indigenous pedagogy, human-rights based approach, teaching through cinema are some other CCE approaches and practices (Bleazby, 2013).

Conceptual Framework of the Study

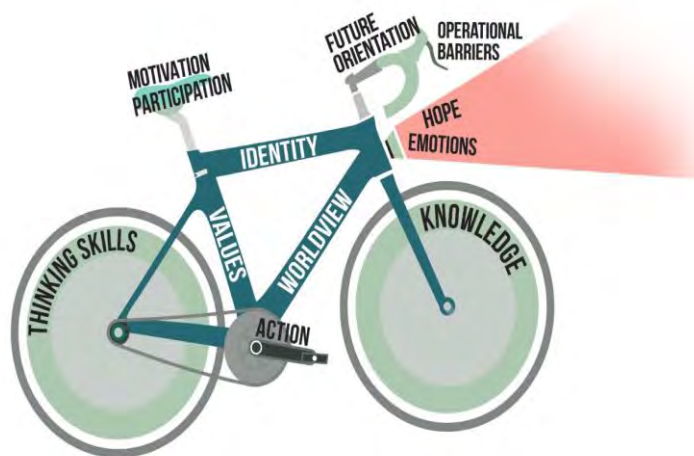
In 2021, UNESCO published a report titled '*Learn for Our Planet*' that reviewed the educational policies and 100 national curricula of its member states and found 47% of them did not contain a single reference to 'climate change' and those that did, only mentioned it superficially. According to Henderson et al. (2017), climate change education has been deemed as an 'uncoordinated' field of study with narrow disciplinary focus since existing conceptual frameworks about integration of climate change in national curricula focus mostly on putting more emphasis on competency-based climate science and environmental education (Henderson et al., 2017).

Very few authors advocate for a more creative, art-based integrative approach to teach climate change that strays from that narrow science-dominant lens (Verlie, 2017; Cantel et al., 2019). Some of these frameworks and models for climate education are more European-focused and do not consider the feasibility of implementation in least developed countries (Szczepankiewicz et al., 2021). Some researchers have proposed a conceptual framework based on Vygotsky's Socio-cultural theory of learning (Spínola, 2021). Moreover, researchers have noted that models for truly holistic interdisciplinary climate education models did not exist as of 2019 (Cantell et al., 2019). A framework called the Bicycle Model was developed by Finnish researchers Cantell et al. (2019) that allows a holistic approach towards climate education which are not only provide personally meaningful knowledge and include engaging pedagogy, but also emphasize thinking skills, values, identity, worldview, action, motivation, future orientation, hope and other emotions and operational barriers.

For the purpose of this study, the Bicycle Model for climate change education has been chosen due to its holistic aspects. This model is compared to the functionality of a bicycle, requiring all its parts to work in harmony to be effective. It symbolizes the interconnectedness of various aspects of climate change education, with the bicycle metaphor serving as a memorable and environmentally friendly representation. This model confirms essential elements from previous literature into a comprehensive framework.

Figure 1

The Bicycle Model of Climate Change Education (Cantell et al., 2019)



Wheels: Knowledge and Thinking Skills

The wheels represent knowledge and thinking skills, fundamental for progress in climate change education. It stresses the importance of not just acquiring knowledge but using it to foster deeper understanding and critical analysis. Various dimensions of climate knowledge, including natural causes, atmospheric conditions, and human impacts, are deemed crucial. Moreover, the model emphasizes the development of thinking skills through critical reflection, exploratory learning, and understanding the political and economic facets of climate change.

Frame: Identity, Values, and Worldview

The frame symbolizes the foundational beliefs, values, and worldviews of learners, shaping their reception and integration of new knowledge and skills. It addresses the need for comprehensive discussions on ethical considerations and the human aspects of climate change. The model suggests a critical engagement with personal and societal values and attitudes towards consumption and environmental responsibility.

Chains and Pedals: Action to Curb Climate Change

This component underscores the necessity of translating knowledge and thinking skills into practical, real-life actions. It highlights the multifaceted nature of environmental action, influenced by personal empathy, societal norms, and the perceived feasibility of actions. The model calls for

long-term planning and encouragement to foster environmental stewardship across different communities.

Saddle: Motivation and Participation

The saddle represents the motivation to engage with climate change issues, which is critical for utilizing the bicycle (model) effectively. It discusses the challenge of making climate change a relevant and actionable issue for learners, emphasizing the role of community and positive engagement in fostering motivation and participation.

Brakes: Operational Barriers

Identifying and understanding barriers to environmental responsibility, such as personal habits, structural limitations, and socio-cultural factors, are crucial. This section highlights the complexity of enacting climate-responsive behavior and the importance of addressing both individual and systemic obstacles.

Lamp: Hope and Other Emotions

The lamp stands for the emotional responses to climate change, advocating for the integration of emotions in education to foster hope and compassion. It acknowledges the potential of emotions to both hinder and enhance learning and calls for a balanced approach that encourages constructive emotional engagement with climate issues.

Handlebar: Future Orientation

Future orientation is crucial for climate change education, aiming to cultivate a critical yet optimistic outlook towards the future. This involves encouraging creative and emotional engagement with potential futures, emphasizing the importance of hopeful, informed action over passive optimism.

In sum, the Bicycle Model for climate change education presents a holistic and integrated approach to teaching about climate change to children. It emphasizes the importance of knowledge, critical thinking, ethical considerations, practical action, motivational aspects, overcoming barriers, emotional engagement, and a future-oriented perspective in creating a comprehensive educational strategy.

2.8 Summary

This chapter explores the role of climate change education (CCE), focusing on its importance in addressing the challenges faced by secondary education in Bangladesh and the Global South. The chapter reviews literature on the impacts of climate change on vulnerable communities, highlighting the urgent need for educational reforms to equip students with knowledge, resilience, and action-oriented skills. It critiques the fragmented integration of CCE in global and Bangladeshi curricula, emphasizing the necessity of interdisciplinary approaches and effective teacher training to combat misconceptions and promote climate literacy. Adopting the Bicycle Model as a conceptual framework, the study advocates for a holistic approach that incorporates knowledge, values, emotions, and practical action to empower students. Despite being highly vulnerable to climate impacts, Bangladesh's education system requires significant enhancements to embed CCE comprehensively and effectively into its curriculum and policy frameworks.

Chapter 3

Methodology

3.1 Introduction

This chapter focuses on the research approach that was used to conduct the study and details information regarding research site, research participants and participant selection procedure, data collection tool, data collection methods and procedure, and techniques used to analyze the collected data. It also highlights the ethical concerns, trustworthiness and rigor of the research used and the limitations of the study.

3.2 Research Approach and Design

The qualitative approach is appropriate for this study, since it prioritizes understanding the participants' perceptions and lived experiences rather than measuring their knowledge or skills quantitatively. Another key reason for choosing the qualitative approach for this research is due to its flexibility by allowing the researcher to investigate complex and evolving issues in depth (Creswell & Poth, 2018). In this research, a qualitative approach provides an opportunity to gather individualized insights, capturing how climate change is perceived by the students and taught by the secondary school teachers in urban low-income communities. Through open-ended data collection methods like In-depth Interviews, Focused Group Discussions, class observations and document analysis, the qualitative approach in this study allows participants to express their perceptions about climate change and pedagogical practices as well as explore curricular differences in a context where climate change education is still an emerging discipline.

This qualitative research approach helps paint a comprehensive view of how students from low-income urban communities in Bangladesh perceive climate change not only in their academic environment but also within the wider context of their community and personal lives- in alignment with the study's other objectives to assess curricular differences, content and pedagogical practices.

3.3 Research Site

I selected two schools for this study, and both are Bangla-medium secondary schools, one falling under the jurisdiction of the Dhaka South City Corporation (DSCC) and the other under the Dhaka North City Corporation (DNCC). For convenience of this study, the schools will be labelled as ‘School A’ and ‘School B’ from now on. School A and B were selected for this study because they are government-approved schools well embedded within the low-income urban communities they serve. Additionally, both institutions have more than 30 years of experience and a long-standing reputation for supporting the children of working-class parents earning minimum wages. Both schools offer education up to the secondary level, with their teaching staff receiving partial or full monthly salary from the Bangladeshi government’s MPO (Monthly Pay Order) scheme. In both schools, secondary students are being taught following the New Curriculum Framework-2021. For this research, I chose these two schools because of my convenience and accessibility.

Table 1

List of research participants who consented to and participated in this study

Category	Number of participants
Schools	2
Science teachers	2
History and Social Science teachers	2
Students	12
Total participants	16

3.4 Research Participants and Participant Selection Procedure

The participants in this study included teachers and students from two secondary schools in Dhaka city. I gathered data from a total of 12 students from 8th grade and 04 secondary teachers from the schools. For qualitative research, purposive sampling is considered particularly effective when the aim is to explore specific perspectives or experiences directly relevant to the research questions (Patton, 2002). Purposive sampling ensures that participants of the study possess specific

characteristics or knowledge that make them suitable for providing meaningful insights (Palinkas, 2015). For this proposed study, purposive sampling enabled me to select students and teachers who had relevant experience with the new curriculum framework.

I selected teachers for this study who were subject-specific educators, teaching subjects like ‘Science’ and ‘History and Social Science’. These subjects were chosen since they are the only ones that include climate change content in the textbooks for 8th grade students. There were three female and one male teacher. They each had an average of 10 years of teaching experience and held Master’s degrees relevant to the subjects they were teaching. Additionally, all these teachers had also participated in government-planned training workshops to implement the new curriculum. Before the new curriculum came along, these teachers have also been trained to teach under the previous 2012 national curriculum, which was formulated based upon the 2010 National Education Policy. Since these teachers had relevant academic backgrounds, training on implementation of both curriculums and substantial work experience, they were able to provide practical insights into how climate change is incorporated into their lessons.

I also interviewed 8th grade students aged 14 to 16, including 06 female students and 06 male students who participated in the study. 06 of these students participated in the FGD, while all them participated in the individual interviews. These students were in 7th grade in 2023, and had been taught under the new curriculum for nearly two years by late 2024. This meant in addition to their perceptions on climate change, these students could also provide the researcher with unique insights into their experience of learning about climate change through subject-specific content and pedagogy in their classrooms.

3.5 Data Collection Method

To gain an in-depth understanding of students’ perceptions towards climate change and the pedagogical approaches of secondary teachers, I used a combination of data collection tools in this study: In-depth Interviews (IDI) that included open-ended questions, Focused Group Discussions (FGD) and classroom observations. For this study, I selected a total of 12 eighth grader students from School A and B for the face-to-face IDIs, and one face-to-face FGD was conducted from 06 of those students. A total of 04 teachers consented to and participated in the IDIs for teachers and four class observations were made from their classes. Additionally, I also collected educational policy documents such as the new Curriculum Framework of 2021 and the teachers’ instructional

guides designed by the Education Ministry that gave teachers detailed instructions on how to teach and create assessments as per the new curriculum and subject-specific textbooks such as the ‘Science’ and ‘History and Social Science’ textbooks for 8th grade were also collected from the internet to conduct document analysis for climate change content and pedagogical instructions for teaching those content.

3.6 Data Collection Procedure

To investigate the research questions, I employed qualitative research methods to gather data from both teachers and students from two secondary schools embedded with two different low-income urban communities situated in Dhaka city. In-depth Interviews (IDIs) and one Focus Group Discussion (FGD) were conducted with teachers and students to gain a detailed understanding of their experiences and perceptions regarding climate change education under the National Curriculum Framework-2021. IDIs are a valuable approach in qualitative research, as they provide a focused conversation on the research topic, allowing participants to express their views without predetermined categorization (Kvale & Brinkmann, 2009). This method enabled me to capture the nuances of the participants’ experiences and perspectives, making it particularly effective for addressing the subjective nature of the research questions (Zhang & Wildemuth, 2009).

I designed an Interview Guide aligned with the research questions, which was reviewed and approved by my thesis supervisor. The IDIs were semi-structured, with open-ended questions allowing participants to reflect on their perspectives towards climate change and their experiences with climate change education under the new curriculum. A total of 14 individual IDIs were conducted, each lasting between 15 and 23 minutes. The IDIs took place on the campuses of School A and School B, where both teachers and students were available for interviews. Additionally, a Focus Group Discussion (FGD) was conducted with 06 students to explore their perceptions about climate change and climate change education under the curriculum framework-2021. FGDs are particularly useful for collecting rich data from participants in their own words, fostering a collaborative environment where participants can engage with each other’s viewpoints (Stewart & Shamdasani, 1990). The FGD lasted approximately 1 hour and 15 minutes, with guiding questions kept simple and brief to match the students’ age and cognitive level.

Prior to conducting the IDIs and FGDs, I ensured that all participants were informed of the study's purpose and the data collection process. I coordinated schedules for IDIs, class observations, and

FGD with the school administrations, and collected signed consent forms from the consenting teachers. For the students, parental consent was obtained for the student participants, and written consent was collected from the teacher participants. I recorded the IDIs and FGD audio with participants' consent, ensuring that I took detailed notes throughout the sessions. The data collection tools, including the interview and FGD guides, were piloted to ensure they were contextually appropriate and validated.

Moreover, classroom observations were conducted as part of the study to observe how climate change is integrated into subject-specific lessons for 8th graders by teachers. Observation is a “meaningful tool” for researchers to understand and interpret situations by uncovering the social and cultural meanings of those involved, especially in the educational field, where it provides valuable insight into the experiences of teachers, students, caregivers, and administrators (LaGarry, 2019). Hence class observation was a key tool for data collection in this study for understanding how secondary teachers who work with students from low-income urban communities teach climate change. I developed an observation checklist to guide the process, which focused on capturing how secondary teachers from low-income urban communities teach climate change. Four 8th grade classes were observed, two Science classes and two History & Social Science classes in two different sections. Each class lasted between 15 and 30 minutes, and I took detailed notes during the observations since video and audio recording were not permitted by the teachers.

Before the classroom observations, I briefed the teachers on the observation process and collected their consent for the observation. The observations provided additional context to understand how teachers approach climate change within the curriculum. Additionally, a document analysis was conducted to examine textbooks, the Teacher’s Guides used by the teachers and the curriculum document, with a specific focus on climate change content. The data collection process was coordinated with the school administration to ensure that consent forms and schedules were managed efficiently.

3.7 Data Analysis Procedure

The data analysis procedure for this study followed an inductive **thematic approach** which allowed sub-themes and themes to emerge directly from the raw data, without enforcing any pre-

existing categories. The data analysis process was carried out in the following the steps laid out by Braun and Clarke (2006):

1. Familiarization with the Data:

The first step involved familiarizing myself with the data. Here, I transcribed the audio recordings of the in-depth interviews (IDIs) and Focus Group Discussions (FGDs) verbatim, ensuring every detail was captured. The transcripts were stored securely on a private Google Drive folder. I also took detailed notes during the class observations. I thoroughly read and re-read the transcripts and observation notes, highlighting key information in different colors. This allowed me to immerse myself in the data and make initial observations.

2. Generating Initial Codes:

I systematically coded the data in this phase. I used color coding to mark specific sections of the transcripts and observation notes that were relevant to the research questions. Each piece of data was assigned a colored code that represented the underlying meaning or concept. The codes were then grouped together based on similarities, and I ensured that every relevant section of data was coded. This allowed me to organize the raw data into manageable chunks.

3. Searching for sub-themes:

After generating the initial codes, I arranged them into sub-themes. I reviewed the codes and grouped them according to broader sub-themes or concepts. This step involved organizing the data into categories that could help address the research questions. I considered which codes could be grouped together under larger thematic categories and began to identify the key areas of focus for the study.

For example-

Table 2*Generating initial codes and search for sub-themes*

Interview/FGD extract	Codes	Sub-themes
"I don't know why it's happening. I just know that climate change is happening because of increasing temperatures and our activities are responsible for this increase." (Student Interview#12, 18/09/2024)	increasing temperatures and our activities	Causes of climate change
"Most of what I know about climate change are from my school textbooks and social media." (Student Interview#3, 3/7/2024)	school textbooks and social media	Sources of climate information: school textbooks, social media
"I don't really get to talk about it with my friends and family so most of what I know comes from watching YouTube videos." (Interview#4, 3/7/2024)	YouTube videos	Sources of climate information: (YouTube videos) social media
"A close relative of mine is now admitted in the ICU due to heat stroke- which has been a very heartbreaking and traumatizing experience for me. I know this has happened because of climate change..." (Interview#6, 3/7/2024)	heat stroke	Perceived threat to family/ community/society due to climate impacts
"A close relative of mine is now admitted in the ICU due to heat stroke- which has been a very heartbreaking and traumatizing experience for me. I know this has happened because of climate change..." (Interview#6, 3/7/2024)	heartbreaking and traumatizing experience for me	Emotional response towards climate change impact

4. Reviewing the sub-themes:

I reviewed the emerging themes to ensure that they accurately represented the data. This involved checking if the themes worked in relation to the entire dataset and the codes. Some themes were split, combined, or refined to ensure they captured the essence of the data. I revisited the data several times to confirm that the themes were coherent and aligned with the research questions. This step helped me refine and clarify the thematic structure.

5. Defining themes:

After reviewing the themes, I defined and named them. Each theme was given a clear title that reflected its core concept. I also detailed what each theme represented, ensuring that the names captured the essence of what the theme was about. This step ensured that the themes accurately conveyed the findings.

For example-

Table 3

Reviewing the sub-themes and defining the themes

Codes	Sub-themes	Themes
<i>"Most of what I know about climate change are from my school textbooks and social media." (Student Interview#3, 3/7/2024)</i>	Sources of climate information: school textbooks, social media	Main sources of climate change information for students
<i>"I don't really get to talk about it with my friends and family so most of what I know comes from watching YouTube videos." (Interview#4, 3/7/2024)</i>	Sources of climate information: YouTube videos	

6. Writing the Report:

Finally, I wrote up the findings in the results and analysis sections of the report. I provided a detailed description of each theme, supported by direct quotes from participants. This helped to present the findings in a coherent narrative that aligned with the research questions. The results were summarized and presented in a descriptive form, ensuring that the themes were clearly linked to the participants' perspectives and the study's objectives.

Finally, the qualitative findings were presented in a summarized and descriptive form according to the general themes of the research questions. Quotes from the participants were also included in the results to authentically represent their perspectives and to develop a coherent narrative based on those perspectives.

In addition to thematic analysis, **document analysis** was also conducted by thoroughly reviewing two of the subject-specific government-issued textbooks for 8th grade, teachers' guides and policy documents such as the National Curriculum Framework-2021. For this process, the content of these documents was evaluated to identify specific categories relevant to the research questions.

For example,

Table 4*Generate codes and themes from the textbooks*

Textbook extract	Codes	Themes
“Climate change is having a major impact on the world’s oceans. These include rising ocean temperatures, increasing acidity, and rising sea levels.” (Pg-149; History and Social Science textbook)	Rising temperature, sea levels and acidity of the oceans as impact of climate change on the world’s oceans	Global impacts of climate change

3.8 Trustworthiness and Rigor of the Research

Trustworthiness in qualitative research refers to the confidence and credibility of the study’s findings (Merriam & Grenier, 2019). To ensure the rigor and trustworthiness of this study, I used four strategies: triangulation, member check, peer examination and audit trail.

Triangulation was used to enhance the trustworthiness of the findings. I triangulated data from a variety of sources, including student and teacher individual interviews, focus group discussion (FGD), class observations and government-produced documents, to cross-check the information and provide a more comprehensive understanding of the research questions. Thus, by using multiple data sources, this study aimed to ensure that the conclusions drawn about the students’ perceptions of climate change and teachers’ pedagogical approaches under the national curriculum framework-2021 were grounded in reality.

Peer Examination was carried out to ensure the rigor and trustworthiness of the research process. The research design, interview and FGD guidelines, and class observation checklist were all reviewed and validated by my thesis supervisor and thesis committee before I began the data collection process.

Member check was another important strategy I applied for this study. I carried out a small-scale piloting of the data collection tools in the field to ensure the tools were rigorous before data collection. To ensure the findings of this study portray an accurate interpretation of the participants’ views, raw data from the FGD and interviews were transcribed carefully. Additionally, after the data collection, transcriptions of these raw data were shared with the

participants for feedback. This process allowed the findings to accurately reflect participants' views (Merriam & Grenier, 2019).

Finally, I also applied the **Audit Trail** strategy to ensure transparency throughout the research process. I maintained a detailed record of all research decisions, including changes to the data collection tools, and a log of field notes throughout the data collection process. This audit trail allowed for an objective review of the research process and ensured that the findings were derived from a transparent and consistent methodology. By applying these strategies: triangulation, peer examination, and an audit trail, this study aimed to ensure the trustworthiness and rigor of the research findings, providing a solid foundation for the interpretation of how Bangladeshi secondary school students perceive climate change, how the National Curriculum Framework 2021 addresses climate change education, and how teachers incorporate climate change into their regular lessons.

3.9 Ethical Issues

This qualitative study includes students and teachers as its participants. Thus, ethical principles were strictly followed, and confidentiality was prioritized. Before conducting the data collection process, approval was taken from the Ethical Committee of BRAC IED, BRAC University. To seek permission from the two schools, the researcher personally approached the schools' Head Teachers first sharing the details of the research: including its title, purpose, duration, data collection tools, researcher profile and researcher's thesis supervisor's contact information. After receiving their permission and signature in the consent form, consent forms for the teachers were submitted to the school authority by the researcher herself, and the authority shared the forms with nine teachers, among whom four agreed to participate in the study. The researcher discussed and coordinated the dates and time slots for the class observations, student and teacher interviews with the school authority as per the class routine and the teachers' availability. At the start of each interview with the teachers, the consent forms (translated into Bengali for the convenience of the participants) with their signs were collected and the forms were read to them again by the researcher in case they had any queries.

Since the student participants were under the age of 18, consent forms were sent to the students' parents via the students under the guidance of the Head Teachers and the students were invited to the FGD and individual interviews once their parents gave consent. Before starting the FGD and

interviews, the researcher clearly informed all participants that the audio of the conversations would be recorded and preserved for the study, that they had the right to refuse being recorded and that their personal information and identities would be kept strictly confidential. It was also explained that if the participants felt uncomfortable answering any questions, they had the right to skip it and that they could withdraw from the study anytime they wanted. Special efforts were taken by the researcher to ensure that the student participants felt comfortable and were at ease.

3.10 Limitations of the Study

This study focused on two secondary schools from two low-income urban communities within Dhaka city, limiting its scope. A larger, more comprehensive study is needed to understand how climate change is incorporated by secondary school teachers in their lessons at the schools embedded in low-income urban communities across Bangladesh, as findings from this study may not be generalized for all such communities.

Only four class observations were conducted, among which two were Science classes and two were History & Social Science classes. Three of these classes lasted 25-30 minutes each, which is significantly shorter than the standard 45 minutes of a full-length secondary class, and the fourth lasted only 15 minutes. Teachers were observed to be rushing through the lessons, lacked lesson plans and could not provide any previous lesson plans. This was mainly due to the school administration's decision on implementing '*revision classes*' to prepare students for their upcoming End of the Year assessments, after the school was shut down for a month during the 2024 July-August Uprising that took place in Bangladesh. After the Uprising, an interim government was formed in Bangladesh under which the Education ministry decided to overhaul the new curriculum and the assessment system that students from grades six to nine underwent (SHED, 2024). Under this circumstance, the school administrations prioritized drafting shorter syllabus as per need, conducted '*revision classes*' and were planning End of Year Assessments in a way that no longer resembled the new curriculum.

Another limitation of the study is that only four secondary school teachers were interviewed for this study, constrained by time and availability. While nine teachers were approached, only four consented to both interviews and class observations. Additionally, no parents were interviewed for this study, which leaves out the understanding of a broader community perspective.

During the in-depth interviews and FGD with students, some of them seemed to confuse the term “climate change” with “environmental pollution” and could not distinguish the two, so probing questions for clarification had to be used by the researcher. Furthermore, a few of the students mentioned “climate change” as a topic was covered in their subject-specific classes and expressed that they were “satisfied” with the way it was being taught. However, other student participants from the same classes expressed “dissatisfaction” with the way it was taught. This indicates that some students may have hesitated to acknowledge existing gaps in climate change education in their school.

3.11 Summary

This chapter details the qualitative research methodology employed to investigate the perceptions of secondary school students and their teachers regarding climate change education in low-income urban communities of Dhaka, Bangladesh. A phenomenological design was adopted to explore participants' perceptions and subjective experiences of climate change within their academic and personal lives. The study utilized a combination of in-depth interviews, focus group discussion, classroom observations, and document analysis to gather rich qualitative data. The data was analyzed using thematic analysis and document analysis to identify key themes and patterns. The chapter also addresses the ethical considerations and limitations of the study, ensuring the rigor and trustworthiness of the findings.

Chapter 4

Results and Analysis

4.1 Overview

The purpose of this chapter is to present findings from the analysis of the data I collected for the study. This begins with the thematic analysis of the data collected from in-depth individual interviews of students and teachers, one FGD of the students and class observations of the Science and History and Social Science teachers' lessons. Through the process of Thematic Analysis, I first generated codes from the collected data, by thoroughly transcribing the recorded individual interviews, FGD and field notes from the class observations, highlighting words, quotes and segments from the text. Furthermore, Content Analysis was also done to review and analyze the content of the NCTB textbooks, the curriculum framework and the Teacher's Guides documents. Finally, I categorized the codes under four broad themes and all these themes are further divided into multiple sub-themes to explain the themes in detail. The themes are as follows:

- 4.2 Students' Cognitive Perception towards Climate Change
- 4.3 Students' Emotional Perceptions towards Climate Change
- 4.4 Students' Applied Perception towards Climate Change
- 4.5 How Teachers Integrate Climate Change in their Lessons and the Challenges they face

Through content analysis of the Science and History of Social Science textbook, curriculum framework and Teachers' Guide documents, I'm trying to find recurring patterns and interpret how specific concepts are framed in these documents. Furthermore, to get a more nuanced understanding of the patterns found through thematic analysis, content analysis of the curriculum document, teaching materials such as the NCTB textbooks and the Teacher's Guides were also carried out. In the following section, the four themes along with the sub-themes are discussed in detail.

4.2 Students' Perception towards Climate Change

4.2.1 Students' Awareness of Environmental Changes Around Them

What Students Think Climate Change is. When asked what comes to their minds when they hear the words 'climate change', students shared a range of thoughts such as: ozone layer damage, lack of trees and green spaces, environmental pollution, "weird weather" patterns, people dying from climate impact events such floods and heat strokes. Overall, all the students participating in the study demonstrated acute awareness of the changes in the surrounding environment and climate.

One female student shared during the FGD that when she hears 'climate change' she thinks about how the damaged ozone layer letting in UV rays had been responsible for warming up the planet faster, thus making the weather acting strange or weird. One example of the 'weird weather' in her opinion is,

"For example, I see that sometimes it's raining a lot here. Now we all are aware that after it rains a lot, the weather should feel colder because of it. Yet that's not what I see! It feels just as hot as it was before the rain. So that's an example of the weird weather."
(Respondent#1, Focus Group Discussion, 4/7/24)

The Ozone does play a role in maintaining Earth's temperature balance, but Ozone depletion is not the cause for climate change by changing the weather patterns. Extra UV rays that slip through the Ozone hole cools the stratosphere more than warming it (NASA, 2024).

Three students (all had parents working blue-collar jobs) mentioned that when they hear the words 'climate change', they immediately think about the health impacts that climate change inflict such as people falling sick, getting heat strokes or cold due to the rising temperature. One student explained,

"The way we have it raining sometimes, followed by harsh Sun- that causes us to sweat a lot. People go to work sweating like that, not everyone has AC or extra fans at home. Those who go to work they don't always have the opportunity to sit under an AC or fan throughout [the working shift] and also don't get to enjoy it when they come home. These are the people who fall sick the most, they get fever and colds easily due to this weather."
(Respondent#6, Focus Group Discussion, 4/7/24)

Another student added that,

“Nine people died from heat stroke in the city recently! So I think about heat strokes when I hear climate change.” (Respondent#7, Focus Group Discussion, 4/7/24)

Students’ Awareness of Environmental Changes. Majority of the students thought that the weather doesn’t feel like what it “*used to*” and that the seasons have all gotten warmer, with winters feeling less cold than ever before. One student explains:

“I just don’t get that same feel of the weather. Just doesn’t feel like it used to. I mean that the weather has become such that even if it’s winter, it doesn’t feel as chilly as it used to, years ago. The summer feels hotter. Most of the year feels hot now. But we are a country with six seasons, right? Supposed to feel different in each season. Now the weather has become such that I can’t distinguish between the seasons. It no longer feels as chilly in Dhaka as it used to.” (Respondent#4, Focus Group Discussion, 4/7/24)

Students felt as if the six seasons of Bangladesh have merged into just two.

“Now it just feels like we have two seasons in Bangladesh: Summer and Winter.” (Interview#6, 3/7/24)

“It feels hot all the time now, no matter the season.” (Interview#5, 3/7/24)

Another student reflected on it during the FGD,

“Agreed, it doesn’t feel that cold during winter now though it used to feel colder when I was a kid. When it’s 24 degrees, it actually feels like 44 degrees!” (Respondent#5, Focus Group Discussion, 4/7/24)

Four students thought that unplanned rapid development in a city that lacks enough trees, along with rising temperatures due to climate change is causing people suffering through heat strokes. One of them remarked on people dying due to heat strokes in the city,

“Not that many trees in this community; a tired person who had been coming home after a long day’s work will not be able to rest under the shade of a tree. Too many buildings squeezed together, where is the space left for trees? I feel like, what would we even do with

all these development- if we cannot even survive? Lots of people are dying here due to heat strokes.” (Interview#1, 3/7/24)

All twelve of the students interviewed from both School A and B, regardless of gender, were highly aware of temperature differences in their local community in Dhaka and in rural home districts outside Dhaka. Whereas the weather used to feel much more tolerable and cooler in their villages compared to Dhaka city, now it feels warmer in the villages as well, leaving little differences between Dhaka and the rural areas across the country. They experienced that colder season felt much warmer in both villages and Dhaka now than ever before. One male student mentioned that the last time he visited his village, he found the weather there becoming warmer as well:

“The weather used to be really tolerable in my grandparent’s village, like if the temperature was 42 degrees here in the city, in the village it would be at least a 38! But last time I went to visit my grandparents, it feels hot there now as well.” (Interview#3, 3/7/24)

Another male student also commented on the rapid urbanization of his grandparents’ village in parallel similarity with the city:

“...when I was little, I used to visit my grandparents in the village a lot with my family. Everyone in the village used to live in tin-shed houses or thatched houses with walls made of earth. But now everyone lives in one or two-storied buildings. Everyone competes over who can build a building faster. They have cut down most of the trees to build buildings.” (Interview#6, 3/7/24)

A female student noted that,

“Before when it rained, the temperature would have dropped, making it feel cooler. It felt so good! We would have a great night’s sleep the day it rained. But I’ve noticed in the past 4-5 years that that the weather no longer feels cooler after it rains. It still feels hot after it has rained. We look forward to rain when it feels hot, but rain no longer feels like the blessing it used to be.” (Interview#4, 3/7/24)

Another female student noted,

“I remember there being quite a few flower trees in this community, I used to collect flowers from them and make necklaces for fun as a kid! But it’s been a few years since they cut down all those trees for buildings. I think that’s why it feels so dusty and hot now. When I open my window, there is no cold breeze.” (Interview#7, 3/7/24)

4.2.2 Students’ Understanding of the Causes of Climate Change

Students could be broadly divided into **three** schools of thought regarding why climate change occurs or what causes climate change to happen:

1. Climate change happens due to human activities or anthropogenic factors only
2. Climate change happens because of both anthropogenic activities and natural processes
3. Climate change happens due to natural processes only

Eight out of the twelve student participants thought climate change happened due to human activities or anthropogenic factors only, indicating that majority of the students were of this opinion. Interestingly, majority of student participants from School A (students at school A lived near a tanning factory that did not abide by environmental regulations) were also of this opinion. This indicates that if students lived near a highly polluting industrial factory, they were more likely to blame anthropogenic activities for climate change although none of them specifically pointed to the environmental pollution caused by such factories as a key anthropogenic cause. In addition, majority of both male and female students thought climate change happened due to human activities only and that humans were solely responsible for it.

Students who thought climate change happened due to human activities or anthropogenic factors only, pointed to a range of human activities such as- cutting down trees or deforestation, polluting the environment by dumping plastic and other non-recyclable waste into water bodies, polluting the air and water through tanning factories (students at school A lived near a tanning factory) as responsible for causing it.

None of the eight students of this opinion specifically mentioned key anthropogenic causes such as GHG emissions due to fossil fuel extraction, agriculture, transportation etc. Temperature increase due to climate change was mostly associated with one major anthropogenic activity: deforestation and land clearing for development purposes. One student explains,

“Human population is increasing in Bangladesh and all over the world so to meet our needs for development, forests are being cleared. Since trees are being cut down, temperatures are rising and as a result, more events like floods and droughts are happening. That’s why climate change is

Another student comments,

“I don’t know why it’s happening. I just know that climate change is happening because of increasing temperatures and our activities are responsible for this increase.”
(Interview#12,18/09/2024)

On the other hand, only two students out of the 12 were of the opinion that climate change happened because of both anthropogenic activities and natural processes. This opinion is actually the scientifically accurate fact. A student mentioned,

“I don’t know the exact scientific reasons for climate change, but I know it happens naturally. It also happens as direct or indirect consequence of things we do- like dumping waste everywhere and polluting the water, soil and air.” (Interview#8,18/09/2024)

The students who held this opinion mentioned the same anthropogenic activities such as multifaceted environmental pollution through inadequate waste disposal and cutting down trees or deforestation for developing properties. They were knowledgeable of these few anthropogenic activities, but they did not know of the natural processes that are also responsible for climate change such as volcanic eruptions, solar variability, orbital variations. Neither of the two students were able to identify these natural causes. One of them identified ‘melting ice due to the Sun’ and the other ‘rising temperature of the oceans’ as natural processes that caused climate change.

Moreover, there were two students who constituted the third of school of thought that climate change happened due to natural processes only. Neither of them could correctly name the natural processes such as volcanic eruptions, solar variability, orbital variations leading to natural climate change. One of them thought cyclones and floods were the natural processes that caused climate change. The other thought climate change was akin to a natural disaster:

“I think climate change is like a natural disaster and we probably do not have a hand in it.” (Interview#9, 18/9/2024)

4.2.3 Students' Knowledge of Local and Global Climate Impacts

All students agreed with the statement '*climate change is a threat to humanity*' and that climate change will have global as well as local impacts. Increasing natural disasters such as floods, heatwaves, droughts and cyclones were the main local climate impacts affecting Bangladesh mentioned by 7 students out of 12. Thus, majority students demonstrated more knowledge of the natural disaster aspect of the climate impacts. More diseases and illnesses triggered by climate change such as rise of mosquito-borne diseases like dengue and malaria, more frequent heat waves in urban communities leading to widespread heat strokes, fevers, allergies and colds were mentioned by 4 students. Other long-term climate impacts such as financial strain on marginalized low-income families were mentioned by one student.

Among them, one female student eloquently expressed her frustration and incredulity due to the inconsistency between human actions and the reality of climate change today:

*"Our actions would make it seem as if climate change is **not** a threat to humanity, as if we have another planet to call home- like Mars! Just watch how people are cutting down trees and polluting the environment! But in reality, this is our only place home.... It is a threat to all of us, yes, we know Earth is our only place home, but we are also polluting everything.... We are digging our own graves."* (Respondent#1, Focus Group Discussion, 4/7/24)

Another added that stopping deforestation is the least that can be done to help counter this threat, but people need to do more:

"Yes it is a threat to all of us, but just stopping the cut down of trees is not enough, we also have to stop all kinds of pollution to make this planet a safer place to live." (Respondent#2, Focus Group Discussion, 4/7/24)

One student noted the financial toll and mental stress climate change can have on vulnerable rural families from personal experience:

"If I mention the financial toll it has for a second- in my village back home, people suffer a lot financially each time a flood happens. Then those of us who live here in the city as their family members, have to send them some money. It feels bad when we can't send help,

*right? Not all of us have the same financial capacity, but still we try our best. So that's a risk we take. If I mention just one incident to you, I have five uncles and one of them lives in our village with his whole family. Due to the recent flood our communication was cut off since they did not have electricity. We were very worried about them and did not even know they needed some money. Now they're okay since the water subsided, but it had been such a pera*¹.*" (Interview#8, 18/9/2024)

Students were generally knowledgeable about common climate impacts affecting Bangladesh but lacked sufficient knowledge on the global climate impacts happening in different regions of the world. When I pointed this out, students pointed to lack of enough information on this in their textbooks and teachers not discussing it in class as key reasons. All the FGD participant students agreed upon that they did not learn about global climate impacts from their 8th grade new curriculum textbooks. One student mentioned knowing very little about global impacts of climate change:

"From what chapters we have read this year so far, I don't remember learning about the impacts of climate change in different parts of the world. I know very little about it." (Respondent#5, Focus Group Discussion, 4/7/24)

4.2.4 Sources of Information Related to Climate Change

Students received their information regarding climate change from a limited range of sources, most commonly from school textbooks and teachers, books outside the school curriculum (also known as 'outside books' by students), Facebook and Instagram reels, and newspaper articles or the news from TV. A student said,

"Most of what I know about climate change are from my school textbooks and social media." (Interview#3, 3/7/2024)

One female student noted that teachers do not discuss or explain it in depth for students when content related to climate change would come up in class,

¹ *pera= used to express mental anxiety or distress in informal Bangla

“It’s not talked about much. If our textbooks contain a few lines on climate change, it’s not discussed enough.” (Interview#4, 3/7/2024)

So, some students compensate for what they do not get to learn from school, through consuming social media content such as YouTube videos and Instagram or Facebook reels.

“I don’t really get to talk about it with my friends and family so most of what I know comes from watching YouTube videos.” (Interview#4, 3/7/2024)

Another mentioned,

“... also watch reel from Facebook and Instagram that give interesting information on climate change and the environment.” (Interview#1, 3/7/2024)

One female student drew comparison between the climate change content in their 2012 curriculum textbooks from 6th grade and the 2021 curriculum framework one, finding the 8th grade textbooks under the latter to be broadly insufficient:

“In class six, yes. From class six textbooks I remember learning about saving the environment, different types of environmental pollutions such as air, water and soil pollution. There are only two chapters in our science book now that include climate change content, which is far less than what we used to have in earlier grades.” (Interview #5, 3/7/2024)

One student who is inactive on social media and do not read books outside textbook, noted that he learns most from TV news pieces, when a particular climate event happens. He also mentions that the teachers at school rarely talk about climate change.

“...And I don’t get to learn a lot from school since Sirs or Madams do not talk about climate change much.” (Interview #7, 3/7/2024)

Most of the female students interviewed shared they personally looked up information regarding climate change when they wanted to learn about it. Male students demonstrated a general lack of having such practice. One male student shared that,

“Actually I personally don’t research a lot on this topic... It’s not talked about a lot in the school or the coaching center.” (Interview#2, 3/7/2024)

Among the 12 students interviewed, majority of the female students seemed to be more interested in doing personal research and were aware about their peers' lack of interest towards climate change issues compared to male students. Male students learned about climate change from school and news media as main sources. They generally did not conduct personal research to further learn about it or talk to their peers about it. Another pattern found is that the students who were not active on social media relied mainly on their textbooks and teachers from school for learning about climate change. Two female students noted that most of their classmates at their class do not seem interested in environmental topics, so they only discuss it with some of close friends. Overall, students' cognitive perception of climate change stemmed from a limited range of influences: from school (though often insufficient), social media, external books, and the news. Gendered patterns and variations in curriculum emphasize the need for better integration of climate education across platforms and age groups.

4.3 Theme 2: Students' Emotional Perception towards Climate Change

4.3.1 Perceived Threat to Self From Climate Impact

Among the twelve students interviewed, all of them thought climate change impacts endangered them personally and put their lives at risk in various ways. Both male and female students seemed acutely aware of the impacts climate change have already left or might leave in their families or community. One student mentioned the anxiety she feels due to climate impacts which she hears about from the local news:

"I believe my life is at risk because I'm getting more anxious day by day. I see a lot of disasters on the news, like the flood that decimated Sylhet, Cox's Bazar and other districts. I feel like the way we're destroying our environment, more disasters like this can happen. It will be bad. It'll not only affect me but everyone. The way we cut down trees and are destroying everything in nature... If we keep this up, more dangers will come."
(Interview#7, 3/7/2024)

Another female student mentioned the melting of ice as a driver behind the recent floods.

"I know that more floods will come due to the melting ice and the flood we're having these days, like the one that just happened a few days ago in Sylhet, we will have more like it."

The flood in Sylhet affected a lot of people, water entered their homes. More people will suffer if floods increase.” (Interview#3, 3/7/2024)

The flood that took place in Sylhet in June, 2024 occurred due to heavy rainfall within a short period of time and the release of the upstream Surma-Kushiara river water by Indian authorities, exacerbating the already high water levels in the region and causing severe inundation in low-lying areas (Bangladesh Red Crescent Society, 2024). Hence this particular flood was not due to ‘melting of ice’ or connected to climate change directly, but this student assumed it such.

A female student who wore the Hijab noted the climate impact on health,

“Those who wear the Hijab, they’re covered so for them the heat and unbreathable air feel like hell. I personally have seen this among my friends and family who wear the Hijab that they have to sometimes loosen or completely discard the Hijab because it just feels too hot, too uncomfortable. I wear the Hijab so I feel the same.” (Interview#1, 3/7/2024)

A male student also noted the health impact and shared the health anxiety he feels due to it:

“I think that climate change will affect my life personally and put my health at risk. Just look at how many people are dying everyday due to diseases now. I think more people are dying from heatstroke and weird weather anomalies nowadays. You will also see that a lot of people are dying from dengue since mosquitoes are becoming more prevalent. In the building that I live, a few of my neighbors got dengue and had to be admitted to hospitals. Feel anxious that it could happen to me any day too. Everytime I get a fever I feel scared. The weather is weird, really hot one day and humid the next. Everytime I go out during the day, my shirt will stick to my skin due to sweat. I feel sick when I sweat a lot, and I seem to be sweating a lot these days. If I fall sick because of the rising temperature, or have a heatstroke, I could die.” (Interview#2, 3/7/2024)

Three students thought that climate change will reduce oxygen levels and increase carbon dioxide in the air, making it harder for humans to breathe, leading to more deaths. One of them said:

“I believe that oxygen will decrease and Carbon dioxide will increase. When that happens, people will die and my life will be at risk too. It will happen due to climate change, yes.

Climate change also makes the weather act strange as the seasons all feel warmer now. I feel sick and catch cold easily nowadays.”(Interview#3, 3/7/2024)

The idea that due to climate change atmospheric oxygen will decrease and carbon dioxide will increase, making the air unbreathable is a misconception. While carbon dioxide levels are indeed rising due to human activities like burning fossil fuel and deforestation, their concentration remains very small (about 0.04% of the atmosphere) and does not pose a suffocation risk for humanity. Oxygen levels, which make up 21% of the atmosphere, are not significantly affected by climate change, as the changes in oxygen are negligible relative to the vast atmospheric reservoir of our planet (NASA, 2021). The primary concern with rising carbon dioxide is its role in warming the planet and affecting ecosystems, not directly making air unbreathable (Keeling, 1996). But this was not the only misconception about climate change students had. Four out of the twelve students interviewed thought air pollution was a climate impact that affected them directly- which is also a misconception. One male student commented,

“Floods are not a direct risk for me since I live in the city but I think air pollution is one. It’s an impact of climate that is invisible to us but it’s happening. I’m inhaling very polluted air everyday. It’s not pure.” (Interview #6, 3/7/2024)

A female student thought that air pollution was a climate impact and it could exacerbate the already existing health issues she has:

“I think for me the health risks are most significant. I have allergy and breathing problems from childhood... feels more difficult to breath and sometimes I feel like I can taste it in my mouth when the air becomes very toxic. Not enough trees to filter it out, I guess. Even though the ceiling fan is working, the room feels hot and difficult to breath freely. The way dust is increasing, air is becoming toxic, oxygen is decreasing since we literally cut down trees around here to the point there’s very few left- of course I’m at personal risk here due to climate change. It’s not just me, I think this toxic air is very bad for small children too.” (Interview#1, 3/7/2024)

The idea that polluted air is an impact of climate change, is a misconception. Air pollution and climate change are two distinct issues, though they are interconnected. Air pollution results from harmful substances like particulate matter emitted from natural sources like volcanoes and

industrial emissions from factories, while climate change involves long-term shifts in weather patterns due to greenhouse gas emissions. While climate change can exacerbate pollution (e.g., through higher temperatures increasing ground-level ozone), air pollution is *not* a direct impact of climate change (IPCC, 2021)

When asked where they learned about the oxygen decrease claim and air pollution as climate impact claim, one of the students interviewed shared that they heard it during a guest speech given by a local politician at their school.

“Heard it during a speech by a VIP political leader who came to our school as a guest speaker for a special program. We don’t always pay a lot of attention to speeches like that, we get bored. But I remember hearing this that day. (Interview#3, 3/7/2024)

This indicates misleading information is being spread among students by non-educator personnel whose claims have not been cross-checked by the teachers.

4.3.2 Perceived Threat to Family or Community

Majority of the students who participated in the study seemed to believe that living in an urban community protected and sheltered them from harshest climate impacts. One student noted how their family members who lived in the rural areas bore the brunt of the climate impacts,

“I live in this city, here we have roads and buildings, so we don’t have that many problems [from climate impacts]. God bless. But some of my family members live in the village- one of my aunts lives there- heard her family suffered a lot when floods occurred. Water entered their house, and they couldn’t cook or have drinking water for days. When you add to the fact that people don’t have electricity in the village, sometimes for 4-5 hours a day due to loadshedding, it becomes very difficult.” (Interview #5, 3/7/2024)

Students also shared personal experiences of climate impact events and the health emergencies those events might have caused in their families:

“A close relative of mine is now admitted in the ICU due to heat stroke- which has been a very heartbreaking and traumatizing experience for me. I know this has happened because of climate change, and our failure to plant enough trees. I can say that I have been a firsthand witness of the impact climate change can leave.” (Interview#6, 3/7/2024)

Maintaining basic religious practices have also proved to be difficult due to certain climate impacts, according to some students' experiences:

“My mother and aunts fast every Saturday and Tuesday. They suffer a lot because of the excessive heat. When the temperature increases a lot, they sometimes cannot tolerate it since they're fasting and fall senseless, unable to do their prayers and stuff. They fall so sick that they are unable to continue fasting and have to break the fasts. They feel really sad when that happens, they'd like to complete their fasts, you know. So for my family, this is a key climate impact that makes it difficult to maintain basic religious practices.”
(Interview#1, 3/7/2024)

Students consistently highlighted how climate change exacerbates diseases and illnesses of different types, such as cancers, heat strokes, colds and fevers, allergies, breathing problems and dengue. When asked how cancers and dengue might be an impact of climate change, students mentioned possible factors such as polluting the environment by dumping waste in water bodies, consuming vegetables and fish grown using the polluted water and creating the environment for the dengue mosquitoes to lay eggs by not cleaning the local ponds and canals. There was a confusion and lack of adequate knowledge among students on exactly how these environmental impacts of man-made pollution were connected to climate change. In reality, rising mosquito-borne illnesses due to climate change is a real threat to tropical regions (World Bank, 2021)

However, students were not able to pinpoint what caused these climate impacts, but most believed humans were responsible for it. One student shared,

“How exactly are these [climate] impacts, I don't know but I believe all of these are tied to humans- we are the ones to blame for these!” (Respondent 3, Focus Group Discussion, 4/07/2024)

4.3.3 Emotional Responses to Climate Change

Students' Emotions on Climate Impacts on Their Families, Communities and Country. Students reported feeling a wide range of emotions: helpless, anger, shame, guilt, sad, annoyed and even happy. They blamed humanity and themselves for facing climate impacts. Despite Bangladesh being a climate-vulnerable country emitting less than of 0.3-0.4% of global greenhouse gas emissions, these students felt like people of Bangladesh are to be held accountable

for their actions towards the environment (Global Carbon Project, 2021). One student mentioned feeling both sad and ashamed:

“When I think about it, I realize that we humans are the reason for these climate impacts. We are going to bear the results now for our own actions. That makes me feel both sad and ashamed.” (Respondent 1, Focus Group Discussion, 4/07/2024)

Another student expressed anger and shame about the climate impacts Bangladesh might face:

“My country is going to face more disasters like floods because of climate change- so of course I feel sad about it. I’m just a teenager so I don’t know what to do about it but it definitely makes me angry when I see adults not taking it seriously.... Just looking at the way people in this country destroy environment, I feel like they are not taking it seriously. I also feel ashamed when I see on social media how foreigners try to save their environment. The least we can do is use less plastic but do we do that?” (Focus Group Discussion, 4/07/2024)

One student commented on the paradox of needing natural resources for development while also facing the consequences of depleting or damaging them:

“I have two kinds of feelings: happy and sad. Happy because seeing my country become developed by using the natural resources is great. If cutting down a tree meant a poor person can make a house and live there, then that’s great. We need development. But then I see how our forests are decreasing, animals are dying, environment is being polluted by us dumping waste everywhere, climate is changing, floods are happening and I start feeling sad. We need nature for our own needs but we are so thoughtless about taking care of it.” (Respondent 2, Focus Group Discussion, 4/07/2024)

Another student shared that they felt angry,

“I feel angry because of the hypocrisy some people have. Like, we sometimes have special guests visiting our school who come and plant trees for special occasions. But that person then goes out [into the community] and you will find that he owns properties in the city that were built by cutting down trees. So when this guest- who is generally a powerful political person comes and plants trees, gives speeches for us to plant trees- how does it

even look? It makes me really angry because I can't stand this hypocrisy.” (Respondent 4, Focus Group Discussion, 4/07/2024)

Another student echoed feeling angry and helpless because of the double-standards in local community-elected political leaders:

“I feel angry too and also helpless. If I elaborate why, Ma'am- there's this political leader from our community who came and planted trees in our school's playground on the 5th June 'World Environment Day' ceremony. We all knew that this person did nothing when dozens of big old trees were cut down earlier this year while they were fixing the roads in this area. If a powerful person like him chooses to do nothing to stop the trees being cut unnecessarily, what can we even do?” (Focus Group Discussion, 4/07/2024)

Another student said they felt sad when seeing community members act “careless” towards the environment:

“I feel very sad about it when I think about climate change impact. But I think people in our community are also very careless when they pollute the environment by dumping waste. What does it say about them when they do not care about trees or the environment?” (Respondent 5, Focus Group Discussion)

Another student demonstrated extraordinary self-awareness, labelling himself as ‘part of the problem’:

“I feel guilt because maybe I'm part of the problem too. Sometimes I pollute the environment without thinking, like discarding plastic bottles here and there. When I think about it, we are to blame for what's going to happen to our community from climate impacts, as well. We are not careful enough.” (Respondent 4, Focus Group Discussion, 4/07/2024)

Lack of green spaces and trees in the community as well as the Dhaka city were remarked on by majority of the student participants. One student mentioned feeling annoyed due to it:

“We have very few trees left in our community. It annoys me greatly when I look out my window from my building and see only densely built buildings all around with not a single tree in sight. And sometimes landlords do not even allow us to plant trees on the rooftop.

But when you think about it, planting trees on our rooftops could have helped us fight climate impacts like heatwaves, no? It's so annoying!" (Respondent 6, Focus Group Discussion)

4.3.4 Students' Thoughts and Reactions to How Climate Change was Being Taught at School Under the New Curriculum

How Climate Change is Being Taught in Their Class. Most students from both school A and B indicated that climate change was not adequately covered in either the new curriculum textbooks or class discussions. One student commented on the textbooks containing few climate content and teachers' not prioritizing the climate change content in their textbooks:

"It's not talked about much. If our textbooks contain a few lines on climate change, it's not discussed enough. Now the new [curriculum] textbooks don't even have enough. If the books contain a few lines on it- my teachers would read these lines out when they come across it in class, discuss a little and then move on. They say that, "What else to teach here? You guys know this already." And that's it. They don't prioritize it enough. Don't explain it enough." (Interview#4, 3/7/2024)

Majority of the students participating in the study shared that they were dissatisfied with how climate change is being taught and that teachers are not talking about it enough.

"I'm not satisfied because we could have been taught more... like how do we save the environment? I remember the teacher telling us planting more trees would help fight climate change, and that's it. If the textbooks told us what more could we do, that would've been great." (Interview#7, 3/07/2024)

Another student pointed out that the textbooks lacked sufficient content on climate change, as well as failing to address students' feelings or concerns about the issue.

"I think our textbooks have specifically not mentioned why climate change is happening and what causes this climate impact or that. Our feelings about climate are also absent [from the textbooks]. (Respondent 1, Focus Group Discussion, 4/7/24)

Students shared that they were encouraged to plant trees from their textbooks, but it was not clear to them why planting trees will help fight climate change. One student shared during the FGD:

“The feelings that I or my friends feel about climate change are not addressed in the textbook. We studied this chapter in our Science Exercise book called ‘Green Friends’ where we were encouraged to plant trees. But in what ways planting trees will help us fight climate change have not been addressed in the book. Our teacher also did not discuss it in class. It’s just that our teacher also never asks about how we feel about climate.”
(Respondent#3, Focus Group Discussion, 4/7/24)

One student had a complaint to share regarding the textbooks:

“We don’t really get a big picture about climate change or its impacts from the textbooks. It’s just not there. I think this could be a complaint from us students to the people who wrote these textbooks.” (Respondent 1, Focus Group Discussion, 4/7/24)

They also added that Science and HSS teachers do not give them much opportunity to talk about climate change in class, during group work or question-answer sessions with the teachers after a lecture. The students felt the classes are not interactive in that sense, and this is also observed during the class observations that the lessons are heavily teacher-centric. This teacher-centric pedagogical practice contradicts the National Curriculum Framework’s guidelines where it is specifically mentioned that lessons are to be interactive, learner-centric, and teachers are to use hands-on activities such as project-based learning, problem-solving exercises and collaborative class work to teach students (Pg-75; NCTB, 2021). One student articulated how their lessons are textbook-dependent, lecture-centric and teachers do not add extra information rather than what is already included in the textbooks:

“Actually we aren’t given a lot of opportunities to have discussions with everyone in class- teachers give us lectures, and then leave. I think they focus too much on the textbooks and just give us what is already there. Extra knowledge about climate change is not given to us.” (Respondent#3, Focus Group Discussion, 4/7/24)

One student shared feeling frustrated about not knowing enough about climate change:

“I don’t know about others, Ma’am, but I personally feel frustrated about it. From this Focus Group Discussion I realized today that I don’t know a lot about climate change. But why is that? If our teachers are teaching this topic, and I feel like I want to know a lot more about it than this.” (Respondent#6, Focus Group Discussion, 4/7/24)

School Activities About Climate Change and Their Effectiveness in Engaging Students. All of the students participating in the study agreed that the school authority and the teachers needed to include more interactive and hands-on learning activities such as group projects, debates, workshops etc. to help students learn about climate change in-depth and make the topic more interesting. One student shared that even though they got to participate in group debates on other subject classes, none such debate were organized to help students learn and think about climate change critically:

“We aren’t even given in-depth knowledge about climate change, forget about the class projects! The textbooks and our teachers, neither talk about climate change enough. We have group debates for some classes, but those are never on environment or climate change related topics. I’ve never seen any projects or debates or group work take place in our school to educate us on this topic in a fun way. It’s probably a far-fetched idea to even think about having these project-based [learning] activities when we aren’t even given in-depth knowledge about climate change in the first place.” (Respondent#3, Focus Group Discussion, 4/7/24)

Another student brought up the unequal opportunities they have as an underfunded Bangla-medium school embedded in a low-income community compared to an English-medium private school in Dhaka, highlighting how educational inequity translate into unequal climate change education for some:

“No, this isn’t done in our school, but I have a friend who studies in an English-medium school where they have this Environment Club and they recently did a poster presentation as part of that club’s activities. They made posters with their teachers’ help to educate kids on climate change and presented those, made TikTok videos, did rallies in front of the school and even wanted to host a debate but couldn’t find the time. I think English-medium kids are lucky because their teachers help them do all these. Our school can never pull this off.” (Respondent#1, Focus Group Discussion, 4/7/24)

Two students mentioned in interviews that they learned more about climate change in earlier grades than in 8th grade, as they thought textbooks from 6th grades, created under the 2012 curriculum guidelines, contained more detailed information on the topic.

“It’s not talked about enough at school. For example, if the textbook contains 100% of things, only 20% of it would be taught and the rest will be assigned as our homework which we will have to learn and do by ourselves.... If I remember correctly, we learned more about climate change in class 6 than we are learning this year.” (Interview#6, 3/07/2024)

Another added,

“In our class 6 textbook we read a lot about different ways of saving the environment, like planting trees and so on. We also read about air, soil, water pollution. We have learned a bit but not much about these topics from our 8th grade textbooks.” (Interview#5, 3/07/2024)

Some students observed that even though their schools celebrated World Environment Day, the activities on that day seemed more performative than informative to them. This observation from students indicates how acutely aware students are about the quality of climate change education they are receiving and the gaps in it. One student commented,

*“Not all our teachers talk about climate change in class. Some teachers do, but only some of the times. If all subject teachers talked about climate change in our classes, that would’ve been better. And other than that, our school celebrates World Environment Day and teachers and guest speakers give speeches to us during the ceremony. They say a lot of generic stuff up on that stage.... Yes, they do mention climate change in those speeches, but they only talk about what **we** can do to fight it. They don’t mention what they’re doing to fight climate change! How funny is that?” (Interview#5, 3/07/2024)*

Another student expressed dissatisfaction, citing the teachers’ lack of awareness about climate change as a core reason:

“No I’m not satisfied because... actually we aren’t taught about climate change a lot. I mean our teachers should have been more careful about teaching us about it. But I honestly feel like they themselves are not very aware and knowledgeable about it.” (Interview#4, 3/07/2024)

Teachers not giving climate change topics a special importance during lectures was noted by students:

“I’m not satisfied because I feel as if our school doesn’t prioritize it enough. Uh... by prioritizing I mean that it’s not given enough importance. Like when Science and HSS teachers are teaching us, and the chapter mentions climate change, they do not discuss in detail about it. It’s almost as if there’s no particular need for them to dive deep into this topic, even though we know so little about it from our textbooks.” (Interview#3, 3/07/2024)

One student echoed the same observation and feeling dissatisfied,

“Actually I’m not satisfied because I think climate change is a very important topic. But it’s not being talked about enough. Of course I’d like it to be discussed more, given its importance. Teachers should be teaching us about it in-depth because they are the only ones who talk to us about it. Not all of us learn about it from the internet because when we use the internet we use it for watching silly videos and stuff. Yes, I mean we don’t necessarily look this stuff up online to educate ourselves. So considering that most of what we learn comes from teachers, they should be more serious about teaching us about it.” (Interview#2, 3/07/2024)

Another student wondered if she will ever feel satisfied with the way climate change was being taught, noting that teachers were not aware about climate change themselves:

“Will I be ever satisfied? Ever? I wonder! I don’t know. Because right now my school is really starting to make me think about it. But they [teachers] are not like they SHOULD BE! They are just like, yes do this and that, plant trees and stuff. They are not very aware themselves. I don’t know to what extent they care about climate change. So I guess I should ask myself will I be ever satisfied?” (Interview#1, 3/07/2024)

4.4 Theme 3: Students’ Applied Perception towards Climate Change

4.4.1 Frequency of Climate Thoughts and Situations That Prompt These Thoughts in Students

Of the 12 students from two schools participating in this study, only one student (female, School A) regularly thought about climate change. The majority *occasionally* thought about it after reading or watching news about climate events, such as flash floods, cyclones, or heatwaves, while two students (male, School A and B) rarely thought about it. Among the 12 students, five female students thought about climate change occasionally compared to the three male students who did.

In general, all female students seemed to think about climate change more frequently than their male counterparts. One female student said,

“I think about climate change when I see floods or cyclones happening in the news or there’s a heatwave in the city.” (Interview#12, 18/09/2024)

In regard to the most common situation that prompted students to think about climate change was either directly experiencing it in their personal lives (such as facing heatwaves) or when watching or reading the news at home about a particularly disastrous climate impact event that left mass casualties (such as flash floods, cyclones). Majority of both male and female students had thoughts about climate change in these two situations only. No student reported having thoughts about climate change during a Science or History and Social Science (HSS) class at school, which could indicate how little climate change is brought up in their classes.

4.4.2 Individual Actions and Personal Responsibility Against Climate Change

Overall, students didn’t take a lot of personal actions in their daily lives against climate change, but the actions they did take included planting trees and reducing plastic usage. 3 students shared they planted trees, 2 students mentioned they try to reduce plastic usage, with the majority reporting they did not take any individual actions against climate. Among the 3 students who reported planting trees, all of them planted trees within the premises of their own residences and not outside in the community. Among the 5 students who took personal actions through either planting trees or reducing plastic use, majority were females and only one were a male student. Thus, female students demonstrated more personal initiative towards fighting climate change than their male counterparts. When asked how planting trees would help fight climate change, some students shared that planting trees would help clean up polluted air and fight climate impacts such as heatwaves. Other than planting trees and reducing plastic use, students in general demonstrated that they did not know much about what individual actions they could take to fight against climate change. One student noted that planting trees would help,

“I think planting more trees and reducing our plastic use properly are great steps anyone can take to fight climate change from their own communities. I personally try to do both.” (Interview#7, 3/7/2024)

Another commented,

“I don’t have any idea what we can do personally, but I think planting lots of trees couldn’t hurt.” (Interview#9, 18/09/2024)

4.4.3 Collective and Community-Based Actions Against Climate as Youth Leaders of the Community

The common collective actions students shared that they wanted to take as youth leaders included urban greenery initiatives such as tree planting initiatives and rooftop gardening in their community. They also were very eager to implement proper waste management systems, recycling, reducing plastic, imposing strict regulations and installing composting schemes that help with tree planting, and awareness raising campaigns. Most students participating in the study thought tree planting initiatives would be more convenient and impactful as climate action. One student shared,

“We can create posters and spread them in the community, urging people to plant trees before we start [planting trees] and then start our work. We can get help from our teachers for it. I think tree planting would be most convenient and affordable action for us. Besides we need trees in this community so it would have a positive impact.” (Interview#10, 18/9/2024)

Another student shared her pessimism during the FGD,

“...If people listened to me, I would have planted trees with everyone. My community would have turned into the greenest one! But if people cut down the trees after a few years then I don’t know what I’d do.” (Respondent 3, Focus Group Discussion, 4/07/2024)

Another student emphasized personal accountability and wanted to focus on awareness campaigns. She seemed to have the misconception that smoking cigarettes was a factor behind climate change.

“We ourselves are responsible for a lot of things that are damaging our environment, such as cutting down the trees, polluting the water or smoking cigarettes. As a community youth leader, I would’ve tried to stop these first and created awareness on how these are harming our environment by running awareness campaigns in the community.” (Respondent 5, Focus Group Discussion, , 4/07/2024)

One student advocated for harsher policies and regulations such as imposing large fines for polluting the environment through the help of local administration:

“I want tough regulations like making people pay 10 thousand to 1 lakh BDT in fines for cutting down trees, dumping plastic and other household waste randomly. People in our community have a very bad habit of tossing waste out of their windows, which is a habit that I won’t be able to get rid of unless I fine people a lot of money for it! Only through tough policies can we fight climate change because I don’t think people would listen to me if I didn’t use these.” (Respondent 1, Focus Group Discussion, 4/07/2024)

Another student shared that he already is part of an initiative that helps keep his community clean:

“I already am a youth leader! My friends and I are in a Social Service Committee where we pick up trash people leave behind and help keep the local community clean. I can’t do it for the entire country but as per my capacity I try my best to keep my community clean.” (Interview#7, 3/7/2024)

One student shared his idea for waste management and composting along with tree planting initiatives:

“As a youth leader of my community, I think I would have created different teams for different tasks and prioritized proper waste management through an organized system for sorting, recycling and reducing all the waste we create in our area. From the waste that can be recycled, a composting initiative could be created that will also help the trees we plant. That seems like a really important way to help”. (Respondent 4, Focus Group Discussion, 4/07/2024)

One student emphasized that they think it’s more important to start collective action against climate change from within the family:

“As a youth leader, I would have started first from my own family. I would have ensured that my family maintained proper waste disposal and stopped doing things that pollute our environment. If I don’t ensure first that my family maintains these things, how can I go tell others to do it?” (Respondent 6, Focus Group Discussion, 4/7/2024)

Students did not talk about possible transition towards renewable energy projects, energy conservation, affordable yet innovative climate-resilient infrastructure or other technological

solutions for their community's needs. They overall seemed to have limited creative ideas for the collective, peer-led or community-based initiatives they could take to combat climate change impacts in their community. This seems to have stemmed from the insufficient climate change education they receive from their teachers and schools.

4.4.4 Perceived Barriers to Personal and Collective Action

Students' lack of knowledge, understanding and awareness about what individual and collective actions can be taken against specific climate change impacts, concern about not being taken seriously due to their age, lack of encouragement from teachers, awareness in the broader community and insufficient resources were the reasons found that demotivated or prevented students from being more personally involved.

"I don't know what I could have done if I was a youth leader of my community because how much could I have done anyway? How much authority would I have? People won't listen to me or take me seriously because I'm a class 8 student." (Respondent 4, Focus Group Discussion, 4/07/2024)

One student noted the lack of resources that they might face when undertaking collective action in their community:

"One question I have when thinking about doing something as a collective is how will we collect the necessary funding to do these initiatives? Just look at our roads here. People who live here cannot even fix the roads when it gets damaged due to rain." (Interview#11, 18/9/2024)

Three students perceived the lack of awareness on climate change in the broader community as the key barrier that prevented them from undertaking personal or collective climate action. One among them noted that people in Bangladesh and in the Dhaka city were not very aware of climate change,

"I think people in Dhaka city and Bangladesh in general just do not think about climate change that much. If people are not aware about it, then it demotivates us younger people to do something about it. When people start thinking about it, only then we do something to change the thing, right?" (Interview#12, 18/9/2024)

4.5 How Teachers Integrate Climate Change in their Lessons and the Challenges they face in teaching climate change

4.5.1 Teachers' Views on Climate Change Education, its Relevance to the School Community and Climate Impacts Affecting the School Community

Teachers' Views on Climate Change Education and its Relevance to the School Community. One of the teachers thought climate change education for her students will be really useful since her students are from low-income families and other than the school, they don't get to learn about climate change from anywhere else. She also seems satisfied with the way climate change is taught to secondary students in her school and thinks the practice should be continued. However, she thought adding climate change as a completely different subject into the secondary curriculum is not necessary and could be burdensome- '*a load*' on the students. She thinks the quantity of and the way climate change content is integrated in Science and HSS textbooks for 8th grade, are enough for the students and if they want to learn more about climate, they can pursue it when they go to college.

*"I don't think a different subject for climate change is necessary. Whatever content on climate change the textbooks include, seem sufficient to me. If students study or absorb these content, it should be enough. I don't think we need more than that for secondary students...What knowledge they receive about climate change from their science and social science textbooks seem sufficient to me. If they're given more to learn on this, it might become a '*load*' for them and they might struggle."* (Teacher A)

Teacher B thinks it's a '*good idea*' to have climate change education and every student from 6th to 10th grade in Bangladesh should be given the *basic understanding of climate change* as it should be included in the curriculum. He thinks his students should be taught of this topic since it's prioritized in the SDGs and to achieve the SDGs, climate change knowledge is a must for students. He did not have any opinion on whether climate change should be taught as a different subject in the curriculum or remain as scattered as it currently is under the National Curriculum Framework-2021 in the textbooks.

Teacher C also thinks it's good to have '*some understanding of climate change*' but says there's no specific plan for teaching it in his school. Teacher D mentioned that teachers like her have no

autonomy when teaching mainstream subjects like Science, HSS and only teach what's in the textbook, following government instructions in the TG and the curriculum.

“Climate change education isn't emphasized much in our school. We should probably do better to teach climate change to our students, but I don't really have the authority to determine that.” (Teacher D)

Teachers had different opinions on how climate change education should be integrated into the subject curriculum but most of the teachers thought climate change education could be useful for their students. However, the majority agreed that more should be done to teach climate change effectively.

Climate Impacts Faced by the School-Community. Most of the participating teachers were able to identify ‘heatwaves’ as the most significant climate impact affecting students’ health and attendance in their school-communities.

“Our students fall sick during heatwaves.” (Teacher A)

Floods were not considered a significant climate impact on the school communities of School A and B due to their urban locations; however, waterlogging during the monsoon season was viewed as a local issue rather than a climate-related concern. Waterlogging caused the roads in the community to be in a dire state which made it harder for students to come to school some days. One teacher articulated this waterlogging issue as an infrastructural one rather than climate issue:

“I don't think we experience that many climate impacts in here. Heatwaves, yes. But we are pretty sheltered from dangerous impacts like cyclones and floods in the city. Yes this school community does get flooded and waterlogged when it rains for longer than half an hour, but that to my opinion is an infrastructural crisis, not a climate impact. Because this is a low-income urban community, the government doesn't really care about the roads here. Roads are in horrible shape and there is very poor drainage system.” (Teacher C)

4.5.2 Teachers' Integration of Climate Change in Regular Subject-Based Lessons and Climate Assessments

How Teachers Taught Climate Change: A Textbook-Dependent Pedagogy. According to the teachers interviewed and observations made in the classroom for this study, climate change education in secondary schools was found largely dependent on prescribed NCTB textbooks. This

practice contradicts with the National Curriculum Framework-2021's guidelines, which explicitly instruct secondary teachers to engage their students through experiential learning, incorporating elements from the local environment as main teaching-learning materials (Pg-78, NCTB 2021). Additionally, the Framework encourages the use of supplementary books, charts, cards, and audio-visual materials, which are not being fully utilized in practice. Teachers depended on the Textbooks and adhered to the school syllabus without creating specific lesson plans targeting climate change knowledge.

“I follow the school syllabus and its timeline in teaching the chapters.” (Teacher A)

The school syllabus, in Bangladesh's educational context, is a document created by school administration at the beginning of an academic year that predetermines when to teach what chapters in a subject textbook, what sections to teach and what to exclude. If the syllabus includes a chapter that has climate content on a particular day's agenda, the Science teacher said she followed the syllabus and implemented the lesson accordingly. The other Science teacher indirectly indicated that he follows the school syllabus as well, relying on the textbook. Teacher C explains that when he will teach a chapter in the ***Science: Investigative Study*** textbook that includes some climate change content, he will talk about climate change in that class. He mentions that he does not design specific lesson plans on climate change, targeting climate change knowledge as a Learning Objective. He explains,

“For example, I haven't yet gotten to the Chapter that includes content on renewable energy in the textbook. When I teach the chapter, I will explain to students why renewables are important to fight climate change. So, I follow the textbook and the context it provides for me to teach them information related to climate change.” (Teacher C)

On the other hand, during class observations, both the HSS teachers were seen covering content relevant to climate change, such as forest ecosystems and marine biomes from the textbook's Chapter 15, but neither connected it to the global climate crisis or elaborated on the impacts that climate change would have on these biomes. One HSS teacher mentioned the insufficient content of the textbook behind this and explains,

“I was teaching the section on marine environment for my class and the text was very condensed with lots of information on the general Scientific aspects of it. Like I said before,

it did not contain enough information about the sociological impact climate change will have on people living in that ecosystem.” (Teacher D)

The other HSS teacher explained that due to time restraint, he did not have the opportunity to talk about climate change on his class on the forest ecosystems of Bangladesh, the class I observed.

Teachers’ Opinions on the Climate Change Content of the NCTB Textbooks. When asked if the textbooks contained sufficient information or content on climate change, the Science teachers believed the current textbooks provide sufficient content, but they had to switch back and forth between the two Science textbooks to paint a nuanced picture. One Science teacher explained,

“There is. I teach Science and for my subject there are two textbooks in the new curriculum- one is ‘Investigative Study’ and the other ‘Exercise’ book. If I follow the ‘Investigative study’ book, that is enough for me because that book contains most of the information related to climate change. The system is such that when I go teach the ‘Exercise’ book, I must also resort to the ‘Investigative Study’ book otherwise I won’t be able to guide the students to do the exercises. And I make sure students fill up the [exercise] tables in the ‘Exercise’ book with the information from the other book.” (Teacher A)

The other Science teacher interviewed also thinks the new curriculum textbooks contain sufficient information on climate change and mentions he also switches back and forth between the two books, but mainly relies on the ‘Investigative Study’ book for teaching climate change. So both Science teachers think there is sufficient information on climate change on the 8th grade NCTB textbooks. HSS teachers, however, found the textbook content insufficient and lacking in real-life examples or sociological perspectives. One HSS Teacher thought the HSS textbook could include “more enriched” content beyond the content it currently has:

“Children should learn about climate change in details. The information in the textbook regarding climate change should have been more enriched.”(Teacher B)

The other HSS teacher expressed dissatisfaction regarding the textbook not highlighting the sociological impact of climate events and thought the textbook could include more real-life examples from communities that are suffering the worst from climate change nowadays. She explained,

*“The new curriculum HSS textbook touches on this topic, but I felt like we needed to **highlight the sociological impact of climate [events]** more. What will life look like in a community in a rural village in the Sundarbans- one of the most disaster-prone area in our country due to climate change, you know? I feel like students probably could use more examples”. (Teacher D)*

When asked if teachers included climate change knowledge from the textbooks only or added other information from different sources, all the participating teachers reported that they do not add information from sources outside the NCTB textbook in their regular lessons and mainly rely on the NCTB textbooks for teaching climate content. This was consistently reflected during the class observations as well.

“Yes, the new curriculum gives us the opportunity to include and utilize information from the internet in our classes. However, I mainly follow the new curriculum textbooks to teach; I don’t add extra information from outside.” (Teacher A)

One HSS Teacher reported he “sometimes” used information from internet but not specifically related to climate change. During class observation, it was observed that he relied entirely on the textbook to teach. He noted,

“The new curriculum textbooks do not actually contain enough information, in my opinion. So if we are to follow this curriculum, we have to add information from other sources like the internet in our lectures. I actually didn’t plan to add anything from the internet today in my lesson, so I relied on the text mainly. But sometimes I do try to add information from the internet, though not [specifically information that is] related to climate change.” (Teacher B)

Running Out of Time and Missing Lesson Plans. The class observations for this study were done after the July-August Revolution in Bangladesh during which school activities were closed for nearly two months. After the schools opened, the teachers were in a rush to complete the syllabus. They did not fully cover all the content of the chapters they were teaching, especially the HSS teachers seemed to rush through some parts of the chapter that included some climate change content, and assigned students the rest of the chapter for homework. None of the teachers whose Science and HSS classes were observed, reserved some time during their lessons to explore

the topics in-depth, drawing proper connection to climate change. One HSS teacher explained the reason behind this rush to complete the syllabus during interview,

“The End of Year assessments start in November, ending in December. Because the schools were all closed for nearly two months due to the political unrest, we have a lot of catching up to do. I might not have sufficient time to cover every single chapter so I skip some pages and try to give students the gist of it. They complete their readings as homework and I check their homework.” (Teacher D)

Four classes were observed for this study, among which two were Science classes and the rest were History and social Science classes. None of the teachers teaching these classes had lesson plans prepared and were not using lesson plans. Upon further requests, the teachers were also unable to provide me with a previous lesson plan they had that included climate change content. Upon interviewing, two teachers shared that a lack of planning and knowledge on how to teach the existing climate content or add extra information from the internet was a challenge for them. The teachers shared during the interviews that they do not create lesson plans for regular lessons and just follow the instructions from the Teacher’s Guide. But during class observations, teachers were seen not following the TG either, because the implementation of the new curriculum had been put on pause by the newly appointed Interim Government of Bangladesh after the July-August Revolution. The TGs contained some instructions on experiential learning strategies that the teachers could have used.

How Teachers Assessed Students’ Understanding about Climate Change. Teachers participating in this study shared that they do not design specific assessments to evaluate students’ climate change understanding. As to why they do not do so, teachers cited reasons like time constraints, large class sizes, and resorting back to the 2012 curriculum assessments instead of the 2021 curriculum framework’s assessments. One teacher explained,

“Problem is that right now we are not following the new curriculum for assessing our students, so we have to go back to the older curriculum assessments. We don’t make the new assessments anymore, we will go back to creating multiple choice questions and essay questions [as per the old curriculum] to evaluate students. And I don’t create separate assessments to assess climate knowledge of my kids. The older curriculum’s assessments are easier in my context so I just use those to create assessments.... No, those are general

assessments. When I'm done teaching the whole syllabus, I will create assessments based on the whole syllabus." (Teacher A)

Syllabus completion pressures, exacerbated by school closures during the July-August Revolution, subject teachers having limited teaching time, impracticality of the new curriculum assessments- these are the factors that lead teachers to rush through their topics, often completely skipping or assigning climate-related sections as homework to students. One teacher said,

"I might not have sufficient time to cover every single chapter, so I skip some pages and try to give students the gist of it." (Teacher D)

Two teachers directly mentioned the impracticality of the new curriculum assessments and why it was 'unrealistic' to design assessments for climate change related topics,

"I don't have a separate assessment method for climate understanding. And it's challenging with large classes- there are about 60 students in one of my classes, and evaluating each student's grasp of specific topics like climate change isn't realistic for me." (Teacher C)

Another teacher also commented on the impracticality of the new curriculum assessments in general:

"And look, in just one section that I teach, I have more than 50 students. I teach three sections. The way the new curriculum wanted us to assess these students, I'm sorry for saying this but I just did not find it humanely possible for me. I found the older curriculum's assessments easier in my context." (Teacher A)

4.5.3 Teachers' Opinions on Whether the NCTB Textbooks Cultivated Climate Change Awareness and a Sense of Responsibility Towards the Environment Among Their Students

Both the Science teachers, Teacher A and C thought the Science textbooks would be able to cultivate a basic awareness on climate change as well as create a rudimentary sense of responsibility towards the environment. The HSS teachers, on the other hand, did not think the textbooks, in their current state, alone would help cultivate climate awareness and sense of responsibility towards the environment among their students. This is an interesting perspective since the HSS textbook contained more content relevant to climate change for students than the

two Science textbooks combined. One HSS teacher gave an example of where she thought the textbooks were lacking,

“The HSS textbook includes some general information on sustainable management of forests and marine resources, but it does not give students an example about how they can actually help adults in their communities do that. Students will not get a picture of what forest management looks like in real life, its challenges.” (Teacher D)

4.5.4 Textbooks as Teachers’ Sources of Information on Climate Change

The NCTB textbooks were the teachers’ key sources of information about climate change. Teachers were relying heavily on these textbooks, with minimal incorporation of information from external resources such as the internet, the news media or relevant academic books on their respective subjects. Teachers only occasionally used the internet to teach but not specifically for teaching climate change topics. One teacher commented,

“I sometimes use information from the internet, though not specifically related to climate change.” (Teacher B)

Teachers admitted that they did not personally research information about climate change for increasing their own understanding. None of the participant teachers have ever attended any government or NGO-arranged training, skill-based workshops or teacher conferences on climate change education or pedagogy in the past 5 years. The teachers also mentioned never inviting a speaker or guest expert on climate change to come to the school and give teachers a workshop or a lecture that could help them gain better understanding and updated knowledge on climate change issues. The teachers mentioned once inviting a guest speaker, a Freedom Fighter who participated in the 1971 Liberation War of Bangladesh to speak to the students, since it was mentioned in the TG to invite one, but never for climate change particularly. This lack of external guest speakers is also mentioned by students during the FGD and interviews. One teacher commented,

“The TG did not mention anything about inviting climate scientists so we didn’t.” (Teacher B)

The government-arranged teacher training all of the participants went through to implement the new curriculum, none included any information or instructional sessions on how to teach or incorporate climate change topics into subject-specific lessons. The teachers also expressed

general dissatisfaction with the training they received for the new curriculum, reporting that the training was insufficient. One participant teacher also expressed uncertainty regarding whether they would receive any further training for this curriculum:

“I wasn’t satisfied, actually. I only received one training session which was for 3 days, and I did not feel like that was enough for me. It’s a completely different curriculum, you know. And now that the new curriculum has been cancelled, I don’t know if I will ever receive another training for it. So what was the point of it, I keep asking myself.” (Teacher A)

One HSS teacher mentioned that,

“... but the teachers’ trainings we had focused mainly on building some understandings. Specifically, how to teach climate or environment related topics were not an agenda of those trainings. We had one simulation class which showed us what a HSS lesson would look like in the new curriculum, but there should have been more such classes.” (Teacher B)

The participant teachers also expressed that the Teachers’ Guidelines (TG) as issued by the government, also did not include much information on how to teach climate change topics to students. This is only partially true, as the HSS Teacher's Guide provides a few, yet specific instructions for teaching climate change using multiple approaches like analyzing fictional news reports from the textbook and facilitating discussions on various global and local climate impacts. The TG also encourages hands-on activities like ecosystem observations, data analysis, and community-based sustainable development projects such as social forestry for the HSS subject. For the Science subject, on the other hand, the TG provides very limited instructions for teaching climate change. The only instructions it comes equipped with is through the "Environmental Protection" chapter, narrowly focusing on sustainable resource use, human impacts on the environment, and promoting ecological balance. It incorporates some instructions for inquiry-based and experiential learning activities like waste management projects, with assessments emphasizing group participation and written reflections. Both Teacher’s Guides lack guidelines on teaching foundational climate change concepts, guidance on linking local issues to global challenges, and realistic community-level solutions. They also exclude teacher training resources and digital tools, leaving educators unprepared for effective interdisciplinary climate education.

4.5.5 Resource Limitations Teachers Face in Teaching Climate Change

A. Tools

Teachers expressed that they lack multimedia tools such as projectors, laptops with stable internet connection in their classrooms, and printers to make their lessons more visually engaging and impactful. Both Science teachers and one HSS teacher noted insufficient multimedia tools in their schools. One HSS teacher shared,

“I don’t have multimedia tools for my class but there is a laptop in the school’s computer lab. I could use it, but since there are other teachers, specifically ICT teachers who need it more than me- I don’t always get to utilize it for my students.” (Teacher B)

A Science teacher commented,

“I could really use a projector and a laptop with internet connection. Kids would love to watch things on the projector. I could also use some colorful worksheets, like the ones I’ve seen teachers at posh schools give their students. We can’t afford printers and ink in the school, otherwise I would have created some worksheets for my students.” (Teacher A)

Teachers were open to using these tools to teach their lessons. One teacher additionally mentioned that they also needed digital training to navigate these tools:

“... also I have not received the ‘Digital training’ yet. The government provides us with this training, but not all of us [teachers] receive it. For example, the government took a long time to arrange the Digital training for our school’s teachers, and when they finally did, only a handful teachers received it. I wasn’t one of them. I don’t know how many years it would take for the government to arrange my training. (Teacher B)

B. Teacher’s Training

Teachers reported a lack of focused training on climate change education and felt they needed more training on delivering it. Government-arranged training programs that the teachers underwent for the implementation of the National Curriculum Framework-2021, were insufficient and did not cover how to teach climate-related topics in the textbooks effectively.

“The trainings I received did not include any information on how to teach climate change.”
(Teacher A)

However, all the teachers participating in the study showed eagerness to participate if more training opportunities to enhance their pedagogical skills and knowledge on climate change were arranged. One HSS teacher commented,

“...as a teacher I believe I’m capable of teaching 6th to 10th graders about climate change. But I could still use some more updated information, you know, learning shouldn’t stop when you’re at a certain age. The more I learn new things, the better my teaching output would be. That’s all.” (Teacher B)

4.5.6 Unspoken Emotions: How Teachers Avoid Addressing Students’ Emotions and Feelings on Climate Change

All four of the secondary teachers who participated in this study admitted that they did not talk to their students about their feelings, emotions and concerns regarding climate change issues. When asked what the teachers observed about their students’ feelings regarding the issue of climate change, they mentioned that they were unaware and did not know anything about how their students felt simply because students’ feelings, emotions and concerns regarding climate change were never really discussed during any lesson. Teachers reported that they do not generally ask students about how they feel regarding the climate crisis or if they have any concerns to share regarding its local or global impacts, during class discussions when the topic of climate change came up. During class observations, it was also confirmed that teachers did not bring up this during lessons and students were not given the opportunity to talk freely about their feelings or emotions regarding climate change issues. Teachers cited time constraints, lack of personal knowledge on discussing emotions that the topic of climate change might rouse in students, and lack of professional training as the reasons behind this. According to one HSS teacher, short duration of his class did not leave him sufficient time or scope to bring up these discussions during his lessons:

“I don’t really have time to talk about how students feel on this topic.” (Teacher D)

Another participant teacher indicated that she felt unequipped to discuss students’ feelings and emotions regarding climate change during class since she was unsure how to deal with it and that she never received any professional training regarding it:

“I’m not sure how I would handle it if my students expressed negative feelings about it. I personally don’t feel like I know much about these, and we also never received any training that help us deal with emotions regarding this.” (Teacher A)

Climate change education in the National Curriculum Framework 2021

4.6.1 Content analysis of the National Curriculum Framework-2021

Document analysis has been defined as a process through which documents are evaluated “*in such a way that empirical knowledge is produced, and understanding is developed*” (Bowen, 2009). In choosing the documents I had to analyze for this study, Flick’s four factors were followed: Authenticity, Credibility, Representativeness and Meaning (Flick, 2018). Only the authentic, credible, representative and meaningful documents were analyzed. Content analysis is one of the various document analysis strategies that are specifically used for the identification and quantification of key themes, patterns, and concepts within a document (Armstrong, 2021). For this study, this strategy allows for a thematic exploration of the curriculum document, focusing on **how** climate change is addressed in it. This method thus provides rich insights into how climate change is embedded in the curriculum in terms of educational goals, subject integration, pedagogical strategies, its connection to local and global environmental challenges and so on. The curriculum document is analyzed with the aim to uncover the depth and context in which climate change is framed within the curriculum. It was coded and sorted into specific categories relevant to climate change education. The categories are as follows:

1. Incorporation of climate change into educational goals and learning objectives
2. Interdisciplinary integration of climate change
3. Pedagogy, Teaching-learning materials and Teacher’s training
4. Assessments on climate change
5. Climate justice and equity

Incorporation of Climate Change into Educational Goals and Learning Objectives.

The goal of the curriculum is to create a new generation of competent global citizens who will be able to adapt to the 21st century’s challenges and needs. Hunger, poverty, climate change, conflicts, pandemics are mentioned as key challenges affecting lives, livelihoods and economies around the

world. For realizing Bangladesh's goal for transitioning from a Least Developed Country to a developed one by 2041, a total transformation of the traditional exam-centric education system was envisioned, with the formulation of the National Curriculum Framework-2021. National Curriculum and Textbook Board (NCTB) conducted the last curriculum revision in 2012, so a new revision was long overdue. The National Curriculum Framework-2021 was the culmination of an effort to develop a competency-based continuous, seamless curriculum from pre-primary to grade 12, for children aged between 4 and 18 years in the context of the national goal to become a developed country by 2041 and global challenges (NCTB, 2021). There are four essential elements competency based on which the curriculum framework is created: knowledge, skills, attitudes and values. Combining these four elements, a total of 10 "core competencies" are created and integrated across all subjects and grades. Taking local and global needs as well as future perspectives of higher education into consideration, 10 'Learning Areas' were developed for acquiring the core competencies. These Learning Areas are the same for all students from pre-primary to grade 10 in secondary level. Among those 10 'Learning Areas', only the 7th one is dedicated to '*Environment and Climate*'.

Learning Area: Environment and Climate. Students are expected to behave responsibly toward nature and wildlife as per this Learning Area. They should be able to understand environmental elements, pollution, conservation, climate change concepts, causes of climate change, and the impacts on individuals, the environment, and socio-economic systems. Students should also learn to adapt to evolving circumstances through strategies aimed at building a safer, habitable world (NCTB, 2021). The limited inclusion of environment and climate change as a topic in only one Learning Areas, indicates that climate change education is not integrated into the broader educational objectives and priorities for this curriculum framework. The curriculum framework also does not include specific, measurable learning outcomes for students to establish explicit goals or action-oriented competencies for climate resilience, such as planning mitigation efforts or understanding adaptation strategies. The framework emphasizes general learning outcomes, such as understanding environmental elements, pollution, and conservation. While these are relevant, the curriculum does not set specific goals for teaching climate mitigation, adaptation, or resilience-building skills, which should be an important part of a competency-based curriculum for a climate-vulnerable country.

Interdisciplinary Integration of Climate Change.

Subject-Specific Integration. The main objective of the Science curriculum, as laid out in the curriculum framework, is to develop scientific literacy through exploratory learning and ingrain socio-scientific values among students. The curriculum for Science offers four specialized fields: a. Physical Science, b. Biology, c. Earth and Space Science, and d. Science, Technology and Society (STS). It has integrated socio-scientific values in the framework with the objective of enabling students to “analyze their surroundings and the impact of human activities” and to make them curious about “the diversity of nature, environment, and culture”. While the Science curriculum promotes scientific literacy and socio-scientific inquiry, it does not include climate science as a dedicated topic. There is no mention of purposeful inclusion of climate science topics in the Science curriculum. This leaves a gap in explicitly teaching students about the causes and consequences of climate change, the human impacts on climate, or the scientific basis of climate change.

The main objective of the History and Social Science (HSS) curriculum, on the other hand, is to develop students into responsible global citizens who can contribute positively to building a sustainable and equitable world. This involves understanding their identity within historical, cultural, and socio-economic contexts, exploring the interrelations between natural and social structures, addressing changes with a focus on opportunities and risks, and practicing sustainable resource management. The HSS subject emphasizes democratic values, social justice, and patriotism, inspired by the spirit of the Liberation War and constitutional principles, while promoting values like cooperation, tolerance, and responsibility. There are four dimensions that determine the HSS competencies: a. Self-identity, b. Natural and Social structure, c. Positive role in changes and d. Resource management and conservation. The main areas of focus for HSS subject are- Social and global citizenship, Environment and climate, Life and livelihood. The HSS curriculum thus addresses climate change through the ‘Environment and climate’ focus area, but it does not include any targeted learning objectives or detailed strategies for addressing climate change relevant topics from a historical or social scientific perspective. While general competencies for environmental responsibility and global citizenship are included in the HSS curriculum, specific learning outcomes related to climate change such as understanding climate impact mitigation strategies, analyzing local or regional climate policies, or proposing sustainable solutions are not outlined.

Overall, the curriculum framework does not emphasize creating interdisciplinary or systemic connections across subjects to deepen students' understanding of climate change within social, economic, and environmental contexts. It seems lacking in interdisciplinary approaches to merge subjects like Science, HSS to give students a holistic understanding of climate change. There is no structured interdisciplinary activities or projects, as part of the framework's experiential learning agenda that combine science, social science and other arenas to address climate change issues comprehensively.

Pedagogy, Teaching-Learning Materials and Teachers' Training. The curriculum framework emphasizes on competency-based education, promotes constructivist and experiential learning and active, learner-centric approaches to encourage a joyful, interactive learning environment. Pedagogical strategies include interactive and hands-on activities such as project-based learning, problem-solving exercises, collaborative learning, and contextual investigations. The teacher is to act as a facilitator, enabling students to actively participating in exploring real-life problems. For grades 6-8, the curriculum framework demands the teaching-learning strategies to be more structured, with only subject teachers conducting subject-specific classes. A variety of teaching-learning strategies are to be employed, focusing on experiential learning to help secondary students develop high-level thinking skills through well-structured activities. Teachers are recommended to utilize digital technology. But other than this, there is no specific mention of using case studies, stories, group projects, field trips or even specific digital tools that teachers are told to utilize to teach students about climate change. There is no direct reference to activities teachers can lead their students to carry out- such as community involvement or environmental activism specifically for climate change issues. This highlights a missed opportunity in the curriculum framework to include pedagogical strategies for teaching climate change.

The teaching-learning materials mentioned in the curriculum include Teacher's Guides (TGs), supplementary reading materials, reference books, audio-visual aids, charts, and models. The curriculum emphasizes using locally available elements as teaching-learning materials. Textbooks are de-emphasized in favor of experiential tools and environments, which is a drastic change in Bangladesh's education dynamics. Despite the comprehensive list of materials and far-sighted thinking regarding locally available materials, there is no mention of teaching-learning resources specifically focused on helping students learn about climate change. Moreover, the framework strongly emphasizes teacher capacity building through continuous professional development

(CPD) programs. It proposes short, medium, and long-term training to equip teachers with advanced pedagogical skills, interdisciplinary approaches, and educational technology. However, there is no specific teacher's training program that will be tailored so teachers can learn how to implement climate change education, thus leaving a wide gap in ensuring teachers are well-prepared to address the topic of climate change effectively.

Assessment. The curriculum adopts a competency-based assessment system, focusing on interconnected skills, knowledge, values, and attitudes rather than isolated content. Formative assessments are embedded within teaching-learning activities, with summative assessments de-emphasized. Observation and reflection-based evaluation, Project-based and experiential learning assessments, Peer and self-assessment are mentioned in the framework. However, specific assessment rubrics or tools for evaluating students' climate change-related knowledge, understanding and skills are not provided. This gap makes it difficult to evaluate the curriculum's success in fostering climate literacy.

Climate Justice and Equity. One interesting aspect of the curriculum framework is that it promotes social justice and global citizenship but **does not explicitly frame climate change as a social justice issue**. There is no mention of the disproportionate impact climate change has on vulnerable groups, such as the low-income communities, rural populations, and indigenous communities. While the curriculum mentions the principle of inclusive education, it does not specifically address equity or inclusivity when it comes to the context of climate change. For example, gender-sensitive approaches or rural or urban inclusivity in addressing environmental issues are not discussed. Moreover, it also does not acknowledge the role of local or indigenous traditions, cultures, or knowledge can have in addressing climate change.

4.6.2 The Gaps in the Curriculum Framework

The National Curriculum Framework-2021 seeks to equip students in Bangladesh with the knowledge and skills to address 21st century challenges, including climate change. However, it falls terribly short of promoting a holistic and effective climate change education. While the curriculum emphasizes competency-based learning, experiential learning and critical thinking skills, it fails to explicitly link these to problem-solving for fighting climate change, leaving students underprepared for the real threats that the climate crisis imposes. The absence of framing climate change as a social justice issue further limits its impact, as it overlooks the disproportionate

effects on vulnerable communities. While experiential learning is encouraged in general, specific active learning opportunities, such as community involvement or ideas for climate activism, are not included. These shortcomings, combined with the lack of interdisciplinary depth and insufficient teacher training to equip teachers with the knowledge and skills necessary to deliver a holistic climate change education, make the framework an inadequate foundation for climate change education. Without significant revisions to emphasize localized context, interdisciplinary approaches, targeted learning outcomes and assessments for climate change topics, the curriculum cannot fully prepare students as climate-literate global citizens.

4.7 Climate change content in the 8th grade textbooks and pedagogical instructions in the Teacher's Guides

4.7.1 Content analysis of the 8th grade textbooks and Teacher's Guides

The 'content analysis', a document analysis strategy was used for the purpose of analyzing the textbooks and Teacher's Guides documents for this study. Conventional content analysis approach was used to evaluate the 8th grade textbooks and Teacher's Guides (TGs) for 'Science' and 'History and Social Science (HSS)', developed under the National Curriculum Framework of 2021 for the academic year of 2024. The National Curriculum and Textbook Board (NCTB) is responsible for developing textbooks for primary and secondary level students in Bangladesh. There are a total of eleven subjects for 8th graders in the secondary level and textbooks have been developed for teachers to follow for teaching each of these subjects. Among the eleven subjects, 'Science' and 'History and Social Science' were the *only* two subjects that had textbooks containing content related to climate change as of 2024. This is why for the purpose of this study, the textbooks of these two subjects were chosen for this content analysis. The goal here is to assess how these resources address climate change content for students and provide pedagogical guidance for teachers.

Table 5*A sampling of the documents used for doing content analysis*

Documents Selected	Data Analyzed
• NCTB Textbook of ‘History and Social Science’ for 8th grade • NCTB Textbook of ‘Science’ for 8th grade [Investigative Study Book] • NCTB Textbook of ‘Science’ for 8th grade [Exercise Book] • Teacher’s Guide for ‘History and Social Science’	• Content regarding climate change • Content regarding climate change • Content regarding climate change • Resources and Pedagogical instructions on how to teach 8th graders about climate change from a Social Science perspective • assessments for evaluating student understanding from a Social Science perspective
• Teacher’s Guide for ‘Science’	• Resources and Instructions on how to teach 8th graders about climate change from a Scientific perspective • assessments for evaluating student understanding from a Science perspective
• Lesson Plans from teachers	• Not available

The content analysis also highlights their effectiveness and gaps to determine if they collectively provide 8th grader students and teachers with the tools needed to teach climate change. The textbooks and Teacher's Guides were coded manually using an inductive approach, allowing themes to emerge naturally from the data. Passages, tables, charts and assessments were carefully reviewed, and repeating patterns were noted. Emerging themes from these resources include:

1. Climate Science concepts and Assessments
2. Causes of climate change
3. Local and global impacts of climate change
4. Climate justice and equity;
5. Explanations of different climate solutions, individual and collective climate actions or responsibilities and
6. Sustainable development and disaster risk reduction (DRR)

Science Textbooks. For the 'Science' subject, two textbooks had been developed. One is titled '*Science: Investigative Study*' and the other one is '*Science: Exercise Book*'. The first textbook is rich in scientific content and includes a total of sixteen chapters, among which there were no specific chapter dedicated entirely to climate change. But there were three chapters throughout the book that included some content relevant to climate change. The second textbook includes a total of ten 'Learning Experiences', among which only two include some climate change content. Overall, the second textbook contains less climate change content than the first book. This book is also more focused on activities and experiential learning and is to be used in supplement with the first science textbook.

Climate Change Concepts in the 'Science: Exercise' textbook. The 8th Learning Experience titled '**Environmental Protection**' of this textbook is the only unit in this book that contains some basic concepts relevant to climate change. Through charts and tables, this unit encourages students to categorize and analyze their resource (food, electricity, gas, water etc.) usage, the type and quantity of the waste they generate from those resources across different timelines to assess their **environmental impact** (Page-116). This is the rudimentary knowledge students need to understand that can lead to later grasping more advanced concepts such as calculation of carbon footprints. From here, it leads students to think about the environmental consequences of excessive natural resource extraction. It later gradually introduces the concept of

waste management and encourages students to critically think about waste management through the "**Reuse, Reduce, Recycle (3Rs)**" framework. This unit includes group activities for categorizing waste (biodegradable, non-biodegradable, recyclable with/without treatment) and creating a 15-day waste generation analysis. Students are instructed to develop waste management models collaboratively, presenting those solutions to local community stakeholders for the assessment.

Through the activities of this Learning Experience, students should be able to develop basic environmental literacy by linking individual actions to broader ecological consequences, expand their critical and analytical skills, collaborative problem solving. This unit also promotes responsible and mindful consumption among students. These topics and assessment activities work to address broader environmental sustainability goals. But this unit **does not** explicitly connect the concepts of waste management, environmental impact assessment and responsible resource usage through the 3Rs- to climate adaptation or mitigation efforts. Hence these concepts cannot be put under the ‘climate action’ theme. This textbook only includes some content that can be put under the ‘Sustainable development and Disaster risk reduction’ theme. Thus, the *‘Science: Exercise’* textbook falls short of being an adequate educational resource for students to learn about climate change.

Climate Change Concepts in the ‘Science: Investigative Study’ Textbook. Climate Science Concepts. Some environmental science concepts throughout this textbook can also be broadly categorized as climate science concepts. For example, in a section titled ‘Different environmental issues in various geographical regions and the role of humans’ in **Chapter 11: ‘Geographical coordinates, local time and regions’**, the text helps students visualize climate change impacts across different regions:

“The effects of climate change are significantly affecting the mountainous and tundra regions. Due to the melting of ice in these regions, the sea level is rising, and the habitat for polar bears, reindeer, and other animals is decreasing. Forest conservation, sustainable development, and reducing greenhouse gas emissions can be significant steps in protecting these regions.” (Pg-143; Science: Investigative Study)

In a section titled ‘Industrial waste and environmental pollution’ in **Chapter 14: ‘Uses of chemistry in everyday life’**, soil, air and water pollution through mismanaged waste disposal by industries

are explained. Inappropriate disposal of plastic and polythene causing microplastics to enter our bodies through the food we eat, harmful mismanagement of industrial waste polluting our water bodies- these are described as *environmental pollution*. The text also mentions that environmental pollutions like these do not just impact one area, but adversely affects “*the climate as a whole*” (Pg-173; Science: Investigative Study).

In a section titled ‘Forest Resources’ from **Chapter 16: *Natural Resources of Bangladesh***, forest ecosystems are emphasized as carbon sinks, explaining their role in absorbing carbon dioxide and regulating regional as well as local climates (Pg-192). This is the first instance where students get to learn about forests as ‘*climate regulators*’, an important climate science concept to understand.

Local and Global Climate Impacts. In the section titled ‘Different environmental issues in various geographical regions and the role of humans’ in **Chapter 11: ‘*Geographical coordinates, local time and regions*’**, the threat to biodiversity and climate stability in evergreen forests across the world caused by excessive deforestation is mentioned very briefly. It is also suggested that conservation, sustainable management, and careful planning are essential strategies to mitigate these harmful changes affecting the forests (Page-143). However, this particular section does not emphasize on these forests’ roles as carbon sinks and how they influence global climate regulation in different parts of the world.

In Chapter 16 ‘***Natural Resources of Bangladesh***’, the fact that climate change has disrupted rainfall patterns, prolonged droughts, and altered the water cycle, affected water availability, putting additional pressure on societal and national well-being- is briefly mentioned (Pg-184). But to help students understand how that happens due to climate change, the details are not explained thoroughly. The textbook does not provide any thorough descriptions of the climate change impacts Bangladesh might face or is facing. Global impacts on different regions of the world are also not discussed properly.

Explanations of different climate solutions, individual and collective climate actions or responsibilities. **Chapter 15: *Renewable and Non-renewable resources*** is the most enriched part of this textbook in content relevant for climate change education. It includes definition and characteristics of renewable resources, describing renewables as “*sustainable and environment-friendly alternatives to non-renewable resources*” (Pg-176). It is emphasized here that renewable

resources generally emit minimal greenhouse gases (GHG) and do not adversely affect climate change. Moreover, it highlights the long-term availability of these resources:

“As they can be replenished naturally or with the help of human technology, there is the assurance of long-term availability of these resources” (Pg-177).

Additionally, the chapter suggests that the mixed use of renewable resources can reduce dependency on single energy sources, offering a more sustainable energy strategy. Examples of renewable resources include solar, wind, hydropower, biomass, geothermal energy, and forests, while non-renewable resources include uranium, mineral resources, metals, precious metals, and fossil fuels. A balanced discussion of renewable resources is presented in the sections titled ‘Examples of Renewables’ and ‘Advantages and Disadvantages of Renewables’. Certain disadvantages of renewable energy technologies are also mentioned such as the limitations of solar and wind power, their costs are expected to decrease over time, making them more affordable (Pg-178-180).

The chapter also addresses the environmental impacts of non-renewable resources. The text warns against the overuse of non-renewable resources, emphasizing that they are finite, and that indiscriminate use could lead to shortages for future generations. It notes that,

“...the extraction, processing, and combustion or burning of nonrenewable resources can cause various types of environmental problems.” (Pg-182).

In **Chapter 16**, in a section titled *Natural Resources of Bangladesh*, the importance of caution in the use of natural resources is highlighted (Pg-194). Examples of renewable resources such as solar energy, tidal energy, electricity, and wind energy are mentioned as being abundant and unlikely to run out in the near future. However, the text warns that resources like underground water, woodland, and agricultural soil can also face scarcity if we overuse them. It advises utilizing water from rivers and canals instead of underground water, avoiding deforestation, and planting new trees to replenish woodland resources: *“Cutting down trees from forests should be stopped, and new trees should be planted”* (Pg-194). Both these chapters will help students gain a perspective on renewable and non-renewable resources, encouraging sustainable resource management.

In **Chapter 15**, under the section titled ‘*Water Management Strategies*’, the textbook briefly mentions rainwater collection as a means of managing water resources sustainably (Pg-185). The

focus on conservation is crucial in addressing the vulnerabilities associated with water scarcity and ensuring sustainable usage. In **Chapter 16**, the section titled ‘**Forest Resources**’ discusses the challenges faced by forest resources in Bangladesh, including deforestation and fragmentation. It acknowledges the Bangladeshi government's efforts to mitigate these issues through various policies and programs aimed at protecting forests (Pg-192). Similarly, in the section ‘**Water Resources**’, the textbook addresses the vulnerabilities of Bangladesh's water resources to natural disasters such as floods, cyclones, and storms. Again, government initiatives to tackle these challenges through measures like flood control, river dredging, and the promotion of sustainable water use practices are mentioned (Pg-193). These chapters provide an overview of some general strategies and government actions to manage natural resources, but examples of individual or community-based collective actions or practices that can also help sustainably manage these resources, are absent from both these chapters.

Sustainable Development and Disaster Risk Reduction. Chapter 11 of this textbook mentions conservation efforts and reduction of GHG emissions as ‘sustainable development practices’:

“In conclusion, through proper planning, sustainable development practices, and conservation efforts, human involvement can make a significant impact in tackling environmental issues in all regions. It is our responsibility to identify the various harmful impacts we pose on the environment, so that we can work towards eradicating them in order to preserve the environment and its resources for our future generations.” (Pg-143)

Summarizing the Gaps and Missed Opportunities in the Science Textbooks.

Insufficient Climate Science Concepts and Assessments. Both Science textbooks for 8th grade under the National Curriculum Framework-2021 are filled with a wide range of missed opportunities and gaps where the science content could have been connected to climate change and discussed with more nuance. The most blatantly obvious gap is that neither the ***Science: Investigative Study*** nor the ***Science: Exercise*** textbook include any nuanced discussion on the natural and anthropogenic causes of climate change. Foundational climate change concepts such as greenhouse gases (GHG), global warming, carbon cycle, albedo effect, differences between climate and weather, carbon sequestration etc. are absent from the textbooks. The role of ocean currents, wind, volcanic eruptions and other geographical factors that influence global climate as

well as short-term fluctuations (like El Niño and La Niña) versus long-term shifts in climate patterns- fundamental climate science concepts like these are also missing from the texts. While group and project-based assessments are included to encourage critical thinking, problem-solving skills, and awareness about responsible consumption, these assessments do not encourage students to think about tackling the climate impacts affecting their communities or country.

Climate Justice and Local Climate Impacts Ignored. Global climate impacts such as heatwaves, droughts, typhoons, desertification, salinity intrusion, permafrost thaw, polar ice caps and glacial melting, thermal expansion of the oceans, ocean acidification, damaging of the coral reefs and biodiversity loss are not discussed. The textbooks do not provide any thorough descriptions of the climate change impacts Bangladesh might face. The Science textbooks also do not include any case studies or real-life local examples of how climate change affects marginalized, vulnerable local and indigenous communities. The glaring gap of including real-life examples of indigenous and local communities sustainably using non-renewable natural resources across the world was a glaring gap in the Chapter 15. Thus, the Science textbooks, despite having the opportunity to do so, fail to include much needed educational content on *Climate justice and equity*- an essential topic to be included in the national curriculum for climate-vulnerable countries like Bangladesh.

Limited Discussion on Climate Solutions and Collective or Individual Climate Actions. Chapter 15 and 16 in the ***Science: Investigative Study*** book lack an explicit connection between renewable resources and their role as climate solutions, as the use of renewables within strategies to combat climate change is not directly framed. Additionally, the text also does not address the socio-economic and policy challenges of transitioning from non-renewables to renewables, nor does it include localized examples or case studies relevant to Bangladesh's climate vulnerabilities. Furthermore, even though the concept of RRR could have been labelled as an effective climate solution in Bangladesh's context in the ***Science: Exercise*** book, it is merely introduced as an environment friendly method for sustainable waste management.

Unexplored Connection Between Environmental Pollution and Climate Change In Local Context. In the '***Science: Investigative Study***' book, Chapter 14: 'Uses of chemistry in everyday life', a section titled 'Industrial waste and environmental pollution' is included which fails to explore the intricate connection between environmental pollution and climate change. It

does not explain how various pollutants (such as GHG) influence the Earth's climate system in multiple ways but takes on a more anthropocentric perspective on the impact of environmental pollution. No specific case study or real-life example is included, though toxic, heavy-metal-rich waste dumping by Bangladesh's leather, dyeing and pesticide industries are briefly mentioned (Pg-173).

Contradictory Messages In Fossil Fuel Extraction While Advocating Sustainable Development. The textbook presents a contradictory narrative on energy resources and sustainability. For example, Chapter 15 in the *Investigative Study* textbook discusses in detail about renewable and non-renewables but fails to drive the point home that renewables are our future, that we must decrease reliance on non-renewables and rely more on renewables for a just energy transition for mitigating climate impacts. Renewables are not emphasized as one of the best climate change solutions in this chapter. This omission makes it harder for the chapter to genuinely convey why moving toward a fair and sustainable energy future is so important. Similarly, in **Chapter 16: Natural Resources of Bangladesh**, there is a conflicting portrayal of fossil fuel usage. The text acknowledges the importance of conserving resources by stating:

“The natural resources of Bangladesh are a crucial component for achieving sustainable development of the country... Bangladesh also has various natural resources, but the quantity of many of them is much lower compared to the country's needs. Therefore, we must use these resources calculatedly.” (Pg-188)

But it contradicts itself by presenting further fossil fuel extraction in an optimistic light. For instance, the quote below highlights optimistic potential for resource exploitation:

“According to experts, with proper management of evaluation, it may be possible to achieve full-scale oil production” (pg. 190).

This encouragement for full-scale oil production is inconsistent with the cautionary message uttered in the same chapter. How can sustainable development goals be effectively achieved while continuing to promote reliance on fossil fuels? Therefore, by focusing on fossil fuel reserve without critiquing its environmental impacts or emphasizing the non-negotiable need for Bangladesh to transition away from fossil fuel dependency, the textbook gives confusing mixed messages to young minds.

History and Social Science Textbook. The ‘*History and Social Science*’ textbook for 8th graders was also published for distribution in December 2023 by the NCTB. The textbook is divided into 10 ‘Learning Experiences’ among which the first and the 9th Learning Experiences are the only two that includes some climate change content. Just like the Science textbooks, the HSS textbook also did not include any chapter or section particularly crafted with the objective of climate change education. These Learning Experiences both had some climate change educational content scattered throughout. An analysis of these content from the HSS textbook are as follows:

Climate Science concepts and Assessments. The HSS textbook includes some content that can be help students grasp some elementary concepts relevant to climate change. The first Learning Experience of the HSS textbook, titled ‘**Society through the lens of Science**’, despite not targeting climate change specifically as a Learning Objective, include a fictional newspaper report titled ‘**Climate Change and Bangladesh**’ as an example that teaches students to think about ‘context’ (Page 11). The changes in the climate are mentioned in the news report as-

“Various changes in the regulators of climate are seen worldwide. The average global temperature has increased than in the past. So, ice in the southern pole is melting and the sea level is also increasing” (Pg-11).

In the 9th Learning Experience of the HSS textbook, titled ‘**Let us protect Nature and Human Bonds**’, different types of habitats or biomes across the planet, their geographical and other features including biodiversity are described in detail. However, there is very few mentions of the patterns of changes that happened over the years in those biomes, what are the reasons that caused those changes, consequences of those changes in the flora and fauna, effects of human activities in these biomes and how humans can preserve these biomes to prevent further damage. For example, the text only explains why the Amazon rainforest is important in **climate regulation** of the entire planet but not how it is being disrupted due to human activities:

“An important example of an equatorial evergreen forest is the Amazon rainforest, which plays an important role in oxygen production. This is why it is known as the “Lungs of the Earth”. It is contributing to global atmospheric carbon sequestration and climate regulation. It is also home to numerous species of flora and fauna, many of which are believed to be undiscovered yet” (Pg-141)

In addition, in the section dedicated to describing the marine biome, the text mentions briefly that Earth's oceans can influence different regions' climate patterns and that marine biomes play a vital role in **regulating climate** and maintaining oxygen balance on earth while also being an essential food source for humans. It is explained how such biomes help regulate climate. This section, however, also mentions how human activities like plastic pollution, overfishing and 'climate change' have damaged the majority of the marine biomes, causing extreme biodiversity loss, including extinction of several fish species. This is useful knowledge for students to understand the impact of harmful anthropogenic activities on nature.

*“Marine biomes play an important role in maintaining oxygen balance on Earth, **regulating climate** and as a source of food and resources for mankind. However, recent studies have shown that only 13 percent of the world's oceans are in their natural state of balance, with the rest severely damaged by human-made factors such as plastic pollution, overfishing and climate change. The **biggest risk in this regard is the impact of climate change.**”* (Pg-145-146)

Climate impacts such as sea level rise, temperature rise of the oceans and acidity increase are also mentioned to be affecting the world's oceans, leading to marine biodiversity loss:

“Climate change is having a major impact on the oceans. These include rising ocean temperatures, increasing acidity, and rising sea levels. These changes are harming marine biodiversity. Species distribution and numbers are changing. It can disrupt the normal processes of the environment.” (Pg-149)

This unit also mentions that humans should take national and international initiatives to protect the biodiversity of this biome. The marine biome and its incredible biodiversity however, is also framed as ‘*a source of food and resource*’ for humans, failing to explain how beyond human needs, this biodiversity is also extremely important for the biome itself. Thus, an Anthropocentric framing of the marine biome and its biodiversity can be noted in the text.

In the same Learning Experience, a section titled “***Forest Resources of Bangladesh and its Sustainable Management***”, lists the importance of forests for maintaining ecosystem balance, protecting biodiversity, **mitigating the effects of climate change**, and providing a variety of

products and services. This is where students are also introduced to the definition of what a **carbon sink** is for the first time:

*“Forests play a very important role in the carbon cycle of the atmosphere. Forest vegetation absorbs carbon dioxide through photosynthesis and stores carbon in trees and soil. They act as **carbon sinks**, reduce greenhouse gas concentrations in the atmosphere, and regulate local and regional climates. Forests are of utmost importance **in mitigating climate change**.... A carbon sink is something that can absorb and retain more carbon dioxide than it releases into the atmosphere.*

Forests, oceans and soils act as important carbon sinks for the Earth” (Pg-150).

The objective of the 9th Learning Experience lies in giving students a beginner level understanding of the broader human-environment interactions, but how exactly climate change as a global phenomenon influences these interactions at both local and global level- is not discussed.

Causes of Climate Change. In the 9th Learning Experience ‘**Let us Protect Nature and Human Bonds**’, in the section about ‘Equatorial and tropical rainforests biome’, deforestation to make space for agricultural land is described as the cause behind biodiversity loss and various other environmental risks (Pg-142). Deforestation is indeed a significant anthropogenic driver behind climate change. The textbook also mentions another key anthropogenic driver behind climate change, GHG emissions. In the news box of a fictional newspaper report that talks about ‘Climate Change and Bangladesh’ from the first Learning Experience ‘**Society through the Lens of Science**’, changes in global climate and nature happening due to anthropogenic activities are briefly mentioned. These changes in nature and climate have created various contexts such historical (Kyoto, COP, Paris agreement), political (national and international policies) and cultural or social (people’s lives, culture, urbanization, vehicles, factories) contexts. This is the main goal of the news report- to help students understand ‘context’. The report states:

*“The key cause of global increased temperature is the **carbon emission**. Such carbon is emitted from the black smoke of the mills and factories, and vehicles. The rate of carbon emission is much higher in industrialized nations. The emitted pollutants and chemical elements from those industries play a role in climate change and environment pollution. Although the liability for such act is not much for Bangladesh in this case, environment*

has been polluted here through urbanization and deforestation. Even it is in lesser extent, but it does play a role in climate change” (Pg- 11).

Other than carbon emissions, deforestation as another anthropogenic cause of climate change is also mentioned in the text. In the same Learning Experience, it is stated that Bangladesh is rapidly losing its forest lands. Forest coverage of Bangladesh from the years 1930, 1975, 1985, 1995, 2006 and 2014 are visually presented through several maps. Through probing questions, students are encouraged to do critical thinking and do their own research work in groups by using the internet to find out the reasons for the changes in forest coverage, effects of deforestation on their lives and what steps can be taken to ensure sustainable preservation of forests as a natural resource (Pg-135-136). Students thus get to learn about deforestation trends in Bangladesh, but how these trends have triggered environmental and social impacts in local communities are not explored. Overall, there is no discussion on the specific natural causes of climate change (e.g., volcanic eruption, solar radiation) and very little on the variety of anthropogenic causes responsible for climate change.

Local and Global Impacts of Climate Change. The text mentions both local and global impacts of climate change to some extent, though it does not dive too deep in detailing the impacts. In the first Learning Experience titled ‘***Society through the lens of Science***’, a news report box of a fictional newspaper report that talks about ‘Climate Change and Bangladesh’, impacts of climate change across the world in general and in Bangladesh are mentioned:

“.. many countries are in danger. Maldives is the one among many countries more at risk. Some portion of it has already been submerged into the water. Environmentalists assume that more areas near the sea-shore may go under the water in the next few years. Bangladesh is also among such threat.” (Pg- 11)

In the Learning Experience ‘**Let us Protect Nature and Human Bonds**’, among the other biomes the Tundra biome is also discussed in detail. The paragraph discussing the Tundra biome gives a brief explanation of specific local impacts of climate change by citing how melting Tundra ice raises sea level, posing risks for low-lying coastal plain countries like Bangladesh. It is also mentioned that this sea level rise can lead to land subsidence, increased salinity, disrupted agriculture, reduced food production, and potentially force large populations like Bangladesh to **become climate refugees** if coastal areas flood (Pg-141). This is the first time students learn about

‘**climate refugees**’ in their textbook. There is no further elaboration of how the climate refugee crisis might unfold or how it would affect Bangladesh from a social science perspective.

In addition to the Tundra, the Taiga (Boreal forests) biome is also discussed, with the discussion mainly limited to its geographical features and biodiversity. But it is stated briefly that this biome is under threat due to climate change as well:

“Like the Tundra, the Taiga biome is also facing climate change and human aggression.” (Pg-148)

No further explanation of how the Taiga biome is being disrupted due to climate change and human aggression is included in the text. It is also briefly mentioned that the unique biodiversity of the Sahara Desert is impacted by human activities. To face climate change, humans must take initiative to ensure the biodiversity is not disrupted (Pg-143). There is no explanation of what influences the desert biomes like the Sahara on climate regulation and how exactly human activities disrupt this. How human activities like Deforestation are endangering Grassland biomes, triggering local environmental impacts such as natural disasters like soil erosion and landslides across the world’s grasslands are briefly stated. The section on Grassland biome mentions that these biomes are vital for agriculture, livestock, and biodiversity, but human activities like burning down forests like the Amazon to create farmland are shrinking these areas, endangering the biodiversity (Pg-144).

In a section titled ‘Disasters and Sustainable Development’ in the **Learning Experience: ‘Let us protect nature’** entirely dedicated to discussing the common natural disasters in Bangladesh, the text describes natural disasters like **landslides** as a direct impact of climate change in Bangladesh (Pg 155-157). It is stated that human activities such as deforestation by clearing land and forests to make space for agriculture and roads have led to soil erosion and topsoil damage, thus causing landslides. Disruptive changes in ‘climate regulators’ such as forests through deforestation and global temperature rise are also cited as the main reasons behind the 15% annual increase of **thundering** in Bangladesh. Drastic changes in rainfall pattern due to climate change and damming of upstream transnational rivers are deemed responsible for **droughts** in Northern Bangladeshi districts such as Rangpur, Dinajpur, Bogra etc. In the same section, an illustrative chart depicts different thermal conditions in villages, suburbs and city centers and the concept of ‘**Urban Heat Islands**’ is introduced to students for the first time. Climate change is mentioned as one of the factors responsible behind creating these ‘**Urban Heat Islands**’ (Pg-158). Therefore, through this

section students will be able to understand that the increase in landslides, thundering, droughts and creation of urban heat islands are all linked to climate change.

Climate Justice and Equity. The HSS textbook does very little to emphasize the importance of climate justice and equity from a historical and social science perspective. The text briefly mentions the inclusion of local and indigenous communities whose livelihood and culture are dependent on the conservation attempts for the forests of Bangladesh. In the fictional newspaper report titled ‘**Climate Change and Bangladesh**’ in the first Learning Experience it is mentioned:

“...the tribes and forest dependent communities whose livelihood and culture are related directly to forest land, can be integrated actively with the conservation of forest. In such case, existing policies need to be updated” (Pg- 11).

Besides this, in the “Sustainable Forest Management” section from the 9th Learning Experience ‘**Let Us protect Nature and Human Bond**’, the crucial importance of recognizing the “*rights of local and indigenous communities have over these forest resources*” are noted (Pg-155). But other than these two statements, there is no elaborate discussion on what these rights might look like in the community-based sustainable resource management processes, or in the collective climate action efforts and what ‘updated policies’ might be necessary for it. No case studies, real life examples or stories of the historic struggles, narratives or unique contributions of marginalized local and indigenous communities in Bangladesh or abroad are included in this text.

Explanations of Different Climate Change Solutions, Individual and Collective Climate Actions or Responsibilities. There is no discussion on individual climate actions in the HSS textbook. But in regards to discussing collective responsibilities or collective climate action, in the section titled ‘Playing an Effective Role in the Sustainable Development’ from the Learning Experience ‘**Let Us protect Nature and Human Bond**’, the text reminds students that Bangladesh is going to face a challenging future due to “*climate related disasters*” and encourages ***environmental stewardship*** among students to build **climate resilience** through sustainable management of natural resources and the disasters the country face:

“... And we will succeed in this task through future citizens like you, who will build a safe and prosperous delta resilient to climate change.” (Pg-139)

But what students can do as a collective or individually to build this climate resilience, is not discussed.

In the news report box from the first Learning Experience, the text indicates historic, socio-cultural and political contexts that were created due to climate change, by mentioning the Kyoto Conference, Paris Treaty and COP summits as collective climate action efforts from governments around the world to protect natural resources through conservation and building social partnership.

“Various measures have been taken locally and internationally to deal with this climate change. Some of the notable steps taken regarding this include decisions at International Kyoto conference in 1997, Paris Treaty in 2015 and COP summits. Here, various cooperation and treaties have been signed among nations to deal with the global warming and climate change. In Bangladesh also, there are ongoing effort from the government to protect environment and forests. Significant among these include formulating Climate Act, declaring conserved forests, encouraging social and partnership forestation etc.” (Pg- 11)

Sustainable Development and Disaster Risk Reduction (DRR). In the first Learning Experience the news report box titled ‘Climate change and Bangladesh’, the term ‘sustainable development’ is first mentioned in the context of climate change and the country’s vulnerability but not defined:

“Capacity is the overall ability of a disaster-affected population to respond positively during or after a disaster. Sustainable development is closely related to the capacity of a community. Bangladesh is a country highly vulnerable to natural disasters due to its geographical location, topography, and climate. Being a delta of the Ganga-Brahmaputra-Meghna river system and bordering the Bay of Bengal, Bangladesh faces various natural disasters throughout the year. Natural disasters in Bangladesh include floods, cyclones, downpours, river bursts, thundering, landslides, droughts, etc.” (Pg-11)

The Learning Experience ‘**Let Us protect Nature and Human Bond**’ is where the text properly introduces students to ‘**Sustainable Development**’ as a method to maintain a balanced relationship between men and nature, preserve nature while also meeting our needs from nature (Pg-129). In the section titled “Playing an Effective role in the goal of Sustainable Development”, the term ‘Sustainable Development’ is introduced in the textbook. Students are encouraged to practice

sustainable development in their own communities by forming civic clubs and nature preservation clubs that include locals in the conservation work (Pg-138).

In a bulleted list titled as “**Sustainable use of resources in the area**”, some collective community-based Sustainable Development measures are mentioned (Pg-139-141). Those measures include creating “***social forestry programs***”, sending letters requesting local authorities or municipality to make the local ponds or canals usable again and separately collect biodegradable and non-biodegradable waste for better waste management. Raising awareness in local community to keep drain systems clean and taking initiatives to sustainably manage natural resources such as electricity, gas, water inside own homes and beyond.

But more details regarding what ***social forestry programs*** actually might look like in reality, are not discussed. How to plan, budget and run fundraising campaigns necessary to execute these ***social forestry programs*** for school students is also not mentioned in the text, with no templates, examples or a real-life case. It can also be noted that some of the steps in this list do not seem realistic considering Bangladesh’s socio-economic context. For example, the measure to request the local authorities to separately collect biodegradable and non-biodegradable waste as “*a part of waste management*” does not make sense since majority of the country’s household waste end up in landfills. Very little household waste are recycled in Bangladesh, due to inadequate recycling facilities, inadequate infrastructure and other socio-political factors (Islam M. S., 2013). Therefore, most of these measures may seem like good steps but without real-life examples discussing the processes, it becomes theoretical and hard to visualize for an 8th grader.

In a section titled ‘***Obstacles to sustainable management of marine resources***’, a list of four obstacles is described, climate change being the third. Other obstacles are overfishing, habitat destruction and pollution, and ocean management:

“Climate change is having a major impact on the oceans. These include rising ocean temperatures, increasing acidity, and rising sea levels. These changes are harming marine biodiversity. Species distribution and numbers are changing. It can disrupt the normal processes of the environment. Mitigating the effects of climate change requires taking and implementing measures to reduce greenhouse gas emissions and protect the balance of marine ecosystems.” (Pg-149)

Sustainable forest management is presented as a part of ‘sustainable development’. Sustainable forest management ensures responsible use of resources, balancing ecosystems and biodiversity. Bangladesh's Future Plan (2021-2041) and Eighth Five-Year Plan (2021-2025) focus on restoring forests, conserving wildlife, promoting alternative fuels, improving land use, and creating jobs for forest-dependent communities, with public awareness and engagement as priorities (Pg-154-155).

In a section titled “*Natural Disasters and our plans*” from the Learning Experience ‘**Let us protect Nature and human bond**’, students are assigned a project-based group work where they create a mock newspaper report by writing down the findings of their research on what natural disasters happen in their area, the problems those disasters cause and what “sustainable management” can be done to prevent the problems (Pg-137-138).

The unit describes six types of natural disasters commonly faced by Bangladesh. Also briefly mentions a few other disasters- most of which are actually caused by climate change but doesn’t describe these as such- also faced in Bangladesh. Seven Disaster Risk Reduction (DRR) activities are listed in this unit (Pg-158-159). Bangladesh's DRR efforts emphasize preparedness, early warnings, and coordinated response to natural disasters. Key activities include establishing early warning systems, enhancing disaster response through search and rescue operations, fostering public awareness, building sustainable infrastructure, and protecting natural ecosystems. Community-based disaster management further empowers local populations, improving resilience and effective recovery in disaster-prone areas).

“Sustainable development ensures environmental management, land use planning, protection of essential needs and services, inter-communication and cooperation and financial capacity to reduce disaster risk. Ensuring the availability of these items enables disaster anticipation, preparedness, disaster response and post-disaster recovery.” (Pg-159)

The content in this unit thus falls under the Disaster Risk Reduction theme and this theme has been considered a key component of climate change education (CCE). In their article, (Kagawa & Selby, 2012) argue that the synergy between DRR and climate change education can help students recognize the relationship between climate change and disasters. Climate change exacerbates many natural disasters such as floods, hurricanes, landslides, droughts etc., making them more frequent and severe. By incorporating DRR elements in climate change educational content,

students might be able to better understand how the environment around them is changing and how it affects disaster risks, especially if they are from climate-vulnerable countries such as Bangladesh. For example, Malawi enriches its curriculum with DRR themes and its curriculum emphasizes the importance of student-led civic engagement in climate resiliency and DRR.

Summarizing the Gaps and Strengths of the History and Social Science Textbook.

- The HSS text overall contained more climate change content compared to the Science textbooks. There were no specific core competencies or learning objectives that targeted competencies relevant to climate change education for the students. There were content relevant to climate change scattered throughout the textbook, with very few assessments designed for evaluating students' knowledge and understanding of climate change. Neither the Science or the HSS textbooks included real-life case studies or narrative-based stories that helped students comprehend climate change at a deeper, personal level. Emotions and feelings regarding the climate crisis were excluded in the HSS textbook. Overall, students would be able to get a rudimentary level understanding about climate change only from this textbook.
- An Anthropocentric framing of different biomes and their biodiversity can be noted in the HSS text, pushing the reductive narrative that the flora and fauna were 'resources' essential for human survival. This framing does not invoke meaningful connection to nature and will make students unable to comprehend how nature exists and should be preserved for more than just human needs.
- There is no discussion on the specific natural causes of climate change (e.g., volcanic eruption, solar radiation) in any of the textbooks. Only carbon emissions and deforestation are mentioned in the HSS text as anthropogenic causes responsible for climate change, not mentioning the other various causes.
- Students will not be able to empathize with the struggles of marginalized local and indigenous communities in Bangladesh and across the world unless they are exposed to the lived experiences of them, historical and socio-cultural contexts that shape the reality these communities face from these textbooks. The HSS textbook should be a comprehensive resource that reflects the diverse narratives, struggles, and meaningful contributions of these marginalized groups, integrating their perspectives into the broader national or global

history. But the textbook falls severely lacking in this significant matter by excluding these narratives, thus depriving students from getting a well-rounded understanding of climate justice and equity.

- What students can do as a collective or individually to build climate resilience, is not discussed properly in the HSS textbook. There was opportunity to expand on the concept of environmental stewardship but it is not utilized by giving students a guideline on what actionable steps they can take, such as individual or community-based initiatives, sustainable practices, reducing carbon footprints, or engaging in local conservation efforts to adapt to or mitigate climate impacts. Providing practical examples of how students can contribute to achieving climate resilience could have empowered them to actively participate in climate action.
- The HSS text presents a list of community-based sustainable development measures, such as creating social forestry programs, improving local water bodies, and promoting better waste management practices. However, it lacks specific details on how these measures would be implemented in reality, such as what social forestry programs would look like or how to fund them. Additionally, some suggested actions, like requesting local authorities to separate waste, seem unrealistic in Bangladesh's socio-economic context, where inadequate recycling infrastructure and socio-political factors hinder effective waste management.
- The HSS textbook overall manages to equip students with the basic but important knowledge that **climate regulators** such as the marine biome, evergreen forest ecosystems, the Tundra and grasslands help maintain Earth's climate stability and natural ecological balance. Students will also walk away with the knowledge that certain anthropogenic activities are disrupting this stability. This is a curricular success and a strength of the HSS text.

4.7.2 Pedagogical Instructions for Teaching Climate Change in the Teachers Guides

The History and Social Science (HSS) Teachers' Guide

Instructions or Guidelines for Teaching Climate Change from a HSS Perspective. The first Learning Experience in the HSS textbook, titled as “Society through the Lens of Science”,

aims to develop the core competency of ‘*investigating how various elements of nature and society create historical, social, cultural, and political contexts from a scientific perspective*’ among students. This Learning Experience includes a small section with a news box of a fictional newspaper report that talks about ‘*Climate Change and Bangladesh*’ (Pg-11). To teach it, HSS teachers are instructed to engage 8th graders in analyzing the news report on climate change through a multifaceted approach. First, they are to guide students to thoroughly read the newspaper report and then facilitate a discussion to analyze an accompanying chart that highlights the historical, social, cultural, and political contexts of climate change. These include significant global events like the Kyoto Protocol, Paris Agreement, and COP Conferences, as well as social factors such as urbanization, transportation, industrial emissions, and deforestation. Teachers are also told to emphasize the role of indigenous and forest-dependent communities in forest conservation and climate change mitigation. Finally, they are to explore the political and ethical dimensions of climate change, including its impact on national policies and international cooperation.

The instructions are succinct and set the expectation well. However, teachers would need to add information from the internet to implement it and facilitate interactive analytical discussions for students, neither of which are feasible considering the 25-30 minutes time span of an average HSS lesson. Teachers would also need to teach the lesson in a student-centered method, which is not feasible yet since many Bangladeshi secondary teachers lack the necessary pedagogical content knowledge to implement such student-centered approaches effectively (Zinnah, 2010).

The 9th Learning Experience in the HSS textbook, titled as “**Let us protect nature and human bonds**”, aims to build the core competency of ‘inspiring communities to actively pursue *sustainable development* by understanding the interconnectedness of environmental and societal dynamics at both local and global levels’ (Pages 50-53). To achieve this, teachers are instructed to guide their students in exploring the relationships between natural and social changes within their local ecosystems and broader global contexts. Students will be encouraged to observe and analyze how human activities impact the environment, such as deforestation, biodiversity loss, and climate-related challenges, fostering a deeper understanding of these issues. Teachers are also instructed to help students develop observational and analytical skills by guiding them in ecosystem observations, data collection, and analysis through maps, charts, and graphs. Additionally, teachers will promote awareness and responsibility by facilitating discussions on the consequences of

environmental changes and encouraging students to reflect on their own roles in preserving natural ecosystems. To translate learning into action, students will be supported in designing and implementing *community-based sustainable development projects*, such as waste management, social forestry, and conservation activities, while also engaging with their families and communities. Furthermore, teachers will foster creativity and collaboration by encouraging students to present their findings and ideas through posters, reports, drama, or PowerPoint presentations, and by promoting participation in clubs like the Wildlife Conservation Club. Through these activities, students will gain the knowledge, skills, and attitudes needed to contribute meaningfully to sustainable development efforts.

To implement these instructions, teachers would need access to a range of resources and adequate training for helping students develop observational, analytical and project management skills.

Assessment Design. For the 1st Learning Experience, the HSS TG emphasizes formative evaluation through group discussions and chart analysis of climate change contexts. Students are assessed on their ability to connect events like the Paris Agreement to social factors such as urbanization and deforestation. This approach fosters critical thinking, collaboration, and understanding of climate-related issues. For the 9th Learning Experience, the TG recommends formative and project-based assessments. HSS Teachers are to evaluate students' understanding and application of sustainability concepts through projects like ecosystem observations, global biome research, and community-based initiatives. Deliverables such as reports, posters, and drama or group presentations are assessed using rubrics that emphasize teamwork, creativity, critical thinking, and communication skills.

The Science Teachers' Guide

Instructions or Guidelines for Science Teachers to Teach Climate Change from a Science Perspective. One of the ten core competencies for Science subject for 8th grade is: *“Students will be able to act responsibly towards the environment by appreciating the role of humans as part of nature in maintaining the natural balance” (Page 9).* The Science TG integrates instructions for climate change education very limitedly in the Learning Experience **“Environmental Protection”** (Pages 88–95). This Learning Experience focuses on teaching students about renewable and non-renewable resources, emphasizing the importance of sustainable resource use and its impact on ecological balance and climate change. It explores the consequences

of human activities, such as deforestation, industrialization, and overexploitation of resources, and highlights waste management principles, including recycling, composting, and reducing waste generation. The competencies developed through this chapter include understanding the ecological balance and interdependence of natural systems, applying scientific inquiry skills to evaluate resource use, and promoting awareness of human impacts on the environment to foster responsible behavior. Teaching methods employ inquiry-based and experiential learning approaches, guiding students to observe, record, and analyze their own consumption and waste generation. Activities culminate in designing practical solutions for sustainable resource management.

Assessment Design. The Science TG emphasizes assessments centered on evaluating students' participation in group activities, written reflections, and outputs like *waste management models* and community presentations. By aligning practical activities with theoretical concepts, this section bridges climate change education with real-world applications.

4.8 Summary

Overall, both Teacher's Guides showcase some limitations that will hamper effective climate change education. Both Teachers Guides lack explicit integration of foundational climate science concepts, such as greenhouse gas emissions, global warming, and the carbon cycle, which are essential for a deeper understanding of climate change. They also do not provide sufficient guidance on linking local environmental issues to global climate challenges, nor do they incorporate actionable, community-level climate solutions like renewable energy adoption or climate-resilient agriculture. Additionally, the TGs omit detailed teacher training resources, leaving educators underprepared to handle the interdisciplinary nature of climate education. Including digital tools, simulations, and real-world climate data could further enhance their effectiveness. Therefore, 8th grade textbooks and TGs for Science and HSS provide a fragmented and incomplete foundation for climate education for 8th grader students in Bangladesh.

Chapter 5

Discussion and Conclusion

5.1 Overview

The purpose of this chapter is to discuss the findings of the three research questions this study is guided by. This chapter includes a thorough discussion on the 8th grader students' perceptions towards climate change, the National Curriculum Framework-2021 and its address of climate change, supported by relevant literature. How the secondary teachers' incorporate climate change into their regular lessons is also discussed. Finally, I give some concluding remarks and make some recommendations based upon the findings.

5.2 Discussion

The findings of the study were interpreted to find the answers to the three research questions. The insights obtained through the findings of this study are discussed and presented under three broad themes.

5.2.1 How Bangladeshi secondary students perceive climate change

The first research question sought to understand how Bangladeshi secondary students perceive climate change. Students' perceptions towards climate change are organized into three categories and discussed below:

Students' Cognitive Perceptions towards Climate Change. Students' cognitive perceptions toward climate change include what students perceived 'climate change' to be and which resources influenced these perceptions, their awareness about environmental changes around them, their understanding of the causes of climate change and their awareness about local and global climate impacts. When asked about what comes to their minds when thinking of the words 'climate change', students participating in this study shared a range of thoughts such as: "*weird weather*" patterns over the years, ozone layer damage, lack of trees and green spaces, and environmental pollution. Some students mentioned that when they hear the words 'climate change', they immediately think about the health impacts that climate change imposes on people,

such as people falling sick more frequently due to cold or fever, people dying from floods or getting heat strokes due to the rising temperatures. By using the term “*weird weather*” patterns, some students indicated it to the high humidity of Dhaka, while one student explained it as the Earth’s damaged ozone layer letting in UV rays, warming up the planet faster, thus making the weather acting strange or weird. Most students thought that the weather now does not feel like what it “*used to*” in their childhood and that the seasons have all gotten warmer over the years. Some students expressed feeling as though the six seasons of Bangladesh have merged into just two: Summer and Winter, with winters becoming less cold than before. All twelve of the students interviewed from School A and School B, regardless of gender, were highly aware of temperature differences in their local community in Dhaka and in rural home districts outside Dhaka. Whereas the weather used to feel much more “tolerable” and cooler in their villages compared to Dhaka city, now it feels warmer in the villages as well, leaving little differences between Dhaka and the rural areas across the country. Some students compared the rural communities of their ancestral villages with the urban communities where they currently live in, noticing a similar pattern of rapid, unplanned development characterized by cutting down local trees to create space for houses in both communities.

These data mainly demonstrate that some students thus perceived the changes in the local weather patterns over a *short-term* period, such as less cold winters and seasons getting warmer, as ‘climate change’. While a change in this local weather patterns is in alignment with the global trend of rising temperatures due to climate change, according to the World Meteorological Organization (WMO) climate is the *long-term* average weather pattern over a period of **at least 30 years**. To determine an actual change in climate, scientists analyze long-term regional or global statistical trends on average temperature, humidity, rainfall and other variables over several decades or even centuries (IPCC, 2007). Climate and weather are two related but distinct concepts, their key difference lies in the timescales at which happen. In contrast to the short time frame of weather changes, Earth’s climate is assessed over much longer periods of time, ranging from months to thousands or millions of years (WMO, n.d.). The students’ perceptions are therefore more indicative of a change in local *weather* patterns rather than a definitive change in climate. Thus, the findings of this study demonstrate that the 8th grader students were confused about the differences between weather and climate. This finding of teenage students’ confusion between weather and climate had also been found by multiple researchers spanning several decades in

different countries (Gowda et al., 1997; Pruneau et al., 2003; Henriques, 2010; Choi et al., 2010; Dawson, 2015; Cartwright et al., 2021).

Students could be broadly divided into the following three schools of thought regarding why they perceived climate change occurs or what causes climate change to happen: majority of the student participants thought that climate change happened due to human activities or anthropogenic factors only. Important to note here that most of the student participants from School A were also of this opinion. Students attending School A lived in close proximity to a highly polluting tanning factory within their community. This indicates that if students lived near a highly polluting industrial factory, they were more likely to blame anthropogenic activities for climate change although none of them specifically pointed to the environmental pollution caused by such factories as a key anthropogenic cause. In addition, majority of both male and female students of both schools thought climate change happened due to human activities only and that humans were solely responsible for it. Study done on Indonesian secondary school students also found that most students perceived climate change to be caused solely by human activities (Kundariati et al., 2024).

These students pointed to a range of human activities such as- cutting down trees or deforestation, polluting the environment by dumping plastic and other non-recyclable waste into water bodies, littering, polluting the air and water through tanning factories (students at school A lived near a tanning factory) as responsible for causing it. None of the students who held this opinion specifically mentioned key anthropogenic causes such as GHG emissions due to fossil fuel extraction, agriculture, transportation etc. Temperature increase due to climate change was mostly associated with one major anthropogenic activity: deforestation and land clearing for development purposes. Students did not name any other greenhouse gas other than carbon dioxide. In contrast, only two students out of the twelve were of the opinion that climate change happened because of both anthropogenic activities and natural processes. This opinion is the only scientifically accurate one among all three opinions. The students who held this opinion mentioned the same anthropogenic activities such as multifaceted environmental pollution through inadequate waste disposal and cutting down trees or deforestation for developing properties. They were knowledgeable of these few anthropogenic activities, but they did not know of the natural processes that are also responsible for climate change such as volcanic eruptions, solar variability, orbital variations. These two students were not able to correctly identify these natural causes

behind climate change. Moreover, there was a small minority of students who constituted the third of school of thought that climate change happened due to natural processes only. Students who held this opinion could not correctly name the natural processes such as volcanic eruptions, solar variability, orbital variations leading to natural climate change. They perceived climate change as similar to a natural disaster and that cyclones and floods were the natural processes that caused climate change.

Regarding climate impacts, all students agreed with the statement ‘*climate change is a threat to humanity*’ and that climate change will have global as well as local impacts. Most students mentioned increasing natural disasters such as floods, heatwaves, droughts and cyclones as the main local climate impacts affecting Bangladesh. More diseases and illnesses triggered by climate change such as rise of mosquito-borne diseases like dengue and malaria, more frequent heat waves in urban communities leading to widespread heat strokes, fevers, allergies and colds were mentioned by some students. Other long-term climate impacts such as financial strain on marginalized low-income families were mentioned by only one student. Students were generally knowledgeable about common climate impacts affecting Bangladesh but lacked sufficient knowledge on the global climate impacts happening in different regions of the world. Students pointed to lack of enough information on global climate impacts in their new curriculum textbooks and teachers not discussing it in class as key reasons behind this insufficient understanding. Thus, majority of the participating students demonstrated more understanding of the local impacts of climate change that directly affect their environment and human health. But students lacked understanding of the numerous long-term economic, geopolitical and social impacts that climate change can have, both in Bangladesh and beyond. This study’s finding of secondary students’ inadequate understanding and conceptual confusions about climate change and its impacts are supported by other researchers (Unal, 2023; Sánchez-Almodóvar et al., 2022).

This study found that students' perceptions of climate change and its impacts stemmed from a limited range of resources: most commonly from school textbooks and teachers (though insufficient discussion about climate change took place in their classes), social media (Facebook, YouTube and Instagram reels), the mainstream news and books outside the curriculum (also known as ‘outside books’ by students). Only one student shared reading about climate change from some ‘outside books’. It was evident that most of these students did not have access to or sought

out books to increase their understanding on climate change or environmental topics. I conducted a perusal of the school libraries in both School A and B and found no books on climate change in there. This study's finding regarding students getting most of their information on climate change from formal education sources is consistent with the UNICEF report which found 85% of young people in Bangladesh learn about climate change in school, the highest percentage among South Asian countries (UNICEF, 2021).

The findings also suggest that female students were more aware about their classmates' lack of interest towards climate change issues compared to their male counterparts. Male students usually learned about climate change from school and news media as main sources. They generally did not conduct any personal research (online or offline) to further learn about it, dig deep or talk to their peers about it. Another pattern observed was that while most students had at least one parent who owned a smartphone with internet access, some students did not have this and were consequently not on social media. These students, lacking access to smartphones and the internet, relied solely on textbooks and teachers for climate change information. These students had the least exposure to information on climate change. Students were mostly enthusiastic to learn about climate change in details and they wanted to learn through more interesting interactive and hands-on learning activities such as group projects, debates, field trips or workshops etc. These activities were to some extent already mentioned in the Teacher Guidelines but the teachers did not implement them.

This study finds that most of the students felt dissatisfied with how climate change was presented in their 8th grade textbooks and how it was being taught by their teachers. Students also noted that textbooks often provide more comprehensive information than what is actually taught, and teachers frequently overlook climate change-related content within their lessons. Students also reported that Science and HSS teachers rarely provided opportunities for students to talk about climate change in class, confirming the data this study gathered through class observations that the classes were largely teacher-centric and textbook-dependent, a practice that contradicts the National Curriculum Framework-2021, which advocates for interactive, learner-centered experiential teaching. Additionally, several students questioned the sincerity of school-wide initiatives like World Environment Day, perceiving these initiatives as superficial and lacking substantive educational value. This study also finds that students sometimes compensate for what

they do not get to learn from school, through consuming social media content such as YouTube videos and Instagram or Facebook reels. Majority of the female students shared they only occasionally looked up basic information regarding climate change on social media when they wanted to learn about it, but their research was not done to specifically consume content on climate change to improve their overall understanding. This finding is similar to that of a study done by Rey et al. (2024) conducted on Spanish secondary school students, revealing them consuming very little climate change content on social media.

Students' Emotional Perceptions towards Climate Change. Students' emotional perceptions towards climate change include their emotional responses towards the phenomenon of 'climate change' and its multifaceted impacts, how they perceived threats from such climate impacts to their own lives, families and communities, their thoughts and reactions to how climate change was being taught at their schools under the National Curriculum Framework-2021 and its effectiveness or lack thereof. Students reported feeling a wide range of emotions, mostly negative, when they thought about climate change and how it affects or might affect their families, communities and country. Their emotional responses to climate change were varied, ranging from feeling helpless, angry, ashamed, guilty, sad, anxiety, afraid, annoyed to frustrated. Although students were not able to correctly identify what caused or might cause these climate impacts, most of them still perceived humans to be responsible for it all. Despite Bangladesh being a climate-vulnerable country emitting less than of 0.3-0.4% of global greenhouse gas emissions, students felt like people of Bangladesh are to be held accountable for their actions or lack of actions towards protecting the country's environment (Global Carbon Project, 2021). Several students said they felt sad and ashamed due to humanity's collective responsibility for causing climate change, acknowledging that the consequences humans will suffer from due to climate change were merely a result of our own actions. Some students also experienced anger and shame when they thought about the environmental situation in Bangladesh, particularly due to adults not taking climate change seriously and the country's continued environmental destruction. A few students drew comparisons between how Bangladeshis and "foreigners" acted towards the environment during the FGD and said they felt frustrated by the local inaction, especially plastic usage in contrast. They also felt sad about the environmental damage caused by rapid urbanization and deforestation. Some students felt anger and frustration over the double-standards of local community-elected political leaders who engage in symbolic environmental actions, like planting trees in school

campus during ‘World Environment Day’ events but continue to take no realistic actions that stop harmful practices damaging the local environment. Students also felt guilt and shame for their own contribution to environmental pollution, acknowledging that they sometimes discard plastic bottles thoughtlessly and recognizing that everyone shares responsibility for the negative impacts of climate change. Additionally, most students took note of the lack of trees and poor waste management in their communities, expressing sadness, anxiety, anger and frustration over the careless environmental behavior of the people in their communities. These findings on students’ negative emotions towards climate change are supported by Hickman et al. (2021), which found that 59% of children and young people from ten countries around the world were very or extremely worried about climate change. Other researchers have also found secondary students’ feelings of worry, fear, and frustration about climate change, often linked to concerns about their future and the perceived ineffectiveness of youth action (Rushton et al., 2023; Jones & Lucas, 2023; Elizabeth et al., 2023; Ojala, 2012).

Among the twelve students interviewed, everyone perceived climate change-imposed various threats to their *personal* lives. Some students shared feelings of anxiety over various climate impacts including increasing floods, heat waves, health risks, and environmental changes. Some students felt anxious when they heard about the natural disasters from the news, referencing the devastating flood that took place in Sylhet in June, 2024 as a common example of a recent climate impact event. The majority of students in the study felt that compared to villages or coastal areas, living in Dhaka’s urban communities shielded them from the worst of climate impacts such as cyclones and floods. A few students reflected on how some of their family members living in remote villages struggled during recent floods, with water entering their home and leaving them without clean water or the ability to cook for days. Some students held the misconception that the ‘melting of ice’ and ‘humans destroying nature’ via deforestation as a driver behind these floods that affected thousands of Bangladeshis in 2024. However, the Sylhet flood occurred due to heavy rainfall within a short period of time and the release of the upstream Surma-Kushiara river water by Indian authorities, exacerbating the already high water levels in the region and causing severe inundation in low-lying areas (Bangladesh Red Crescent Society, 2024). Hence this particular flood was neither due to ‘melting of ice’ and deforestation nor connected to climate change directly, but some students mistakenly assumed it to be such. Though the floods that took place in

2024 did not affect the students' communities, they still recognized these events as a future threat due to climate change.

Health issues were another significant threat students perceived as climate change impact. Students shared how rising temperatures, heightened humidity and polluted air in Dhaka had already begun to affect their personal well-being. A female student who wears the Hijab described how the uncomfortable combination of rising temperatures, polluted air and humidity often forced her to loosen or remove her Hijab for ease. Several students of both genders noted the increased prevalence of dengue, fevers, colds, allergies and heat strokes in their communities. There was a general feeling of distress and anxiety among several students that they might fall ill to these diseases and illnesses. Additionally, several students reflected on personal experiences where climate-related events had led to health emergencies in their families, further underscoring the vulnerability of rural communities to climate change.

Students consistently highlighted how climate change exacerbates diseases and illnesses of different types, such as cancers, heat strokes, colds and fevers, allergies, breathing problems and dengue. These findings are also supported by studies done on Malaysian and Indonesian secondary school students who held similar perceptions on the health issues caused by climate change impacts (Abd Hamid, Yahaya & Rahim, 2021; Deshiana et al., 2022; Puspita et al., 2020). Gautam et al. (2021) also found similar awareness about health impacts of climate change as recognized by Nepalese secondary students.

When asked how cancers and dengue might be an impact of climate change, students mentioned possible factors such as polluting the environment by dumping waste in water bodies, consuming vegetables and fish grown using the polluted water and creating the environment for the dengue mosquitoes to lay eggs by not cleaning the local ponds and canals. Students accurately perceived cancers and dengue fevers as being climate impacts on health. Researchers found rising global temperatures and altered precipitation patterns have expanded the habitats of *Aedes* mosquitoes (Xu & Wang, 2024; Trejo et al., 2023). The American Cancer Society found that changes in climate can lead to increased UV radiation exposure, thereby elevating skin cancer risks (Nogueira et al., 2020). But students were confused on the exact ways these health impacts of environmental pollution were connected to climate change. In reality, rising mosquito-borne illnesses due to climate change is a real threat to tropical regions (World Bank, 2021)

Students' Applied perceptions towards Climate Change. This study found that climate change was not a frequent topic of thought for most of the 8th grader students. Most students thought about climate change only occasionally, a few times a year, mainly when personally experiencing heatwaves or when exposed to news coverage about severe weather events like floods or cyclones. Additionally, female students, in general, seemed to think about climate change more often than male students. There is little research available specifically on Bangladeshi secondary school students' frequency of thoughts about climate change. However, the finding is in contrast to the UNDP's People's Climate Vote's, the largest global public opinion survey on climate change which found that 55% of children under the age of 18 around the world thought about climate change regularly, as in on a weekly or daily basis (UNDP, 2024).

While a few students, predominantly females, took individual actions like planting trees and reducing plastic use, most students did not engage in significant personal efforts to fight climate change. Those who did plant trees, typically did so on the premises of their own residences and not outside in their community. Students expressed uncertainty about what individual actions they could take, highlighting a need for greater awareness and education about personal responsibility in addressing climate change. Regarding collective action, students proposed local environmental initiatives like tree planting, waste management, recycling and awareness raising campaigns, but some of them were doubtful about the feasibility and sustainability of these initiatives. Students identified several barriers hindering their personal and collective climate actions. These included a lack of knowledge about effective things they could do to fight climate change, concerns about not being taken seriously due to their age, having access to limited resources, and a broader lack of awareness about climate change in their communities. They also worried about securing community support and ensuring the long-term impact of these collective actions. These factors collectively discouraged students from taking more proactive steps to address climate change, despite feeling worried and anxious about climate change. This finding aligns with a 2021 study conducted among Malaysian secondary school students, which found that despite over 50% of the respondents were aware of climate change through school education, this awareness had not translated into proactive actions against climate change (Abd Hamid, Yahaya, & Rahim, (2021)). Two different studies done on Indonesian high school students also found that despite being aware of climate change, most students have not yet taken any action to tackle climate change (Deshiana et al., 2022; Kundariati et al., 2024).

Overall, findings suggest that students had limited creative ideas for individual and collective, peer-led or community-based initiatives they could take to mitigate climate change impacts in their community. This seems to have stemmed from the insufficient climate change education they receive from their schools.

5.2.2 Students' Misconceptions about Climate Change

This study revealed that the 8th grader students held several misconceptions about climate change. The following table outlines the misconceptions participant students had:

Table 6 Climate change misconceptions students held

	Categories	Students' Misconceptions
1	Individual or collective actions that are harmful for the environment but do not directly cause climate change	Climate change happened due to people's - Littering of plastic and other trash - Smoking cigarettes
2	CO ₂ as the only greenhouse gas	- Students were not able to identify other greenhouse gases except carbon dioxide
3	Environmental pollution causing climate change	Climate change being caused by - Air pollution or pollutants in general - Water pollution - Soil pollution
4	Damage or depletion of the Ozone layer causing climate change	- Damage in the ozone layer is letting in lots of UV rays (no explanation of how that ozone damage was caused other than that human did it) - UV rays are solely responsible for warming up the planet faster, thus making the weather acting strange or weird
5	Proposing general environmental actions as climate action	- Stopping littering

	- Stopping all kinds of environmental pollution - Proper waste management - Keeping streets clean
6	Skepticism towards feasibility of collective community-based climate action - People in the community will not take students' efforts seriously due to their age - People in the community might resort back to their old ways by polluting the environment or cut down the trees students will plant
7	Climate change akin to a natural disaster - Climate change is a natural disaster - Cyclones and floods were the natural processes that caused climate change
8	People will die because of rising Co₂ levels - Rising carbon dioxide levels would decrease atmospheric oxygen to dangerous levels, making the air unbreathable and causing people to die
9	Weather vs Climate - Confusing short-term weather effects with long-term climate change impacts
10	Climate change as a solely human-induced phenomenon - climate change happened due to human activities only (insufficient understanding of natural causes of climate change such as volcanic eruptions, solar radiations etc.)

The 1st misconception among students regarding climate change happening due to actions that are harmful for the environment such as littering was also confirmed by other researchers (Boyes & Stanistreet, 1997; Gowda et al., 1997). The 2nd misconception was also commonly found among

teenage students in Spain and Singapore (Punter et al., 2011; Chang & Pascua, 2015). The 3rd misconception was broadly found among majority of the participants in this study, a finding that was also found among students across several countries (Boyes, et al., 2008; Punter, et al., 2011; Shepardson, et al., 2009; Liarakou, et al., 2011; Yazdanparast et al., 2013). While air pollution and climate change are interconnected, they are distinct issues; air pollution results from harmful emissions, while climate change is driven by greenhouse gases and long-term shifts in weather patterns due to greenhouse gas emissions. While climate change can exacerbate pollution (e.g., through higher temperatures increasing ground-level ozone), air pollution is *not* a direct impact of climate change (IPCC, 2021). The 4th misconception that Earth's damaged ozone layer letting in UV rays was warming up the planet faster and directly causing climate change and UV rays being the sole factor behind global warming among secondary school students was also found by other researchers (Chang & Pascua, 2015; Çimer, et al., 2011; Dawson & Carson, 2013). Misconceptions in the 5th category were also found by Boyes and Stanistreet (1997). The 6th one regarding students' skepticism towards collective climate action was also previously observed by (Rye et al., 1997; Pruneau et al., 2003)

Regarding the 7th and 9th misconceptions, students' confusion of associating climate change to natural disasters and not being able to distinguish weather with climate have also been observed before (Gowda et al., 1997; Pruneau et al., 2003; Henriques, 2010; Choi et al., 2010; Chang & Pascua, 2015; Dawson, 2015; Cartwright et al., 2021). Notably, the 8th misconception that rising carbon dioxide levels would decrease atmospheric oxygen to dangerous levels, making the air unbreathable, could be traced back to a local politician's speech during a school program. Some students from School A recalled hearing the claims about decreasing oxygen levels and climate-related air pollution in the politician's address, which had not been verified by teachers. Such misunderstandings reflect wide gaps in climate education and highlight the risk of misinformation being spread by non-educators. The 10th misconception of climate change happening due to human activities only is also a common misconception (Bodzin et al., 2014; Çimer, et al., 2011; Chang & Pascua, 2015; Kundariati et al., 2024). Considering the insufficient discussions about climate change at school, students compensated for it by looking up information about it on social media, without the digital literacy needed to filter out misinformation, this can also be dangerous to students by instilling further misconceptions.

The data suggests that while students demonstrated a general awareness about climate change and its local impacts, their understanding is often incomplete due to these misconceptions. While these misconceptions are not uncommon among youth, these findings emphasize the need for more accurate and updated climate change education in schools.

5.2.3 Climate Change Education in the National Curriculum Framework 2021 and NCTB textbooks

The second research question focused on how the National Curriculum Framework- 2021 addresses climate change education. The analysis revealed that while the framework recognizes climate change as a critical issue that 21st century Bangladeshi students would face, it falls short in its integration across subjects and lacks clear, measurable learning outcomes related to climate change. The framework introduces an "**Environment and Climate**" learning area, but it does not fully embed climate change into broader curricular themes. One of the major gaps identified in the curriculum framework is the lack of an interdisciplinary approach to climate change education. For 8th grade students, limited amount of climate change content relevant to the learning area were scattered across two subjects only: Science and 'History and Social Science'. The framework emphasizes critical thinking and competency-based learning but the exclusion of climate change content from other subjects means students may not fully grasp the interconnectedness of environmental, economic, and social systems in addressing climate issues. The limited inclusion of climate change content can hinder students' ability to develop a holistic understanding of the climate crisis. Moreover, the absence of specific climate change assessments means that teachers may not have the tools to evaluate students' understanding or track their progress in becoming climate-literate citizens.

For example, content analysis of the two 8th grade Science textbooks revealed that climate change content in the "Science: Investigative Study" textbook introduces several relevant concepts relevant to climate change, including the role of human activities in environmental pollution, the importance of forests as carbon sinks, and the local and global impacts of climate change. However, the textbook falls short in several areas. It lacks detailed discussions on other foundational climate science concepts. The History and Social Science textbook, on the other hand, lacked discussions of climate justice and the disproportionate impacts on vulnerable communities, and it does not emphasize enough on the importance of renewable energy solutions to mitigate

climate change. The textbooks promote general environmental actions such as tree planting, waste management and recycling, though did not label them as climate actions. The textbooks also did not include stories or real-life examples of young people taking sustainable initiatives to take climate action. These gaps reflect a broader trend in educational resources of several countries that fail to connect the science of climate change to real-world, actionable solutions (Swim et al., 2009).

5.2.4 How secondary school teachers incorporate Climate Change into their regular lessons

The third research question explored how teachers incorporate climate change into their regular lessons.

Teachers' views on climate change education, its relevance to the school community and climate impacts affecting the school community. Despite the scientific evidence on Dhaka's vulnerability to climate change, participant teachers of this study were of the opinion that their urban low-income school communities in Dhaka faced and might face very few climate impacts. Most of the participating teachers were able to identify '**heatwaves**' as the most significant climate impact affecting their students' health and class attendance in their school communities. Cyclones, floods or increasing risks for floods were not considered significant climate impacts on the school communities by the teachers, adding that they felt "**sheltered**" from these due to their urban locations. Waterlogging due to floods during the monsoon seasons was viewed by some of the teachers as a chronic local issue borne out of infrastructural inequity rather than a climate-related threat. However, the reality is that Dhaka is far from being immune or sheltered from climate impacts. According to a national Climate Vulnerability Assessment report published by the Ministry of Environment, Forest and Climate Change of Bangladesh, this megacity faces a risky combination of climate impacts such as flooding, heat waves, diseases, storm surges, and intensifying cyclones (MoEFCC, 2023). Although there is no city-level data available for Dhaka's climate risk projection yet; by analyzing the National Adaptation Plan for Bangladesh (2023-2050) and the Bangladesh Delta Plan for 2100, an overall Climate Change Risk Assessment (CCRA) of both Dhaka North and Dhaka South was incorporated in the Climate Action Plan (CAP) for the Dhaka South City Corporation published in May 2024. The CCRA's projected climate hazards for Dhaka city included erratic rainfall and urban flooding, storm surges from cyclones, rising temperature and heat waves (DSCC, 2024). Due to climate change, Dhaka also faces severe water insecurity with scientists projecting worsening conditions under various carbon emission scenarios

(Tahsin & Murshed, 2023). A phenomenon recognized in the 8th grade History and Social Science textbook as a climate impact, the rise in ‘Urban Heat Island’ effects with land surface temperatures increasing by nearly 6°C compared to Dhaka’s surrounding areas has also been observed by scientists (Rahman, Islam, & Shampa, 2024). While flooding has a long history in the city, climate change is projected to exacerbate flooding through more erratic rainfall patterns and overflowing of the rivers, thus posing a direct threat to the inhabitants of Dhaka (Dasgupta, et al., 2015; Haque, 2021). A 2016 study revealed that 70% of the Greater Dhaka district falls within ‘moderate to very high hazard zone’ for flood inundation (Sayed & Haruyama, 2016). Cyclones and storm surges are also climate-induced threats to the city (Rabbani, Rahman, & Islam, 2011). Diseases such as Dengue, Malaria, diarrhea, heat stroke, allergies, respiratory and cardiovascular diseases are considered as key climate impacts on human health in Bangladesh, particularly affecting children and vulnerable urban poor communities (WHO, 2018; WHO, 2015; UNICEF, 2016; Kabir et al., 2016). The urban poor of Dhaka are predominantly noted as a vulnerable group to these multiple climate impacts due to various factors such as the city’s fragile, mostly unplanned infrastructure, lack of sanitation and lack of employment security (Khan, 2010).

Despite their views on their school communities facing fewer climate impacts, most of the participating teachers were aware of Bangladesh’s overall vulnerability to climate change and recognized the importance of climate change education for the country, believing it could be useful for their students. This finding is in alignment with the findings from a study on Pakistani secondary school teachers that revealed most of the teachers agreed on the importance of climate change education (Hamid, Fida, & Zaman, 2024).

Teachers had different opinions on how exactly climate change education should be integrated into the national curriculum but all of them agreed that climate change education could be useful for Bangladeshi students. One of the teachers believed the existing integration in textbooks was sufficient and opposed introducing Climate Change as a separate subject to avoid ‘burdening’ students. Another did not have any opinion on it but supported giving secondary students from grades 6 to 10 basic climate change understanding as a key component aligned with SDG priorities. Other two teachers acknowledged the importance of climate change education but pointed out a lack of plans by the school authorities on teaching climate change and teachers’ general lack of autonomy in deciding what to teach, as they were bound by the textbook content and government

guidelines. Despite differing opinions on how climate change education should be integrated, teachers all agreed on the importance of climate change education for their students. Three out of the four school teachers believed that more should be done to teach climate change effectively in their schools. Only one teacher out of the total teacher thought the way climate change is being taught in their school was sufficient.

Textbook-Dependent Pedagogy and Teachers' Perspectives on Climate Change Content in NCTB Textbooks. When asked about sources they used to expand their knowledge of climate change, the secondary school teachers admitted they did not personally seek out or research information about climate change to increase their own understanding. The NCTB Science and History and Social Science textbooks were the teachers' key sources of information about climate change. Teachers relied heavily on textbooks for teaching, incorporating minimal information from external sources. While they only occasionally used the internet to enrich their lessons, they never included information or learning materials from news media or relevant academic books, and internet use was not specifically focused on climate change related topics. None of the participant teachers of this study had attended any training, skill-based workshops or teacher conferences on climate change education. They also recounted never independently inviting a speaker or guest expert to provide workshops or lectures on climate change for their students.

Science teachers who participated in this study believed the 8th grade NCTB textbooks provided adequate content on climate change. As per the guidelines of the Teacher's Guides, both teachers mentioned that they switched back and forth between the two Science textbooks but relied heavily on the "Investigative Study" textbook for detailed information and frequently cross-referenced it with the "Exercise" book to ensure students could complete the exercises from the latter. In contrast, HSS teachers felt their textbooks fell short in addressing climate change, citing a lack of depth, real-life examples, and sociological perspectives, particularly on how climate change impacts affect vulnerable communities across Bangladesh. Science teachers also believed the Science textbooks could cultivate basic awareness about climate change and a sense of environmental responsibility, while the HSS teachers disagreed. The HSS teachers both shared the opinion that the HSS textbooks were insufficient for this purpose even though they contained relatively more climate-relevant content than the Science textbooks. An HSS teacher pointed out

that the HSS textbooks lacked practical examples, such as what ways students could actively participate in sustainable forest management, leaving them without a clear understanding of real-world applications and challenges.

This study found climate change education in secondary schools from low-income urban communities in Dhaka to be largely textbook-dependent, since the teachers were heavily relying on NCTB textbooks. This practice strays from the National Curriculum Framework-2021 guidelines, which emphasize experiential learning, integration of local environmental elements, and the use of supplementary materials like books, charts, maps, and audio-visual tools. Teachers did not create specific lesson plans targeting climate change as a learning objective but instead taught the climate change content when it appeared in the textbook chapters, scheduled by the school syllabus. For instance, Science teachers whose classes were observed for this study shared that they followed the school's syllabus timeline, discussing climate change topics only when a relevant chapter, such as the one on renewable energy, was due in it. The Teacher's Guide for Science subject included a sample time plan for executing the learning sessions, that the teachers could adjust and implement accordingly in their classrooms. But they did not follow the TG guidelines in covering the content. They did not design lessons with climate change as a primary focus or explore additional resources beyond the textbook.

Similarly, HSS teachers covered topics relevant to climate education such as forest ecosystems and marine biomes from their textbooks but failed to connect these topics to broader issues like the global climate crisis or its sociological impacts on different communities. One HSS teacher attributed this to the textbooks' lack of depth, pointing out that the content focused heavily on scientific aspects despite being a social science book while neglecting the human and community impacts of climate change. Another HSS teacher cited 'time constraints' as a barrier preventing them from leading discussions about climate change in class, highlighting a general pattern of limited engagement with the subject beyond the textbook content. Neither the Science nor the HSS teachers supplemented the textbooks' climate change content with local real-life examples, visual aids or other relevant engaging tools that helped students grasp the content more effectively. However, this is textbook-dependent pedagogy is also not new, since secondary teachers across the South African countries of Malawi and Lesotho were found to have mostly relied upon traditional lecture-based, teacher-centric pedagogy to teach students CCE content and focused on

covering textbook content only so students could pass exams (Ramakhula et al., 2014; Wadson et al., 2023). Kenyan secondary school teachers reported lacking knowledge and training to teach CCE (Ndiritu et al., 2016; Ronald et al., 2017). Similar problem was also found in secondary classrooms across Uganda and Botswana (Ketlhoilwe & Kurusa, 2015). In case of Bangladesh, this textbook-dependent, teacher-centered pedagogical practice in the field indicates a wide gap between the curriculum framework's vision of experiential learning and learner-centered classroom practices.

Resource limitations teachers face in teaching climate change: Tools & training.

Teachers faced two major resource limitations in teaching climate change: tools and training. Regarding tools, the 8th grade classrooms lacked multimedia resources such as projectors, laptops with stable internet, and printers, which hindered teachers from creating visually engaging lessons. While some schools had laptops in shared computer labs, these were often prioritized for ICT teachers, leaving limited access for others. Teachers expressed interest in using tools like projectors and colorful worksheets but cited financial constraints, such as the inability to afford printers and ink. Additionally, they felt unprepared to navigate digital tools effectively due to a lack of government-provided digital training, which had been delayed or only offered to a limited number of staff. On the other hand, participant teachers also reported insufficient training on how to teach climate change content effectively. While they had attended sessions related to the National Curriculum Framework-2021, these lacked specific guidance on integrating climate change education. Teachers expressed a strong desire for additional, focused training to enhance their pedagogical skills and keep their knowledge up-to-date, recognizing the importance of continuous learning to improve their teaching outcomes.

A pedagogical disconnect between the Teacher's Guides and teachers' classroom practices. Teacher's Guides serve as essential tools for teachers, helping to standardize knowledge and skills that students should learn (Ivanchenko, Lurie, & Melnikova, 2023). The Teacher's Guides (TG), as prepared by the National Curriculum Board, were meant to be utilized as critically important teaching-learning material for implementing the competency-based National Curriculum Framework-2021. The Board wanted the Teacher's Guides to help teachers conduct "*enjoyable and learner-centered classroom activities*" for their respective subjects, to ensure students' learning activities are not confined within the classroom and not dependent solely on the

textbooks (Pg-5; NCTB, 2021). Since the National Curriculum Framework-2021 emphasizes experiential learning, the textbooks include a range of hands-on learning activities such as group work, projects, presentations and field trips, the teachers are to utilize the step-by-step guidelines laid out in the TGs to facilitate such activities inside or beyond the classroom. The teachers are instructed to utilize the TG and create annual learning plans based on the TG, adjusted to fit local circumstances like holidays or natural disasters. Overall, the TGs are designed to aid teachers and thus are valuable material.

In terms of helping teachers who teach History and Social Science subject, the subject-specific TG for it included very few instructions on teaching climate change. This TG includes two instructions for two different Learning Experiences in the History and Social Science textbook: one guides teachers to facilitate an interactive analytical discussion-based lesson by encouraging students to analyze a fictional newspaper report titled ‘Climate change and Bangladesh’ while the other instructs the teachers to help students develop observational and analytical skills via ecosystem observations, data collection, and chart analysis of climate change contexts. However, the reality is that the History and Social Science teachers who participated in this study did not follow these instructions to teach the content relevant to climate change. The History and Social Science teachers expressed that their subject TG did not include sufficient information on how to teach climate change topics to students. This is only partially true, as the History and Social Science TG includes very few but specific instructions for teaching textbook content relevant to climate change from two different learning units.

The TG also provided brief instructions for evaluating students through formative assessments, with criteria for analytical reports, collaborative posters, drama, and group presentations, using rubrics that emphasize teamwork, creativity, critical thinking, and communication skills. Teachers are also to evaluate students' understanding and application of sustainability concepts through projects like ecosystem observations, global biome research, and community-based initiatives. Teachers are instructed to assess students' ability to connect events like the Paris Agreement to social factors such as urbanization and deforestation. In addition to not adhering to the TG for teaching these contents, the History and Social Science teachers also did not follow them when designing assessments and did not design specific assessments to evaluate students' understanding

of the content relevant to climate change. The History and Social Science teachers mentioned that the TG assessments were impractical to implement due to time constraints and large class sizes.

On the other hand, the Science TG was designed to help Science teachers deliver a non-traditional science education based on exploratory learning, that has scientific literacy, metacognition and socio-scientific values at its core. The National Curriculum Framework-2021 promotes a science education that “...is not limited only to rigorous theory and a few laboratory tests, but emphasis is given to the acquisition of scientific literacy, which will help learners develop a scientific outlook and science-oriented lifestyle” (Pg-7; NCTB, 2021). For the two Science textbooks for 8th grade students, the teachers were to utilize the Science TG to impart 10 core competencies. Only one competency of the ten competencies for 8th grade Science is relevant to climate change education, and the Science TG offers only brief instructions for teaching the unit associated with that competency. Under that competency, Science teachers are instructed to help students investigate their own resource usage and household waste generation, later develop an effective waste management model based on their findings and present the model to community stakeholders. These activities are not presented as ‘climate action’ in the textbook or the TG, but they are relevant to climate change education as they encourage students to explore sustainability practices, understand the environmental impact of waste, their own role in it and contribute to solutions that can mitigate climate change effects, such as promoting resource conservation. However, during the class observations it was evident that the Science teacher participants were skipping the planned activities from the Science TG during their classroom instructions, which significantly lowered the lesson quality.

The Science TG emphasizes teachers to assess students by their participation in group activities, written reflections, and outputs like the waste management models and community presentations, for this learning unit. Neither Science teachers who participated in this study were planning to implement the TG assessments. Both Science teachers shared that they also did not create separate assessments for evaluating the students’ understanding or knowledge of climate change based on the content they’ve been taught. The Science teachers were of the opinion that the large class population made it “challenging” and “impractical” for them to implement the formative assessments as dictated by the TG under the National Curriculum Framework-2021.

In sum, there was a noticeable pedagogical disconnect between the guidelines of the TGs and the actual classroom practices of the secondary school teachers. Though the Science and History and Social Science Teacher's Guides from the National Curriculum Framework-2021 included step by step breakdown of each learning sessions and time allotment, the teachers had the freedom to make necessary adjustments. The TGs were designed to help teachers facilitate the learning experiences in their textbooks. The TGs did not include highly scripted daily lesson plans, but a breakdown of teacher to-dos for the learning sessions from each learning experience from the textbooks. Science teachers and 'History and Social Science' teachers, however, did not consult the TGs that were designed to aid them in teaching, facilitating learning activities and assessing students. Time constraints due to subject-teachers having limited lesson time (average Science lesson or History and Social Science lesson spanned 25-30 minutes), pressure from the school administration to complete the school syllabus (exacerbated by school closures during the July-August Revolution), impracticality of implementing the new curriculum assessments, teachers receiving insufficient training on implementing experiential learning- are found to be the common reasons given for this pedagogical disconnect. Notably, as early as 2008, researchers identified time constraints and large class sizes among the key "contextual constraints" that discouraged Bangladeshi secondary teachers (who taught English) from using Teacher's Guides in their classrooms (Farooqui, 2008). This indicates that though the Teacher's Guides have evolved under different national curriculums, the "contextual constraints" continue to burden teachers.

It is usual for teachers to make adjustments or modifications in their classroom instructions from how the Teacher' Guides are written as part of adaptive teaching (Parsons, et al., 2018). However, Piper et al. (2018) found through their study on Teacher's Guides across 13 countries and 19 projects in the Global South that the changes that school teachers make, often reduce the amount of group work and interactivity as dictated in the Teacher's Guides (Piper, Sitabkhan, Mejía, & Betts, 2018). The TGs under the National Curriculum Framework-2021 did not contain highly structured daily lesson plans that leave little wiggle room for teachers. Rather the documents contained detailed breakdowns of teacher to-dos for each learning sessions, allowing adjustments based on classroom context. Thus, the reason why the Bangladeshi secondary school teachers strayed from these Guides in their classrooms is not because of rigid structures but due to a combination of systematic challenges in implementation. Ultimately, the observation from this research confirms that the school teachers not utilizing the Teacher's Guides drastically reduced

the quality of their subject-specific lessons, as the lessons became less interactive and were not learner-centered. This observation is consistent with the findings of Piper et al. (2018).

Furthermore, what was an unexpected discovery during this study is that the teachers were reverting to some of the assessment strategies from the National Curriculum-2012. Teachers shared that they were planning end of the year summative assessments that included Multiple Choice Questions, short question-answers for assessing the students. This complete deviation from the National Curriculum Framework-2021 took place due to the Bangladeshi Interim Government's decision to partially withdraw the Framework-2021 in August 2024, revise and reprint the textbooks modified in light of the National Curriculum-2012.

The absence of emotional engagement on climate change in Bangladesh's classrooms.

Incorporating students' emotions and their personal experiences about climate change into classroom discussions can be significant for effective climate change education. Some researchers have highlighted the role of emotional engagement in promoting deeper understanding, critical thinking, and active participation. As Willox et al. (2012) found, creating space for emotional discourse helps students to integrate their feelings with cognitive understanding, fostering a holistic approach to climate literacy. This integration is particularly relevant in contexts like Bangladesh, where school education must balance global awareness about climate change with local relevance. Educators should connect climate change topics to students' lives, enhancing relevance and emotional investment (Godin & Johanson, 2024). Furthermore, Ojala (2012) argued that ignoring students' emotions regarding climate change can lead to increased climate anxiety and a sense of helplessness, particularly among young people. Discussing and engaging with students' feelings might be particularly important for students in urban low-income communities in Bangladesh, since these communities often experience direct impacts of climate change such as flooding, heat stress, and economic instability, making the students' emotional responses to climate change deeply tied to their "*lived realities*" (Islam & Winkel, 2017). Neglecting these emotions in the classroom not only alienates them from the subject matter but also perpetuates educational inequities by failing to connect abstract climate education to their personal and local experiences.

This study found that students' emotional responses to climate change were mostly negative, ranging from anxiety, helplessness, angry, ashamed, guilty, sad, afraid, annoyed to frustrated.

These emotions were often linked to their personal experiences with extreme weather events, such as floods and heatwaves. However, the lack of opportunities to discuss and process these emotions within a supportive environment can lead to feelings of isolation and helplessness. Effective climate change education can help students to address and manage these emotions, fostering environments that encourage open dialogue and transform these emotions into motivation for action and deeper understanding. It is important for teachers to creating safe spaces in the classrooms for these discussions is crucial for emotional processing and action-oriented learning.

Teachers not feeling personally and professionally equipped to deal with student emotions, and time constraints are key challenges obstructing emotional engagement for Bangladeshi secondary school teachers. While focusing on student emotions is crucial, school teachers feeling unprepared and unequipped to address these topics, is also an observable pattern across different educational systems in the world, highlighting an observable need for professional development in climate change education all over (Carmichael, 2024). Rushton et al. (2023) highlighted the need for targeted teacher professional development which enables them to respond to the emotions young people experience in the context of climate change education. In conclusion, failing to address students' emotions about climate change, especially in vulnerable contexts, undermines both the psychological well-being of students and the effectiveness of formal education in preparing them for a climate-resilient future. This gap calls for specific pedagogical strategies and professional development for teachers that allow them to actively engage with students' emotions.

5.2.5 Applying the Bicycle Model to interpret the findings

Finnish researchers Cantel et al. (2019) advocated for a holistic and interdisciplinary approach to climate change education. Below, the seven elements of the Bicycle Model are used as a conceptual lens to interpret the findings of this study and highlight the gaps in the current educational practices in Bangladesh under the National Curriculum Framework-2021:

Wheels: Knowledge and Thinking Skills. The wheels of the Bicycle Model emphasize foundational knowledge and critical thinking as drivers of progress in climate education. However, this study found that students had a fragmented understanding of climate change. While students demonstrated general awareness of local impacts such as increasing heat waves, floods, and rising health risks, they lacked deeper knowledge about global climate change processes, certain scientific mechanisms (e.g., greenhouse gas emissions beyond CO₂), economic and political

factors. Students often confused short-term weather changes with long-term climate trends, indicating a need for more rigorous critical reflection and exploratory learning in classrooms. This gap in secondary education in low-income urban schools in Dhaka reflects a missed opportunity to cultivate the critical thinking skills highlighted by the Bicycle Model. Classroom practices, largely confined to textbook-driven and teacher-centered approaches, further limited the potential for students to engage in exploratory or competency-based learning. The absence of interdisciplinary content across subjects, despite the National Curriculum Framework's emphasis on critical and experiential learning, hindered students from developing an integrated understanding of socio-economic and political dimensions of climate change- a key component of the Bicycle Model.

Frame: Identity, Values, and Worldview. The frame of the Bicycle represents the foundational beliefs, values, and worldviews that shape learners' reception and integration of new knowledge. This study revealed that students recognized human activities, such as deforestation and pollution, as primary contributors to climate change. However, they exhibited a narrow understanding of systemic factors and natural causes, reflecting a need for broader engagement with ethical considerations and cultural attitudes. Moreover, students' perceptions of personal responsibility and societal inaction revealed a disconnect between their values and their communities' environmental behaviors. The findings align with the Bicycle Model's call for critical engagement with personal and societal values to foster environmental responsibility. Ethical discussions on consumption, waste, and shared accountability could provide a framework for addressing these gaps.

Chains and Pedals: Action to Curb Climate Change. The chains and pedals symbolize the translation of knowledge into action. This study found that while some students took individual steps such as tree planting or reducing plastic use, most were unsure about meaningful actions to address climate change. Barriers included limited resources, lack of community support, and uncertainty about the feasibility of collective initiatives. The Bicycle Model emphasizes fostering long-term planning and environmental stewardship, which were largely absent in the educational practices observed. Encouraging collaborative, community-based projects and providing guidance on actionable steps could enhance students' agency and alignment with this component of the model.

Saddle: Motivation and Participation. The saddle, representing motivation, revealed a significant challenge in making climate change education relevant and engaging for students. Although students expressed strong emotional responses, including anxiety, frustration, and guilt, these feelings were not channeled into sustained interest or action due to a lack of supportive educational environments. The bare minimum inclusion of climate change content in the NCTB textbooks and teacher-centered pedagogy negatively affected students' motivation to learn about climate change. This could have been prevented by implementing the interactive learning experiences the Teacher's Guides instructed teachers to implement such as group presentation and field trips, but teachers were bound by various contextual barriers that prevented them from doing so.

Brakes: Operational Barriers. Operational barriers, symbolized by the brakes, were evident in systemic challenges and constraints that secondary teachers struggled with, such as insufficient teacher training, lack of multimedia resources, and time constraints due to heavy curricular loads and large class sizes. These barriers hindered teachers from implementing experiential and student-centered learning, as outlined in the National Curriculum Framework. Teachers' reliance on outdated pedagogical practices and inadequate use of Teacher's Guides further restricted opportunities for holistic climate education.

Lamp: Hope and Emotional Engagement. The lamp highlights the role of emotions and hope in climate education. This study revealed that students' emotional responses to climate change and how it was being taught were predominantly negative, with feelings of helplessness, anger, fear, shame, and frustration. The lack of classroom discussions around addressing students' personal experience and emotions relevant to climate change contributed to a sense of isolation and disempowerment, echoing the model's warning about the potential of unchecked emotions to hinder learning. Bicycle Model's emphasis on balancing emotional responses to encourage optimism, hope and action could have been achieved in this context if teachers were equipped to integrate emotional engagement into climate education through creating safe spaces for discussion and activities that promoted constructive emotional processing.

Handlebar: Future Orientation. The handlebar represents future orientation, focusing on cultivating a hopeful and proactive outlook. The findings highlighted that students viewed climate change as a distant, albeit severe, threat rather than an immediate challenge. This perception

reflects a lack of emphasis on future-oriented thinking in the curriculum and teaching practices. The Bicycle Model advocates for engaging students creatively with potential futures, encouraging them to envision solutions and take ownership of their roles in mitigating climate change. Integrating scenario-based learning and storytelling could inspire a sense of purpose and long-term commitment to environmental stewardship.

In applying the Bicycle Model to this study's findings, it becomes clear that climate education in Bangladeshi secondary schools falls short of providing the holistic, interdisciplinary approach needed to empower students as climate-literate citizens. Addressing gaps in knowledge, values, action, motivation, and emotional engagement requires systemic reforms, including curriculum revisions, enhanced teacher training, and resource investments. By aligning educational practices with the Bicycle Model's principles, schools can create a comprehensive framework for equipping students with the skills, values, and resilience needed to face the climate crisis with hope and action.

5.3 Conclusion

The findings of this study suggest several gaps and key areas for improving climate change education in Bangladeshi secondary schools. Firstly, the National Curriculum Framework-2021 requires substantial revisions and modifications to effectively integrate a holistic climate change education. This integration should include clearly defined learning outcomes, comprehensive assessments, and connections to broader issues such as social justice, poverty, and sustainability. Expanding teacher training programs to include both climate science and relevant pedagogical strategies is equally critical. Such training would ensure that educators possess the necessary knowledge, skills and resources to engage students with these complex topics. Dependence on teachers should also be reduced by introducing collaborative community-based climate education schemes led by local youth to teach students through community-based projects, field activities, and initiatives. Secondly, the study reveals that textbooks and teaching materials need to be updated and modified to provide a more thorough exploration of climate change. This should encompass its scientific foundations, local and global impacts, and practical, actionable solutions. Including perspectives on climate justice, particularly concerning the experiences of vulnerable communities can offer students a more holistic understanding of the issue. The textbooks should also include content on common climate change misconceptions and information on how to

navigate digital media in this age of scientific disinformation. Moreover, the research further indicates that while Bangladeshi secondary students demonstrate a basic awareness of climate change and recognize its effects on their lives and surroundings, their understanding is often fragmented. This fragmentation is shaped by limited exposure to structured climate education and a focus on localized experiences. Students generally lack a nuanced understanding of basic scientific processes behind climate change, its far-reaching local and global implications. Students also held on to a lot of misconceptions regarding climate change and felt a range of negative emotions towards climate change, as well as the way it was being taught. This highlights an urgent need for schools to provide more accurate information on climate change. In summary, the current curriculum and textbooks provide a basic foundation for climate change education but fall short in addressing the urgency and breadth of the climate crisis. Enhancing teacher training, revising the textbooks and prioritizing experiential and interdisciplinary approaches are crucial steps toward fostering climate literacy. By equipping students with the knowledge and skills to understand and address climate change, schools can prepare them to navigate future challenges and contribute to building a more sustainable and equitable world.

5.4 Recommendations for Policymakers

Following are some recommendations for policymakers to improve the state of climate change education in secondary level in Bangladesh based on the study's findings:

1. An integrated climate change curriculum that comprehensively addresses the diverse aspects of climate change, including its scientific basis, socio-economic and political impacts on vulnerable local as well as global communities and climate actions to tackle these impacts is needed for Bangladesh. A separate subject on climate change might not be appropriate for Bangladesh's context so detailed interdisciplinary learning units or sections dedicated to climate change, its impacts and solutions can be added in every subject from 6th to 10th grade textbooks.
2. The curriculum also needs to emotionally engage students, move on from the disaster-centric fear-mongering narrative to shift towards a more optimistic, actionable and climate justice-based narrative. The textbooks should be modified to include more age and context-appropriate educational content on climate change for Secondary students. Considering the complex web of Bangla/English medium and Madrassa education streams in Bangladesh,

it is also important to consider how the textbook content can be porous despite existing socio-economic barrier.

3. The curriculum should also include guidance for collaborating with local vulnerable and marginalized communities, Government agencies and NGOs to create opportunities for school students to engage in real-world climate action projects that will serve the communities need.
4. A holistic curriculum designed to address climate change education must be inclusive, as per the Bicycle model. It must make sure that assessments and pedagogical guidelines for teaching content related to climate change must be feasible to implement with students with disabilities, students from marginalized communities, indigenous students, Madrasah students, students from underfunded schools.
5. The Teacher's Guides under the National Curriculum Framework-2021 must be revised and modified with the contextual constraints most Bangladeshi school teacher face in mind, so teachers find them easy to follow and design lessons accordingly for their classroom context.
6. Teachers participating in this study all responded positively towards receiving training to teach climate change. They should be given specialized periodical professional development training (with options for training modules to be made easily accessible online or offline) that make them capable of independently implementing student-centered pedagogical practices. Teachers of all subjects should be equipped with the necessary knowledge, skills, and relevant Socio-emotional Learning to address and manage students' emotions, the misconceptions towards climate change they possess and so on.
7. Beyond the scope of teachers' professional development trainings, financial incentives and awards could be used to motivate teachers across the country. Teachers should also be given incentives for attending district or national-level climate education conferences, skill development courses online or offline workshops on an annual basis.
8. Training Bangladeshi school teachers to teach climate change can be an added responsibility on their shoulders and demand more of their time, energy and attention. Arranging nationwide *Teach the Teacher* campaigns will provide the perfect opportunity

to flip the typical teacher-centric pedagogy and allow secondary students to practice 21st century skills for communicating climate change. Inter-school teacher collaborative efforts and organizing national or district-level events like Climate Education Summit on an annual basis so teachers can share best practices and learn from experts for free can also be a good alternative.

9. Instead of over-reliance on underpaid school teachers to teach students about climate change, supplementing the curricula with community-based climate education schemes and awareness campaigns led by local youth leaders, skilled university students or experienced young-professionals could be considered. These alternative educators could also teach students the digital literacy skills needed to sort through climate misconceptions.
10. Free outdoor learning camps, guided tours, art exhibitions, Climate Olympiads, and film or documentary festivals to facilitate both parent and community engagement could prove highly effective. Prestigious scholarship opportunities at district and national competitions for brainstorming innovative solutions can also make learning exciting for youth. Engaging community religious and spiritual leaders in the effort could also have a tremendous advocacy impact.
11. Since most students from low-income urban communities had access to social media, engaging content on climate change could be carefully created. Free Courses on climate change created in collaboration with popular science communicators or social media personalities could also be promoted on social media platforms for secondary students.

5.5 Recommendations for Further Research

- More studies are critically needed to explore Bangladeshi secondary teachers' pedagogical content knowledge of climate change.
- More studies should be conducted to understand the type of institutional support secondary teachers from underfunded schools of low-income urban and rural communities in Bangladesh need to effectively address their students' emotions on climate change and its impacts.
- More studies should be conducted to understand what teaching-learning materials and curricular content can be created in everyday teaching in the climate-vulnerable countries

of the global South, that will be feasible to implement without being a financial burden on low-income families and underfunded schools with little resources.

- Comparative studies between pedagogical practices regarding climate change education in English medium, Bangla medium schools and Madrasah streams in Bangladesh should be done
- There is very little information available on what type of social media content Bangladeshi secondary students consumed on climate change and sustainability issues, therefore this could be an important topic to explore.

References

- Abd Hamid, I., Yahaya, W. A., & Rahim, H. ((2021)). (Izzah, Abd, Hamid. Assessment of Awareness and Behaviour Among Secondary School Students on Climate Change. 6(6):259-264. doi: 10.47405/MJSSH.V6I6.829.
- Ahmed, M. (2022, December 28). *New curriculum cannot transform our school education*. Retrieved from The Daily Star: <https://www.thedailystar.net/opinion/news/new-year-new-curriculum-cannot-transform-our-school-education-3207231>
- Ahmed, M. (2023, November). *New school curriculum: A great opportunity or a looming disaster?* Retrieved from The Daily Star: <https://www.thedailystar.net/opinion/views/news/new-school-curriculum-great-opportunity-or-looming-disaster-3462861>
- Ahmed, M. A. (2022). Teachers' perceptions about climate change: A comparative study of public and private schools and colleges in Bangladesh. *Frontiers in Climate*.
- Ahsan, S. B. (2023, November). *What Bangladesh's new curriculum framework aims to achieve*. Retrieved from The Confluence: <https://theconfluence.blog/what-bangladeshs-new-curriculum-framework-aims-to-achieve/#:~:text=The%20NCF%2D2021%20is%20the,knowled>
- Akther, S. (2022, August 8). *Social Inclusion: Children with disabilities deserve to be encouraged*. Retrieved from D+C Development and Cooperation: <https://www.dandc.eu/en/article/bangladesh-persons-disabilities-tend-be-excluded-mainstream-society>
- Alam, G. M., Alam, K., & Mushtaq, S. (2018). Climate change perceptions and local adaptation strategies of hazard-prone rural households in Bangladesh. *Climatic Change*, 151(3-4), 629-643.
- Ali, M. S. (2024, April 3). *Op-ed: The new competency-based curriculum: A bold step, but is it practical?* Retrieved from The Business Standards:

<https://www.tbsnews.net/thoughts/new-competency-based-curriculum-bold-step-it-practical-822031>

- Alvaro, F., Morote., & Maria, H. (2024). Knowledge and perception of Spanish school children of climate change. *Children's Geographies*, doi: 10.1080/14733285.2024.2303581.
- Apollo, A., & Mbah, M. (2021). Challenges and Opportunities for Climate Change Education (CCE) in East Africa: A Critical Review. *Climate*, 93.
- Armstrong, C. (2021). Key Methods Used in Qualitative Document Analysis. *SSRN Electronic Journal*.
- Bangladesh Red Crescent Society. (2024). *Sylhet Flood 2024 – Situtation Report 1*.
<https://bdracs.org/sylhet-flood-2024-situtation-report-1/#:~:text=Due%20to%20continuous%20rains%20in,lying%20areas%2C%20including%20the%20cities.: BDRCS>.
- Barraza, L., & and Walford, R. A. (2002). Environmental education: A comparison between English and Mexican School Children. *Environmental Education Research*, 171-186.
- Barua, A., Yasin, A., & Shahriar, A. F. (2024). SWOT Analysis of National Curriculum Framework 2021 and its textbooks from a Gender perspective. *European Journal of Education Studies*.
- Bas, M., Teksoz, G. T., & and Ertepinar, H. (2011). Emphasizing local features for effective environmental education: Environmental attitudes of elementary school students living in Turkey. *Science Education International*, 119- 132.
- BBS. (2024, March). *Bangladesh Sample Vital Statistics 2023: Key Findings*. Retrieved from Bangladesh Bureau of Statistics:
https://bbs.portal.gov.bd/sites/default/files/files/bbs.portal.gov.bd/page/b343a8b4_956b_45ca_872f_4cf9b2f1a6e0/2024-03-24-05-41-69f984d80716a740d40f7044bea63285.pdf
- Bieler, A., Haluza-Delay, R., D. A., & Mckenzie, M. (2017). A national overview of climate change education policy: Policy coherence between subnational climate and education policies in Canada (K-12). . *Journal of Education for Sustainable Development*, 11 (2), 63-85.

- Birdsall, S. (2020). *Nurturing hope: From climate-change worriers to eco-warriors*. NZCER Press.
- Biswas, M. (2013). *Climate Change and its Impacts on Bangladesh*. Bangladesh Institute of Planners.
- Blazar, D., & Kraft, M. A. (2017). Teacher and Teaching Effects on Students' Attitudes and Behaviors. *Educational Evaluation and Policy Analysis*, 39(1), 146–170.
- Bleazby, J. (2013). Social reconstruction learning: Dualism, Dewey and philosophy in schools. *Routledge*.
- Blum, N., Breiting, S., Naz, J., Goh, K., & Pedretti, E. (2013). Balancing the Tensions and Meeting the Conceptual Challenges of Education for Sustainable Development and Climate Change. *Environmental Education Research*.
- Bodzin, A. M., Anastasio, D., Sahagian, D. P., C. &, & R. (2014). Investigating climate change understandings of urban Middle-Level students. . *Journal of Geoscience Education*, 62(3), 417–430. <https://doi.org/10.5408/13-042.1>.
- Bond, H. (2023, November). *Advancing Climate Action Through Justice-centered Climate Education*. Retrieved from SDG Knowledge Hub: <https://sdg.iisd.org/commentary/guest-articles/advancing-climate-action-through-justice-centered-climate-education/>
- Borde, B., Léna, P., & Lescarmontier, L. (2022). Education as a Strategy for Climate Change Mitigation and Adaptation. In M. Lackner, B. Sajjadi, & W. Chen, *Handbook of Climate Change Mitigation and Adaptation*. Springer.
- Borgen Project. (2020, May 19). *EDUCATION FOR CHILDREN WITH DISABILITIES IN BANGLADESH*. Retrieved from Borgen Project: <https://borgenproject.org/education-for-children-with-disabilities-in-bangladesh/>
- Bourn, D., & Hatley, J. (2022). Target 4.7 of the Sustainable Development Goals: Evidence in schools of England. In D. E. Centre, *Development Education Research Centre Research Reports*. London: UCL: Institute of Education.

- Bowen, G. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal*, 27–40.
- Bowen, G. A. (2009). Document Analysis as a Qualitative Research Method. *Qualitative Research Journal*, Vol. 9 Issue 2, 27-40.
- Boyes, E., & Stanisstreet, M. (1992). Students' perceptions of global warming'. *International Journal of Environmental Studies*, 42(4), 287-300.
- Brown, V. A., Harris, J., & Russell, J. (2010). *Tackling Wicked Problems Through the Transdisciplinary Imagination*. Routledge.
- Brownlee, M. T., Powell, R., & Hallo, J. (2013). A Review of the Foundational Processes that Influence Beliefs in Climate Change: Opportunities for Environmental Education Research. *Environmental Education Research* 19 (1).
- Busch, K. C., Henderson, J. A., & Stevenson, K. T. (2018). Broadening epistemologies and methodologies in climate change education research. *Environmental Education Research*, , DOI: 10.1080/13504622.2018.1514588.
- Cantell, H., Tolppanen, S., Aarnio-Linnanvuori, E., & Lehtonen, A. (2019). Bicycle model on climate change education: presenting and evaluating a model. *ENVIRONMENTAL EDUCATION RESEARCH*, <https://doi.org/10.1080/13504622.2019.1570487>.
- Carmichael, M. (2024). Perspectives on Addressing Young People’s Climate Distress in Education. . 329-346.
- Carter, S., & Thompson, R. (2019). Emotional engagement in climate education: Strategies and outcomes. In Green, & B. White, *Innovative approaches to environmental education* (pp. 45–67). Academic Publishers.
- Chang, C., & Pascua, L. (2017). The state of climate change education reflections from a selection of studies around the world. *International Educational Research in Geographical and Environmental Education*, 177-179.
- Chevron Corporation. (2022, January). *education*. Retrieved from Chevron Bangladesh: <https://bangladesh.chevron.com/community/education>

- Chowdhury, M. S. (2023, October). *Bangladesh National Curriculum framework 2021: Challenges and possibilities*. Retrieved from Shikkhok Batayon: <https://www.teachers.gov.bd/blog/details/758814?page=554&bangladesh-national-curriculum-framework-2021-challenges-and-possibilities>
- Chowdhury, T. (2014). Nature of Environmental Education in Bangladesh: A School Level Assessment with reference to National Curriculum. *International Electronic Journal of Environmental Education*.
- Christensen, R. &. (2015). The climate change attitude survey: Measuring middle school student beliefs and intentions to enact positive environmental change. *International Journal of Environmental and Science Education*, 10(5), 773-788.
- Climate Generation: A Will Steger Legacy. (2018). *Position Statement on Climate Change Education in the Humanities*. Retrieved from Climate Generation: A Will Steger Legacy.
- Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design: Choosing among five approaches*. Sage.
- Cutter-Mackenzie, A., & Rousell, D. (2018). Education for what? Shaping the field of climatechange education with children and young people as co-researchers. *Child. Geor.*, 17, 90-104, <https://doi.org/10.1080/14733285.2018.1467556> .
- Daily Star. (2023). *New curriculum rolls out, preparations not enough*. Retrieved from Daily Star: <https://www.thedailystar.net/news/bangladesh/politics/news/fakhrul-sees-no-noteworthy-change-us-position-3610956>
- Daily Sun. (2023, November 11). *Parents to hold rally demanding cancellation of new curriculum*. Retrieved from Daily Sun: <https://www.daily-sun.com/printversion/details/720978>
- Dalelo, A. (2011). Global climate change in geography curricula for Ethiopian secondary and preparatory schools. *International Research in Geographical and Environmental Education*, 20(3), 227–246.
- Das, A. (2023, December). *New curriculum a shield for combating future*. Retrieved from Observer BD: <https://www.observerbd.com/news.php?id=449695>

- Dasgupta, S., Zaman, A. M., Roy, S., Huq, M., Jahan, S., & Nishat, A. (2015). *Urban flooding of Greater Dhaka in a changing climate : building local resilience to disaster risk* . Retrieved from World Bank: <http://documents.worldbank.org/curated/en/683381468001782892/Urban-flooding-of-Greater-Dhaka-in-a-changing-climate-building-local-resilience-to-disaster-risk>
- David, M., Ndeti., D. W., Victoria, N. M., Shanley., C, N. M., Pascalyne, K. N., . . . Johnson. (2024). The perceived impact of climate change on mental health and suicidality in Kenyan high school students. *BMC Psychiatry*, doi: 10.1186/s12888-024-05568-8.
- Deshiana, A., Sriyanti, I., & Ismet, I. (2022). High school students awareness and attitudes toward climate change. *Berkala Ilmiah Pendidikan Fisika*, 10(3), 255-239.
- DeWaters, J. E., Andersen, C., Calderwood, A., & Powers, S. E. (2014). Improving Climate Literacy With Project-Based Modules Rich in Educational Rigor and Relevance. *Journal of Geoscience Education*, 62(3).
- Dhaka Tribune. (2022, September). *Climate education for Bangladeshi children: Necessity or luxury?* Retrieved from Dhaka Tribune: <https://www.dhakatribune.com/epaper/294880/climate-education-for-bangladeshi-children>
- Dhaka Tribune. (2022, August 26). *Dipu Moni: Teachers' role getting changed in new curriculum*. Retrieved from Dhaka Tribune: <https://www.dhakatribune.com/bangladesh/nation/292981/dipu-moni-teachers-role-getting-changed-in-new>
- Dhaka Tribune. (2023, January 23). *Plagiarism in Textbooks: NCTB seeks explanation from writers panel*. Retrieved from Dhaka Tribune: <https://www.dhakatribune.com/bangladesh/education/302935/plagiarism-in-textbooks-nctb-seeks-explanation>
- Dhaka Tribune. (2024, March 17). *PM Hasina asks parents, teachers not to put pressure on students*. Retrieved from Dhaka Tribune:

<https://www.dhakatribune.com/bangladesh/342009/pm-hasina-asks-guardians-teachers-not-to-pressure>

Dhaka Tribune. (2024, April 1). *Teachers in trouble as assessment app Noipunno dysfunctional*. Retrieved from Dhaka Tribune: <https://www.dhakatribune.com/bangladesh/education/343140/teachers-in-trouble-as-assessment-app-noipunno>

Dildar, D., Hakeem, K. H., & Ehsanullah, B. (2024). High School Student's Views and Perception about Climate Change. *ICCC (special)*, 549-552. doi: 10.70436/nuijb.v3i02.296.

District & School Improvement Center at American Institutes for Research. (n.d.). Retrieved from American Institutes for Research (AIR) website: https://www.air.org/sites/default/files/18-3576%20DSI%20Framework%20for%20Systemic%20Improvement_Updated%20July%202018.pdf

Doebel, S., & Frank, M. (2023). Broadening Convenience Samples to Advance Theoretical Progress and Avoid Bias in Developmental Science. *Journal of Cognition and Development*, 1-12.

DSCC. (2024, May). *Climate Action Plan for Dhaka South City Corporation*. Retrieved from DSCC: https://dscportal.gov.bd/sites/default/files/files/dscportal.gov.bd/page/089f17d2_a3ec_4309_a171_5dcd2d25b13f/2024-06-13-05-17-88d5cb2246c32a2f9f94c43f8337d977.pdf

DSHE. (2023, November 30). *Notice for starting Input of Performance Indicators (PIs) and Behavior Indicators (BI) in the Noipunno app*. Retrieved from DSHE: <https://file-rajshahi.portal.gov.bd/uploads/034a928f-13f5-4966-b634-ea236f4c75f9//656ffd10f/656ffd10f3668392283388.pdf>

Education, O. f. (2023). *Final Report: EMOTIONS, CLIMATE CHANGE, AND THE CLASSROOM: A RESOURCE FOR PRIMARY SCHOOL TEACHERS*. UNESCO.

Eilam, E. (2022). Climate Change Education: The Problem with Walking Away from Disciplines. *Stud. Sci. Educ.*, 58, 231–264.

- English, M., & Kitsantas, A. (2013). Supporting Student Self-Regulated Learning in Problem and Project-Based Learning. . *Interdisciplinary Journal of Problem-Based Learning*, 7(2).
- Fang, G. X. (2022). Climate Change Education In Singapore: A Survey of Science Teachers. *HSSE Online*, 11(2), 60- 68.
- Farooqui, S. (2008). Teachers' Perceptions of Textbook and Teacher's Guides: A Study in Secondary Education in Bangladesh. *THE JOURNAL OF ASIA TEFL*, Vol. 5, No. 4, 191-210.
- Fatima, A.-D., & Molinari, C. (2017). Interdisciplinarity: Practical approach to advancing education for sustainability and for the Sustainable Development Goals. *The International Journal of Management Education*.
- Feldbacher, E., Waberer, M., Campostrini, L., & Weigelhofer, G. (2023). Identifying gaps in climate change education - a case study in Austrian schools. . *International Research in Geographical and Environmental Education*.
- Finnegan, W. (2023). Its beautiful, living without fear that the world will end soon: digital storytelling, climate futures, and young people in the UK and Ireland. *Children's Geographies*.
- Flick, U. (2018). An introduction to qualitative research. *Sage*.
- General Economic Division. (2015). Seventh Five Year Plan FY 2016- FY 2020. Accelerating Growth, Empowering Citizens.
- Germanwatch. (2021). *Global Climate Risk Index 2021: Who Suffers Most from Extreme Weather Events?* Bonn: Germanwatch.
- Global Carbon Project. (2021). *Global Carbon Project's report*. Retrieved from Global Carbon Project: <https://www.globalcarbonproject.org/>
- Godin, E. L., & Johanson, B. (2024). Unlocking the Power of Emotional Connections: Strategies for Teaching Climate Change in Middle School. *Science scope*, 47(5), 15-23.
- Greer, K., King, H., & Glackin, M. (2023). The 'web of conditions' governing England's climate change education policy landscape. . *Journal of Education Policy*.

- Gwekwerere, Y. N., & Shumba, O. (2021). A call for transformative learning in Southern Africa. https://doi.org/10.1163/9789004471818_011: BRILL eBooks.
- Hamid, S., Fida, F., & Zaman, M. S. (2024). TEACHERS' ATTITUDES & BARRIERS TO IMPLEMENTING CLIMATE CHANGE EDUCATION IN SECONDARY SCHOOLS. *Journal of Social Sciences Development*, 3(3), 116–127.
- Han, Q. (2015). Education for sustainable development and climate change education in China. . *Journal of Education for Sustainable development*.
- Haq, S. M., & Ahmed, K. J. (2020). Perceptions about climate change among university students in Bangladesh. *Natural Hazards*, 3683–3713.
- Haque, A. N. (2021). Climate risk responses and the urban poor in the global South: the case of Dhaka's flood risk in the low-income settlements. *International Journal of Disaster Risk Reduction*.
- Hasan, M., & MacDonald, G. (2021, September). *How Climate Change Deepens Bangladesh's Fragility*. Retrieved from United States Institute of Peace (USIP): <https://www.usip.org/publications/2021/09/how-climate-change-deepens-bangladeshs-fragility>
- Henderson, J., Long, D., Berger, P., Russell, C., & Drewes, A. (2017). Expanding the Foundation: Climate Change and. *Educational Studies*.
- Hestness, E., McGinnis, J. R., Breslyn, W., McDonald, R. C., & Mouza, C. (2017). Examining science educators' perspectives on learning progressions in a climate change. *Journal of Science Teacher Education*, 28(3), 250–274.
- Hickman, C., Marks, E., Pihkala, P., Clayton, S., Lewandowski, R., Mayall, E., . . . Van Susteren, L. (2021). Climate anxiety in children and young people and their beliefs about government responses to climate change: A global survey. *The Lancet Planetary Health*, 5(12), e863–e873. <https://doi.org/10.1016/>.
- Ho, L. C., & Seow, T. (2017). . (2017). Disciplinary boundaries and climate change education: teachers' conceptions of climate change education in the Philippines and Singapore. . *International Research in Geographical and Environmental Education*, 26(3), 240–252.

- Huq, S. (2019, November). *Climate emergency, planetary emergency and our survival*. Retrieved from Daily Star: <https://www.thedailystar.net/opinion/politics-climate-change/news/climate-emergency-planetary-emergency-and-our-survival-1829776>
- Huq, S., & Rabbani, G. (2011). Climate change and Bangladesh: Policy and institutional development to reduce vulnerability. *Journal of Environmental Science & Policy*, 14(1), 1-9.
- IIED. (2009). *CLIMATE CHANGE AND THE URBAN POOR*. International Institute for Environment and Development (IIED).
- IPCC. (2007). *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment*. Cambridge: Cambridge University Press. Retrieved from IPCC: <https://www.ipcc.ch/site/assets/uploads/2018/02/ar4-wg1-faqs-1.pdf>
- IPCC. (2014). IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. (p. 151). IPCC.
- IPCC. (2018). Global Warming of 1.5°C: An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response. IPCC.
- IPCC. (2021). *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. New York: Cambridge University Press.
- IPCC. (2023). *Climate Change 2023: Synthesis Report*. Geneva, Switzerland: Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC.
- Islam, M. A. (2023, September 16). *Introduce climate education at our schools*. Retrieved from Observer BD: <https://www.observerbd.com/news.php?id=437537>
- Islam, M. S. (2013). Solid waste management in Bangladesh: Current practices and future challenges. . *Environmental Monitoring and Assessment*, 185(3), 2047–2058.

- Islam, M., & Islam, D. S. (2022). Challenges of Virtual Teaching Learning Activities in Bangladesh. *Society & Change*, Vol. XV, No.3,.
- Islam, S. N., & Winkel, J. (2017). *Climate change and social inequality*. Retrieved from UN Department of Economic and Social Affairs Working Paper No. 152: <https://www.un.org>
- Ivanchenko, O., Lurie, K., & Melnikova, O. (2023). GUIDELINES FOR TEACHERS AS A COMPONENT OF INFORMATION SUPPORT FOR AN EDUCATIONAL DISCIPLINE. *Grail of Science*, (25).
- Iyengar, R. (2020, April 23). *Charting a Roadmap for Radical, Transformative Change in the*. Retrieved from State of the Planet: Earth Institute, Columbia University: <https://blogs.ei.columbia.edu/2020/04/23/workshop-change-climate-breakdown/>
- Jasim, M. M. (2021, October). *Fund crisis, closure constant worries for disabled children's schools*. Retrieved from The Business Standards: <https://www.tbsnews.net/bangladesh/education/fund-crisis-closure-constant-worries-disabled-childrens-schools-322711>
- Johnson, R., & Lee, T. (2021). *Teaching climate change: Strategies for educators (7th ed.)*. Green Press.
- Jorgenson, S. N., Stephens, J. C., & White, B. (2019). Environmental Education in Transition: A critical review of recent research on climate change education. *The Journal of Environmental Education*, 50 (3).
- Jurek, M., Frajer, J., Fiedor, D., Brhelová, J., Hercik, J., Jáč, M., & Lehnert, M. (2022). Knowledge of Global Climate Change Among Czech Students and Its Influence on Their Beliefs in The Efficacy of Mitigation Action. *ENVIRONMENTAL EDUCATION RESEARCH*.
- Kagawa, F. (2022). *The Heat is On! Towards a Climate Resilient Education System in Bangladesh*. Kathmandu: UNICEF Regional Office for South Asia.
- Kagawa, F., & Selby, D. (2010). *Education and Climate Change: Living and Learning in Interesting Times*. Routledge.

- Kagawa, F., & Selby, D. (2012). Ready for the storm: Disaster risk reduction and climate change education. *Journal of Education for Sustainable Development*.
- Kamruzzaman, M., Hossain, M., & Khan, M. N. (2023, March). *Make education accessible for children with disabilities*. Retrieved from The Daily Star: <https://www.thedailystar.net/opinion/views/news/make-education-accessible-children-disabilities-3262201>
- Kapranov, O. (2021). Discursive representations of education for sustainable development in policy documents by English and Estonian schools. *Discourse and communication for sustainable education*, 55-66.
- Kate, H., James, J., & Tidmarsh, C. (2019). Using Wicked problems to foster interdisciplinary practice among UK trainee teachers. . *J. Educ.*
- Keeling, C. C. (1996). Increased activity of northern vegetation inferred from atmospheric CO₂ measurements. *Nature*.
- Khan, M. (2010). *Impact of Climate Change on the Livelihood of the Urban Poor: A Case of Dhaka City*. Dhaka: North South University.
- Korstjens, I., & Moser, A. (2017). Series: Practical guidance to qualitative research. Part 4: Trustworthiness and publishing. *European Journal of General Practice*, 24(1), 120–124.
- Kumar, B. (2017). *Climate Change in Bangladesh: Causes, effects and suggestions*. Retrieved from Daily Asian Age: <https://dailyasianage.com/news/91661/climate-change-in-bangladesh-causes-effects-and-suggestions>
- Kunkle, K. A., & Monroe, M. C. (2018). Cultural cognition and climate change education in the US: Why consensus is not enough. *Environmental Education Research*, doi: 10.1080/13504622.2018.1465893.
- Kvale, S., & Brinkmann, S. (2009). *Interviews: Learning the craft of qualitative research interviewing*. Sage.
- Kwauk, C. (2022). *The Climate Change Education Ambition Report Card: An analysis of Updated Nationally Determined Contributions submitted to the UNFCCC*. Retrieved from

- Education International: <https://www.ei-ie.org/en/item/25344:the-climate-change-education-ambition-report-card#:~:text=Conducted%20by%20Christina%20Kwauk%2C%20the,a%20tool%20for%20climate%20action.>
- Læssøe, J., Schnac, Breiting, S., & Rolls, S. (2009). Climate Change and Sustainable Development: The Response from Education. *International Alliance of Leading Educational Institutes*.
- LaGarry, A. (2019). Observing Schools and Classrooms. *Oxford Research Encyclopedia of Education*, <https://doi.org/10.1093/acrefore/9780190264093.013.983>.
- Larue, J., Jacques, K. B., & Munang, R. (2016). Putting Climate Change Education in the Vision of Africa Development. Results-based Activities on Climate Change Education in Sub-Saharan Africa. 118.
- Leavy, P. (2011). *Essentials of Transdisciplinary Research (1st ed.)*. Routledge.
- Lee, T., Markowitz, E., Howe, P., Ko, C., & Leiserowitz, A. (2015). Predictors of public climate change awareness and risk perception around the world. *Nature Climate Change*, 5(11), 1014–1020.
- Lehtonen, A., Salonen, A., & Cantell, H. (2019). Climate Change Education: A New Approach for a World of Wicked Problems. In A. Lehtonen, A. Salonen, & H. & Cantell, *Sustainability, Human Well-Being, and the Future of Education* (pp. 10.1007/978-3-319-78580-6_11.). University of Helsinki.
- Lenzen, M., Dey, C., & Murray, J. (2002). A Personal Approach to Teaching about Climate Change. *Australian Journal of Environmental Education*, 18, 35–45.
- Levesque, A., & Rocque, R. (2024). An innovative framework for teaching climate change: integrating emotion coping strategies and exploring a new climate emotion scale among Canadian youth. *Environmental Education Research*, 1–21.
- Libarkin, J. C., Gold, A. U., Harris, S. E., McNeal, K. S., & Bowles, R. P. (2018). A new, valid measure of climate change understanding: associations with risk perception. *Climate Change*, 403-416.

- Makisa, K. (2016). Assessment of Integrated Environmental Management in Public and Private Schools in the Copperbelt Province of Zambia. *Journal of Education and Practice*, 7(28), 102 – 109.
- Malak, M. S. (2013). Inclusive Education Reform in Bangladesh: Pre-Service Teachers' Responses to Include Students with Special Educational Needs in Regular Classrooms . *International Journal of Instruction*, 6 (1).
- Mantula, F. e. (2024). Qualitative Research Approach in Higher Education: Application, Challenges and Opportunities. *East African Journal of Education and Social Sciences*, doi: 10.46606/eajess2024v05i01.0343a.
- Marquart-Pyatt, Shwom, R. L., Dietz, T., Dunlap, R. E., Kaplowitz, S. A., McCright, A. M., & Zahran, S. (2011). Understanding public opinion on climate change: A call for research. *Environment: Science, Policy for Sustainable Development*, 53(4), 38–42.
- Mason, G. (2023). *What can John Dewey teach us about teaching and learning in the 21st century?* Retrieved from Western Sydney University Online Engagement and Teaching Hub.: <https://lf.westernsydney.edu.au/engage/theory/what-can-john-dewey-teach-us-about-teaching-and-learning-in-the-21st-century>
- McKenzie, M. (2021). Climate change education and communication in global review: Tracking progress through national submissions to the UNFCCC Secretariat. *Environmental Education Research*, 27, 631–651.
- Merriam, S. B., & Grenier, R. S. (2019). *Qualitative research in practice: Examples for discussion and analysis (2nd edition)*. Jossey-Bass.
- Methods. (2019, December 18). *Four Styles of Situational Leadership*. Retrieved from Methods: <https://methodsof.com/blog/situational-leadership/>
- Milér, T., Hollan, J., Válek, J., & Sládek, P. (2012). Teachers' understanding of climate change. . *International Conference on Education and Educational Psychology (ICEEPSY 2012)*, 69, 1437–1442.
- Mochizuki, Y., & Bryan, A. (2015). Climate change education in the context of education for sustainable development: Rationale and principles. *J. Educ. Sustain*, 4–26.

- MOEF. (2021). *Nationally Determined Contributions (NDC) 2021: Bangladesh*. Dhaka: Ministry of Environment, Forest and Climate Change .
- MoEFCC. (2023). *Nation-wide Climate Vulnerability Assessment in Bangladesh*. Dhaka: Ministry of Environment, Forest and Climate Change, Government of the People's Republic of Bangladesh.
- Mokaya, D. C., Mwangi, D., & Kariuki, C. (2016). Infusing climate change content into Kenya's secondary school taught curriculum: success and challenges. *IOSR Journal of Environmental Sciences, Toxicology and Food Technology*, 10 (9), 23 - 29.
- Monroe, M. C., Oxarart, A., & Plate, R. R. (2013). A role for environmental education in climate change for secondary science educators. . *Applied Environmental Education & Communication*, 4–18. doi:10.1080/1533015X.2013.795827.
- NASA. (2021). *Global Carbon Dioxide: 2020-2021*. Retrieved from NASA: <https://science.nasa.gov/resource/global-carbon-dioxide-2020-2021/>
- NASA. (2024). *Is the Ozone hole causing climate change?* Retrieved from NASA Science: <https://science.nasa.gov/climate-change/faq/is-the-ozone-hole-causing-climate-change/>
- NCTB. (2012, December). *Bangladesh National Curriculum 2012*. Retrieved from https://file.portal.gov.bd/files/se0.sreemangal.moulvibazar.gov.bd/news/flf003e4_9d24_45dc_974d_4cb2eb4e7ad3/4b1ee2279c3761b13f400c80d713819e.pdf
- NCTB. (2021). *National Curriculum Framework- 2021*. Retrieved from NCTB.
- NCTB. (2023, December). *২০২৪ শিক্ষাবর্ষের মাধ্যমিক স্তরের অষ্টম শ্রেণির পাঠ্যপুস্তক*. Retrieved from NCTB: <https://nctb.portal.gov.bd/site/page/b2b83e65-3935-4508-a61b-558407e1ea7b>
- Nepraš, K., Strejčková, T., & Kroufek, R. (2022). Climate Change Education in Primary and Lower Secondary Education: Systematic Review Results. *Sustainability*, 14(22).
- New Age . (2023, March 5). *Poor planning hampers curriculum implementation*. Retrieved from New Age BD: <https://www.newagebd.net/article/195963/poor-planning-hampers-curriculum-implementation>

- New Age. (2021, December 12). *Trial of new curriculum to begin in Jan 2022*. Retrieved from New Age BD: <https://www.newagebd.net/article/157135/trial-of-new-curriculum-to-begin-in-jan-2022>
- New Age. (2022, January). *New school curriculum use faces challenges*. Retrieved from New Age BD: <https://www.newagebd.net/article/191706/new-school-curriculum-use-faces-challenges>
- Nogueira, L. M. (2020). Climate Change and Cancer. *CA Cancer Journal*.
- O'BRIEN, A., & HEGELHEIMER, V. (2007). Integrating CALL into the classroom: the role of podcasting in an ESL listening strategies course. . *ReCALL, Volume 19, Issue 2*, 162-180.
- Observer Bangladesh. (2024, January). *Support teachers to help implement new curriculum*. Retrieved from Observer BD: <https://www.observerbd.com/news.php?id=454673>
- Öhman, J., & Öhman, M. (2013). Participatory approach in practice: An analysis of student discussions about climate change. *Environmental Education Research*.
- Ojala, M. (2012). Hope and climate change: The importance of hope for environmental engagement among young people. *Environmental Education Research, 18*(5), 625–642.
- Ojala, M. (2015). Hope in the face of climate change: Associations with environmental engagement and student perceptions of teachers' emotion communication style and future orientation. *J. Environ. Education, 133–148*.
- Ojala, M. (2023). Climate-change education and critical emotional awareness (CEA): Implications for teacher education. *Educational Philosophy and Theory*.
- Palinkas, L. A. (2015). Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Administration and Policy in Mental Health and Mental Health Services Research, 533-544*.
- Parsons, S. A., Vaughn, M., Scales, R. Q., Gallagher, M. A., Parsons, A. W., Davis, S. G., . . . & Allen, M. (2018). Teachers' Instructional Adaptations: A Research Synthesis. *Review of Educational Research, 205-242*.
- Patton, M. Q. (2002). Qualitative research & evaluation methods (3rd ed.). *Sage Publications*.

- Pihkala, P. (2017). Environmental Education After Sustainability: Hope in the Midst of tragedy. *Global Discourse*, 7(1), 109-127.
- Piper, B., Sitabkhan, Y., Mejía, J., & Betts, K. (2018). *Effectiveness of Teachers' Guides in the Global South*. Research Triangle Park, NC: RTI Press.
- Prothom Alo. (2022, December 25). *DSHE cannot avoid responsibility for hindering implementation of new curriculum*. Retrieved from Prothom Alo: <https://en.prothomalo.com/opinion/editorial/8uk9xtlemk>
- Puspita, T., Friskarini, K., Marina, R., & Suryatma. (2020). Knowledge and Attitude of Junior-High-School Children in Bogor, Indonesia, Related to Climate Change Health Impacts.
- Rabbani, G., Rahman, A., & Islam, N. (2011). Climate Change Implications for Dhaka City: A Need for Immediate Measures to Reduce Vulnerability. Resilient Cities: Cities and Adaptation to Climate Change - Proceedings of the Global Forum 2010. . Otto-Zimmermann, K. (eds) Resilient Cities. Local Sustainability, vol 1. : Springer, Dordrecht.
- Rahman, B. (2021, March 29). *Integrating climate change education in school curriculum*. Retrieved from Observer BD: <https://www.observerbd.com/news.php?id=305730>
- Rahman, M. H., Islam, A. S., & Shampa, S. (2024). A Case Study of the Temporal Evaluation of the Urban Heat Island (UHI) Effect: Impacts on Water Availability and Air Quality of Dhaka City. *The American Geophysical Union (AGU)*. San Francisco.
- Rahman, S. (2024, January). *Implementing new curriculum will be challenging*. Retrieved from The Daily Star: <https://www.thedailystar.net/opinion/interviews/news/implementing-new-curriculum-will-be-challenging-3526311>
- Rahman, S., Tasmin, S. U., K., M., Islam, M. T., & Sujauddin, M. (2014). Climate Change Awareness among the High School Students: Case Study from a Climate Vulnerable Country. *International Journal of Built Environment and Sustainability*, 1(1).
- Ramakhula, M., Kheleli, M., & Ratsele, A. (2014). 'Climate Change Education in the Formal Curriculum in Lesotho' in *Climate Change Education in SADC School Curriculum*.

- Reed, M. & O.-R. (2020). Evaluating impact from research: A methodological framework. *Research Policy*.
- Reliefweb. (2020). *Tackling Climate Change and Preserving the Water Body: A Bangladeshi Perspective*. <https://reliefweb.int/report/bangladesh/tackling-climate-change-and-preserving-water-body-bangladeshi-perspective>.
- Rey, L. P. (2024). Climate Change and Social networks: The use of Instagram and TikTok among secondary-school students in relation to sustainability.
- Riad, S. S., & Podder, R. (2015). Implementation of Secondary Curriculum 2012 in Bangladesh: Expectations and Obstacles. *Swami Vivekanand Journal of Educational Research*, Vol II (1).
- Ronald, M. A., Merab, K. A., & B. M. (2017). Impact of Secondary School Geography Content in Mitigating Climate Change in Uganda. *IOSR Journal of Environmental Science, Toxicology and Food technology*, 45, 35 – 43.
- Rousell, D., & Cutter-Mackenzie-Knowles, A. (2019). A systematic review of climate change education: giving children and youth a voice and a hand in redressing climate change. *Children's Geographies*.
- Rushton, E., Sharp, S., & Walshe, N. (2023). Reflecting on Climate Change Education Priorities in secondary schools in England: Moving beyond learning about climate change to the emotions of living with climate change. *Sustainability*.
- Rye, J., Rubba, P., & Wiesenmayer, R. (2011). An investigation of middle school students' alternative conceptions of global warming. *International Journal of Science Education*, 3(2), 527-551.
- Sabbab, S., & Ahmed, S. (2024, January 1). *Restructuring climate education in Bangladesh*. Retrieved from Dhaka Tribune: <https://www.dhakatribune.com/opinion/op-ed/337332/restructuring-climate-education-in-bangladesh>
- Sánchez-Almodóvar., E., Isabel, M., Gómez-Trigueros., & Jorge, O.-C. (2022). Climate Change and Extreme Weather Events in the Education of the Citizens of the Twenty-First Century: The Perception of Secondary Education Students.

- Sanders, L. R. (2001). Improving Assessment in University Classrooms. *College Teaching*, Volume 49, Issue 2, 62-64.
- Save the Children Bangladesh. (2016, December). *SHIKHON Stories (booklet)*. Retrieved from Save the Children Bangladesh: https://bangladesh.savethechildren.net/sites/bangladesh.savethechildren.net/files/library/Shikhon%20stories%20combined%20%28ban%2Beng%29_0.pdf
- Save the Children Bangladesh. (2018). *SHIKHON: Non Formal Basic Education for Hard to Reach Children*. Save the Children Bangladesh.
- Save the Children. (n.d.). *Effects of climate change on future generations*. Retrieved from Save the Children: <https://www.savethechildren.org/us/what-we-do/emergency-response/climate-change>
- Save the Children UK. (2017). *International Development Committee Project Report*. Isle of Man: Save the Children UK.
- Sayed, M., & Haruyama, S. (2016). Evaluation of Flooding Risk in Greater Dhaka District Using Satellite Data and Geomorphological Land Classification Map. *Journal of Geoscience and Environment Protection*, 110-127.
- Schreiner, C., Henriksen, E. K., & Hansen, P. J. (2005). Climate Education: Empowering Today's Youth to Meet Tomorrow's Challenges. *Studies in Science Education* 41 (1), 3-49.
- Secretary-General's remarks on Climate Change [as delivered]* (2018). [Motion Picture].
- Shea, N. A., Mouza, C., Drewes, A., & . (2017). Climate change professional development: Design, implementation, and initial outcomes on teacher learning, practice, and student. *Journal of Science Teacher Education*, 27(3), 235–258. doi:10.1007/s10972-016-9456-5.
- SHED. (2024, September 1). *SHED Circular*. Retrieved from Secondary and Higher Education Division, Education Ministry: https://shed.gov.bd/sites/default/files/files/shed.portal.gov.bd/notices/ae6676f5_7447_4d53_8303_f3c95f8d4f4f/518.pdf

- Shepardson, D., Niyogi, D., & Charusombat, U. (2009). Seventh grade students' conceptions about global warming and climate change . *Environmental Education Research*, 15(5), 549- 570.
- Shohel, C., Maruf, M., Goutam, R. T., Atm, S. A., & Shahriar, S. (2021). Climate Change Adaptation and Sustainability in the Bangladeshi School Curriculum. . doi: 10.4018/978-1-7998-7512-3.CH013.
- Shumba, O., Kasembe, R., Mukundu, C., & Muzenda, C. (2008). Environmental sustainability and quality education: Perspectives from a community living in a context of poverty. *Southern African Journal of Environmental Education*, 25, 81-97.
- Siegner, A. B. (2018). Experiential climate change education: Challenges of conducting mixed-methods, interdisciplinary research in San Juan Islands, WA and Oakland, CA. *Energy Research and Social Science*.
- Silberman, A., & Carioscia, S. (2016). *The Importance of Holistic Approaches to Climate Change*. Retrieved from Global Futures Initiative- Georgetown University: <https://globalfutures.georgetown.edu/responses/the-importance-of-holistic-approaches-to-climate-change>
- Singh, V. (2021). Toward a transdisciplinary, Justice-Centered pedagogy of climate change. *BRILL eBooks*, 169–187.
- Singh, V. (2023). *Toward an Effective Pedagogy of Climate Change: Lessons from a Physics Classroom*.
- Smith, J. A., Flowers, P., & Larkin, M. (2009). *Interpretative phenomenological analysis: Theory, method, and research*. SAGE.
- Smith, J. D., & Brown, L. M. (2020). The impact of climate change education on student engagement. *Journal of Environmental Education*, 45(2), 123–135.
- Spínola, H. (2021). Environmental Culture and Education: A. *Creative Education*, 983-998.
- Steph, H., Jillian, G., Liz, C., Brooke, D., Wilmsen., Julia, D., . . . Strickland. (2023). Towards an interdisciplinary agenda for teaching in the climate crisis: reflections from the humanities

- and social sciences. . *Environmental Education Research*, doi: 10.1080/13504622.2023.2273791.
- Stewart, D. W., & Shamdasani, P. N. (1990). *Focus Groups: Theory and Practice*. California: Sage Publications.
- Sulistyawati, S., Mulasari, S. A., & Sukesu, T. W. (2018). Assessment of Knowledge regarding Climate Change and Health among Adolescents in Yogyakarta, Indonesia. *Journal of Environmental and Public Health*.
- Swim, J., Clayton, S., J Doherty, T., & Gifford, R. (2009). Psychology and global climate change: Addressing a multi-faceted phenomenon and set of challenges. A report by the American Psychological Association's task force on the interface between psychology and global climate change. *American Psychologist*.
- Szczepankiewicz, E., Fazlagić, J., & Loopesko, W. (2021). A Conceptual Model for Developing Climate Education in Sustainability Management Education System. *Sustainability*.
- Tahsin, N., & Murshed, S. B. (2023). Forecasting Climatic Stress on Water Security for Different Emission Scenarios in Dhaka (Bangladesh). *Advances in science, technology & innovation*, 265-267. .
- The Business Standards. (2019, October). *Over 19 million Banglaedeshi children at risk of climate change*. Retrieved from The Business Standards: <https://www.tbsnews.net/environment/climate-change/over-19-million-bangladesh-kids-risk-climate-change>
- The Business Standards. (2019, November 29). *Uniform curriculum for secondary level from 2022*. Retrieved from The Business Standards: <https://www.tbsnews.net/bangladesh/uniform-curriculum-secondary-level-2022>
- The Business Standards. (2023, December 23). *Education in 2024: New curriculum awaits students, teachers*. Retrieved from The Business Standards: <https://www.tbsnews.net/supplement/education-2024-new-curriculum-awaits-students-teachers-767026>

- The Business Standards. (2024). *Why We Need the New Curriculum*. Retrieved from The Business Standards: <https://www.tbsnews.net/features/pursuit/why-we-need-new-curriculum-816891>
- The Daily Star. (2023, December 31). *New School Curriculum: A step forward yet concerns remain*. Retrieved from The Daily Star: <https://www.thedailystar.net/news/bangladesh/news/new-school-curriculum-step-forward-yet-concerns-remain-3506766>
- The Daily Star. (2023). Opportunities and Challenges to Inclusive Education for Children with Disabilities in Bangladesh. *CDD* (pp. 1-2). Dhaka: Center for Disability in Development (CDD) . Retrieved from <https://www.thedailystar.net/roundtables/news/opportunities-and-challenges-inclusive-education-children-disabilities-bangladesh-3371986>
- The Financial Express. (2022, September 21). *Fresh curriculum from next year to prepare students for 4IR, says PM*. Retrieved from The Financial Express: <https://thefinancialexpress.com.bd/national/fresh-curriculum-from-next-year-to-prepare-students-for-4ir-says-pm-1663693038>
- The Financial Express. (2023, November 10). *A year after introduction of new education curriculum*. Retrieved from The Financial Express: <https://today.thefinancialexpress.com.bd/editorial/a-year-after-introduction-of-new-education-curriculum-1699544636>
- The Financial Express. (2023, May). *Coping with new school curriculum*. Retrieved from The Financial Express: <https://thefinancialexpress.com.bd/views/opinions/coping-with-new-school-curriculum>
- The Financial Express. (2023, June 22). *New education curriculum in a shambles*. Retrieved from The Financial Express: <https://thefinancialexpress.com.bd/views/columns/new-education-curriculum-in-a-shambles>
- The Guardian. (2021, November 15). *Ratchets, phase-downs and a fragile agreement: how Cop26 played out*. Retrieved from The Guardian:

- <https://www.theguardian.com/environment/2021/nov/15/ratchets-phase-downs-and-a-fragile-agreement-how-cop26-played-out>
- thisisFinland. (2019). *FINNISH SCHOOLS EMPHASISE CLIMATE CHANGE EDUCATION*. Retrieved from <https://finland.fi/life-society/finnish-schools-emphasise-climate-change-education/>
- Thomas, T. (2021, November 2). *Climate change is forcing girls out of school — here's what young women want leaders to do about it*. Retrieved from <https://assembly.malala.org/stories/climate-change-is-forcing-girls-out-of-school>
- Trædal, L., Eidsvik, E., & Manik, S. (2022). Discourses of climate change education: The case of geography textbooks for secondary and higher secondary education in South Africa and Norway. *Norsk Geografisk Tidsskrift – Norwegian Journal of Geography*, 76, 94-119.
- Trejo I, B. M. (2023). Changing temperature profiles and the risk of dengue outbreaks. . *PLOS Clim*.
- Uddin, M. K. (2023). Environmental education for sustainable development in Bangladesh and its challenges. *Sustainable Development*, 1137-1151.
- UN. (2016). *Education is key to address climate change*. Retrieved from United Nations (UN): <https://www.un.org/en/climatechange/climate-solutions/education-key-addressing-climate-change#:~:text=The%20UN%20Framework%20Convention%20on,information%20access%20on%20the%20issue>.
- Unal, M. (2023). The Climate Literacy Levels of Secondary School Students and Their Opinions on Climate Change. *Bartın üniversitesi eğitim fakültesi dergisi*, 12(4):673-690. doi: 10.14686/buefad.1346851.
- UNDESA. (2022). *World Population Prospects 2022: Summary of Results*. Retrieved from United Nations Department of Economic and Social Affairs, Population Division: <https://population.un.org/wpp/>
- UNDP. (2022, September). *Ensuring climate justice for the urban poor*. Retrieved from UNDP: <https://www.undp.org/bangladesh/blog/ensuring-climate-justice-urban-poor>

- UNDP. (2023). *Rising up: How youth are leading the charge for climate justice*. . Retrieved from UNDP: https://www.undp.org/blog/rising-how-youth-are-leading-charge-climate-justice?utm_source=chatgpt.com
- UNDP. (2024, September). People's Climate Vote- UNDP. <https://peoplesclimate.vote/>.
- UNESCO. (2020). *The Impact of Climate Displacement on the Right to Education*. France: UNESCO.
- UNESCO. (2021). *Learn for our planet: a global review of how environmental issues are integrated in education*. Paris: UNESCO.
- UNESCO. (2022). *Climate Change Communication and Education: Country Profile of Japan*. UNESCO.
- UNESCO Institute for Statistics . (2012). *Children out of school, primary*. UNESCO .
- UNESCO Institute for Statistics. (2022). *Secondary education, teachers - Bangladesh*. Retrieved from UNESCO Institute for Statistics (UIS): <https://apiportal.uis.unesco.org/bdds>
- UNICEF. (2019). *A Gathering Storm: Climate Change Clouds the Future of Children in Bangladesh*. <https://www.unicef.org/rosa/media/3001/file> : UNICEF.
- UNICEF. (2020). *Impact of climate change on children in Bangladesh*. Retrieved from UNICEF: <https://www.unicef.org/bangladesh>.
- UNICEF. (2021). *Disability inclusive education practices in Bangladesh*. Kathmandu: UNICEF.
- UNICEF. (2021). *Rising to the Challenge: Youth Perspectives on Climate Change and Education in*. Retrieved from UNICEF: <https://www.unicef.org/rosa/media/12321/file/Rising%20to%20the%20Challenge%20->
- UNICEF. (2021). *The climate crisis is a child rights crisis: Introducing the Children's Climate Risk Index*. Retrieved from UNICEF: <https://data.unicef.org/resources/childrens-climate-risk-index-report/>
- UNICEF. (2021). *The climate crisis is a 'child's rights crisis'*. <https://www.unicef.org/media/135686/file/Analysis%20of%20the%20CCRI%20for%20Least%20Developed%20Countries.pdf>: UNICEF.

- USAID. (2018). *Fragility and Climate Risks in Bangladesh*. Retrieved from <https://www.strausscenter.org/wp-content/uploads/Country-Brief-Fragility-and-Climate-Risks-in-Bangladesh-2018.pdf>
- Van Driel, J. H., & Berry, A. (2012). Teacher professional development focusing on pedagogical content knowledge. *Educational Researcher*, 41(1), 26–28.
- Vay, J. N., Cunningham, A., Soul, L., Dave, H., Hoath, L., & Lawrance, E. L. (2024). Integrating mental health into climate change education to inspire climate action while safeguarding mental health. . *Frontiers in Psychology*, 14., <https://doi.org/10.3388>.
- Verlie, B. ((2017)). Rethinking Climate Education: Climate as Entanglement. *Educational Studies*, DOI: 10.1080/00131946.2017.1357555.
- Verlie, B., & Flynn, A. (2022). School strike for climate: A reckoning for education. *Australian Journal of Environmental Education*, 38(1), 1-12.
- Wadson, D., Mulenga, I. M., & Milupi, I. (2023). Teacher Preparedness and Strategies Used in Teaching of Climate Change Education in the Southern Region of Malawi. . *East African Journal of Education and Social sciences*.
- Weissberg, R. P., Durlak, J. A., Domitrovich, C. E., & Gullotta, T. P. (2015). *Social and emotional learning: Past, present, and future*. In *Handbook of social and emotional learning: Research and practice*. (pp. 3–19). : The Guilford Press.
- Willox, C., Harper, S. L., & Edge, V. L. (2012). Storytelling in a changing climate: A case study in participatory climate change adaptation research. *Environmental Science & Policy*, 23, 14-25.
- Wilson, M., & Sloane, K. (2000). From Principles to Practice: An Embedded Assessment System. *Applied Measurement in Education*, Volume 13, Issue 2, 181-208.
- WMO. (n.d.). *Climate*. Retrieved from World Metereological Organization: <https://wmo.int/topics/climate>
- World Bank. (2021). *Climate Change in Bangladesh: Impact on Infectious Diseases and Mental Health*. Retrieved from World Bank:

<https://www.worldbank.org/en/news/feature/2021/10/07/climate-change-in-bangladesh-impact-on-infectious-diseases-and-mental-health>

- Yani, S., Lasmita, S., I. F., Amalia., & Arip, N. (2024). High school students' preconceptions about the concept of climate change considered from the perspective of visual representation. . *Research in Physics Education*.
- Zeeshan, M., Sha, L., Tomlinson, K. W., & Azeez, P. (2020). Factors shaping students' perception of climate change in the western. *Environmental Sustainability*.
- Zhang, Y., & Wildemuth, B. M. (2009). *Qualitative Analysis of Content: Applications of Social Research Methods to Questions in Information & Library Science*.
- Zinnah, M. A. (2010). Social science teachers' pedagogical content knowledge: A case study at general secondary school level in Bangladesh. *International Journal of Educational Development*, 30(1), 80-87.

Appendices

Appendix A. Consent Letter for Parents

Parents' Informed Consent Form

PURPOSE OF THE STUDY

I understand that my child is being invited to participate in a research study conducted by Zeba Sajida Saraf, a Master's student at the Brac Institute of Educational Development (BIED), BRAC University. The purpose of this study is to explore the perceptions of climate change among low-income secondary school students in Bangladesh and to understand how teachers integrate climate change into their lessons under the curriculum framework of 2021.

PARTICIPATION DETAILS

If I agree to my child's participation, I understand that he/she will be asked to take part in an interview and a focus group discussion (FGD) conducted by the researcher. The interview and FGD will involve questions about my child's understanding and perceptions of climate change and their experiences with climate change education in their school.

DESCRIPTION OF RESPONSIBILITIES

- My child will participate in an interview with the researcher
- My child will participate in a Focus Group Discussion with other students from his/her class

RISKS

- There are no known risks to my child from participating in this research
- Participation is completely voluntary, and my child may withdraw any moment without any consequence.

BENEFITS

- My child will have the opportunity to share their views and contribute to research that may inform educators as well as education and development policymakers
- Participation may help my child to reflect on their understanding of climate change

CONFIDENTIALITY

I understand that all information collected from my child in the study will be kept strictly confidential. Data will be stored securely on a password-protected laptop, and no information will reveal my child's identity. Audio recordings of the interviews will be kept confidential, with

participants' identities concealed. No reference will be made in oral or written reports that reveal my child's name, his/her teacher's name or school name. All data will be used by the researcher to explore my child's perception toward climate change, the pedagogical practices regarding climate change education and how the teachers integrate climate change in secondary classrooms. Additionally, I also understand that reports using the recordings from this study may be shared with the research community at conferences and in research papers.

CONTACT

Zeba Sajida Saraf

Email: zeba.sajida.saraf@g.bracu.ac.bd

Brac Institute of Educational Development, BRAC University

If I decide for my child to participate, I am free to withdraw my child's participation at any time without consequence. If I withdraw my child's participation, his/her information will be removed from this thesis.

If my child participates in this research project, I can get information about the research project and copies of my child's interview and group discussion data.

Parent/Guardian's name: _____

Child's name: _____

Parent/Guardian's Signature: _____

Date: _____

Researcher name: _____

Signature: _____

Date: _____

Appendix B. Permission Letter for School Authority

To

The Headteacher

.....

Dhaka, Bangladesh.

Subject: Request for providing support for Master's thesis

Dear Sir/Madam,

I, Zeba Sajida Saraf, am doing my Master's thesis on "Students' Perceptions about Climate Change Education and Pedagogical Approach in the 2021 Curriculum Framework of Bangladesh: An Exploratory Study" under the Brac Institute of Educational Development (BRAC IED). This study intends to explore the perceptions of climate change among low-income secondary school students in Bangladesh and how teachers integrate climate change in their lessons under the curriculum framework of 2021.

To collect data, in-depth interviews of six secondary students from class 8 along with a Focus group discussion will be conducted and recorded by the researcher. After that, in-depth interviews of a few subject teachers will be collected and their classes on the subjects Science, History and Social Science will be observed. As a researcher, only I have the access to the recordings and transcripts of these interviews, discussions and observations. Participation in this study will be entirely voluntary and participants have the right to withdraw their consent from the study anytime they are willing. All the participants' identities will be kept confidential, and information will be used only for this research purpose. In case of the students, consent of their parents will also be taken.

Therefore, I would like to seek your permission to allow me to conduct this research in your school. I hope you and your colleagues will kindly provide me with the support necessary. If you have any queries regarding this study, please contact me through the information provided below.

Thank you for giving me your valuable time.

Sincerely,

Zeba Sajida Saraf

Master's Student

Email: zeba.sajida.saraf@g.bracu.ac.bd (Brac Institute of Educational Development, BRAC University)

Appendix C. Consent Form for Teachers

Teachers' Informed Consent Form for Research

“Students’ Perceptions about Climate Change Education and Pedagogical Approach in the 2021 Curriculum Framework of Bangladesh: An Exploratory Study”

Zeba Sajida Saraf, Master’s Student

Brac Institute of Educational Development, BRAC University

I have read the information provided thoroughly and understand it. After careful reading, I have decided to participate in the research project titled, “Students’ Perceptions about Climate Change Education and Pedagogical Approach in the 2021 Curriculum Framework of Bangladesh: An Exploratory Study”.

The study aims to explore the perceptions of climate change among low-income secondary school students in Bangladesh and how teachers integrate climate change in their lessons under the curriculum framework of 2021.

I agree to the conditions listed below with the understanding that I may withdraw my participation from the project at any time and I may choose not to answer any questions that I do not want to answer.

DESCRIPTION OF RESPONSIBILITIES

- I will participate in an interview with the researcher (face to face or over the phone)
- I will allow the researcher to observe my class in session

RISKS

- There will be no risks to me, other teachers and students from this research
- My consent is optional and voluntary
- No information will be recorded that might be uncomfortable for me.

BENEFITS

- I understand that I might benefit from participation by gaining insights into existing climate change education pedagogy and contributing to the potential improvement of current pedagogical practices.
- I understand that I will have the opportunity to reflect on my own teaching methods regarding climate change education, which can lead to a positive impact in my students’ learning experiences.

CONFIDENTIALITY

I understand that the information in the study records will be kept strictly confidential. Data will be stored securely on a password-protected laptop, and no information will reveal subjects' identities. Audio recordings of the interviews will be kept confidential, with participants' identities concealed. No reference will be made in oral or written reports that reveal my name. All data will be used by the researcher to explore my pedagogical practices regarding climate change education and how I integrate climate change into my subject-based lessons in secondary classrooms. Additionally, reports using the recordings may be shared with the research community at conferences and in research papers.

CONTACT

Zeba Sajida Saraf

Email: zeba.sajida.saraf@g.bracu.ac.bd

Brac Institute of Educational Development, BRAC University

If I decide to participate, I am free to discontinue participation at anytime without prejudice. If I withdraw my participation, my information will be removed from this thesis.

If I participate in this research project, I can get information about the research project and copies of my interview and classroom observation data.

Teacher's name: _____

Signature: _____ **Date:** _____

Researcher name: _____

Signature: _____ **Date:** _____

*The teacher would be able to keep a copy of this form for his/her records

Appendix D. Interview Guide for Teachers

Theme	Interview questions
Teachers' views on the state of climate change education	1. How do you, and your school view climate change education? Do you think teaching climate change to your students from this community might be beneficial for them? If yes/no, why. 2. What impact do you think your students' community is facing climate change impacts? Can you give some examples?
Integration of climate change knowledge across the new curriculum NCTB textbooks: Science, History & Social Science, Life & Livelihood subjects at 8 th grade	3. In your opinion, do the textbooks in the new curriculum in the subject you teach contain sufficient information about climate change, its causes, impacts and adaptation efforts? 4. Do you think these new textbooks will help you to develop the (cognitive & social) skills/competencies and consequently cultivate climate awareness and a sense of responsibility towards the environment among your students?
Integration of climate change in regular subject-based lessons	5. How do you integrate climate change topics into your regular subject-based lessons? Do you include climate change knowledge from the textbooks only or do you add other information from different sources? 6. How often do you teach climate change related topics in your subject-based lessons?
Assessment	7. How would you assess your students' understanding about climate change, its impacts and adaptation efforts under the new curriculum's guidelines?
Sources of information on climate change	8. Have you or any of your colleagues invited expert guest speakers to hold any workshops or give lectures about climate change and its impacts for your students? 9. Do the Teachers' Guideline (TG) as issued by the government, include information on how to teach climate change to students in the new curriculum? 10. The teacher training you received to implement the new curriculum, did they include information/sessions on how to teach climate change? If yes, was the training sufficient for you? 11. What are your sources of information about climate change? (e.g., News/Social media etc.) Do you personally research information about the discipline of climate change education for increasing your own understanding of the pedagogy? 12. Have you attended any training, skill-based workshops or conferences on teaching climate change from 2021-today (govt./NGO-arranged)?

Challenges faced when teaching climate change	13. What type of challenges do you face when teaching about climate change or incorporating climate change topics into your subject lesson? Can you give me an example? 14. What resources/support do you need for implementing climate change education or teaching climate change in your classroom?
How Teachers manage students' emotions on climate	15. What have you observed about your students' feelings about the issue of climate change? How do you deal with those feelings of your students?

Appendix E. Interview Guide for Students

Interview guide:

Theme	Interview Questions
Basic concepts & Causes	1. Have you experienced any changes in the environment over the years? (e.g., increase in temperature, drought, decrease in rain, warmer winters, increasing floods/cyclones etc.) 2. Why does climate change happen? Can you identify some of the causes of climate change?
Consequences	3. Do you believe that climate change can endanger your life? 4. Can you identify some key consequences that climate change has in your daily life? (e.g., sea level rise, global warming/ rising temperatures, pollution, ice sheet melting, coral reef dying, desertification etc.)
Climate action/mitigation	5. What actions can people take in their daily lives against climate change? Do you take any of them?
Source of information	6. How often do you think about climate change? (daily/weekly/rarely) 7. Where do you receive most information about climate change from? (friends, school, TV, tiktok etc) 8. How is climate change taught in your classes? Are you satisfied with the way it is being taught?

Appendix F. FGD Guideline

FGD of students

Guiding questions for the focus group discussion of 8th grade students-

1. What comes to your mind when you think about the words ‘climate change’?
2. Share your thoughts on the statement: “Climate change is a threat to humanity”
3. Do you think your community will be affected by climate change? If yes, what impacts will be on your community and your country?
4. How do you feel when you think about these impacts on your community and country?
5. Do you think your new textbooks have properly addressed/ discussed these feelings (or what to do with these feelings) that might arise in many other Bangladeshi students like you?
6. Did your teachers address/ discuss these feelings in class?
7. As a group, share & discuss how climate change is presented in your new textbooks and other learning materials used by your teachers.
8. What activities (group work, projects, debates, assignments, expert talks, online videos) have you participated in school related to climate change that helped you learn about it in-depth?
9. As a group, discuss how effective these learning activities and the new textbooks have been in making you more knowledgeable/interested about climate change.
10. If you were youth leaders in your community, what collective and individualized actions/activities would you like to take to fight climate change? (e.g., protests, rallies, tree planting projects, waste recycling)

Appendix G. Class Observation Protocol

	Class duration: Place: Student number: Student gender:		Subject: Learning outcome: Learning materials used:
No	Criteria	Yes/No	Observation Notes
1	Teacher's utilization of available learning materials to teach climate change (materials include: new curriculum textbooks, other supplementary texts/worksheets, print-outs from the internet)		
2	Teacher's utilization of new curriculum instructions/guidelines to incorporate climate change in their subject-based learning outcomes		
3	Climate change content knowledge of teachers		
4	Student engagement & participation (Student talking time vs Teacher talking time)		
5	How teacher assesses student's climate change knowledge after a lesson		
6	Teacher's responsiveness/reaction to student queries about climate change		
7	Teacher's approach to dealing with students' feelings about climate change		