EFFECTS OF A SCHOOL GARDEN ON CHILDREN'S SCIENCE KNOWLEDGE IN A PRIMARY SCHOOL OF DHAKA

BY

DEWAN SABRINA SHARMIN

A thesis submitted in partial fulfilment of the requirement for the degree of

MASTER OF ARCHITECTURE

Department of Architecture

BANGLADESH UNIVERSITY OF ENGINEERING & TECHNOLOGY

Dhaka, Bangladesh

March 2023

Department of Architecture
Bangladesh University of Engineering and Technology
Dhaka-1000, Bangladesh.

The thesis titled "EFFECTS OF A SCHOOL GARDEN ON CHILDREN'S SCIENCE KNOWLEDGE IN A PRIMARY SCHOOL OF DHAKA" Submitted by Dewan Sabrina Sharmin, Roll No-1014012020 F, Session: October-2014, has been accepted as satisfactory in partial fulfillment of the requirements for the Degree of MASTER OF ARCHITECTURE on this day 29th March, 2023.

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DEDICATION

To My Parents

Marina Rahman & Dewan Sadequr Rahman

Acknowledgement

This research has garnered significant contributions from several individuals. Foremost, it is imperative to acknowledge the indispensable role of my supervisor, Dr M. Zakiul Islam, who granted me the remarkable opportunity to delve into this topic. I am profoundly indebted to him for demonstrating how to research children's environments and generously imparting his expertise on the subject matter. The successful completion of this research endeavour owes much to his unwavering guidance and supervision.

I would like to express my gratitude to Mr. Faez Mahbub Chowdhury, Assistant Clinical Psychologist, Member, Bangladesh Clinical Psychology Society, for being an essential guide in this course of work. As an architecture student, I aimed to focus on built environment research. However, Mr Faez conveyed the psychological dimension of children's lives, introduced me to different educational research methods and helped form the achievement test questionnaire and its analysis.

I am thankful to all the children and their parents of Engineering University Girls' School and College, Dhaka, who have volunteered in this research. I am grateful to Mr Ashutosh Chandra Sarkar, the Headmaster of Engineering University Girls' School and College, for allowing me to intervene in the school and providing all the support. I also want to mention the cooperation of the science teachers, Ms Sultana Rajia and Ms Shaila Parvin, during the field survey and data collection. I want to thank Mr Babul, the gardener, for setting up the school garden, which was our outdoor learning space and lab.

I had unyielding support from my mother throughout the research process. Her concern for this work's timely and successful completion was evident in her actions. Her dedication and commitment to my work were the inspiration that drove me to complete the research.

I want to express my deep gratitude to Mr Sheikh Muhammad Rezwan, Assistant Professor, Department of Architecture, Daffodil University, for providing the much-needed initial guidance and conducting an informative Zoom session outlining the possible workflow; Mr Imamur Hossain, Assistant Professor, Department of Architecture, Sonargaon University, for the drone shots of the school premises at the shortest notice and Mr Mahbub Babui, Researcher, Bangladesh bank, for his expert opinion on the statistical approaches for the quantitative part of the research.

Last but not the least, I express my sincere gratitude to my friends and family, including but not limited to Mamun Ferdaus, Nazmul Ahmed Roni, Nabila Sayed, Zafrul Kabir, Nuzat Subah, Nafisa Bari, Rezuana Shoma, and Obidul Haque Titu for their invaluable technical and moral support during times of need, enabling me to successfully complete my thesis.

Abstract

The design and use of classrooms at schools have received considerable attention, while the design and use of the school's immediate outdoors have received much less. Nevertheless, worldwide studies found that school children between 7 and 11 learn best when their lessons are integrated with the outdoors. Researchers in industrialised civilisations have become interested in the outdoors since it contributes to better cognitive ability. However, more research needs to be done in the setting of developing nations. In Bangladesh, urban primary schools with inadequate facilities—poorly lit and ventilated classrooms—can potentially use this outdoor area as a learning environment for children. This idea is examined in this thesis.

This research investigates the impact of a school garden intervention on primary school students' science knowledge. A garden, set up on the school ground, and science lessons from the textbook imparted in the garden made up the garden intervention. Students (N=55) in the fifth grade (aged 8 to 10) participated in the study, divided into treatment (n=24) and control (n=31) groups. The study adopts a mixed methods research strategy and incorporates a 7-item achievement test emphasising natural and plant science to measure differences in students' science learning as the quantitative part of the study. A questionnaire survey to investigate affective and physical factors influencing children's science knowledge and systematic observation, focus group discussions and in-depth interviews with teachers and students were part of the qualitative aspects of the study.

The achievement test indicates that science knowledge increased among children in the garden intervention, while the t-test confirms that the school garden ($t = 3.378 > p$ at 0.002) significantly affects children's science knowledge. The *knowledge, analysis*, and *evaluation* levels within the cognitive domain of learning are where the difference is most noticeable. Also, the children demonstrated higher involvement, motivation, and passion for learning in the garden.

Keywords

Children, Science learning, Schools, School gardens, Bangladesh

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List of Abbreviations

ADHD	Attention Deficit Hyperactivity Disorder
BANBEIS	Bangladesh Bureau of Educational Information and Statistics
BSI	The Boston Schoolyards Initiative
CRC	Conventions on the Rights of the Child
DPE	Directorate of Primary Education
EIC	Environment as an Integrating Context
FGD	Focus Group Discussion
GPS	Government Primary School
LGED	Local Government Engineering Department
NCTB	National Curriculum and Textbook Board
NGO	Non-Government Organization
PEDP	Primary Education Development Project
PSQL	Primary School Quality Level
PWD	Public Works Department
RNGPS	Registered Non-Government Primary School
SABA	Spontaneous Architecture at the Bezalel Academy
UK	United Kingdoms
UN	United Nations
USA	United States of America
ZPD	Zone of Proximal Development

Chapter 1: Preamble

1.1 Introduction

The aesthetics of learning spaces affect brain function and impact how students feel in school, as well as how they feel about their school, from the front door through the school grounds to the classroom (Persaud, 2014). Using existing spaces wisely can have a significant impact on learning. Nevertheless, schools are frequently designed with a concentration on the classroom because of the assumption that learning only occurs there, typically overlooking the outdoor environment. In many instances, residences, especially in Dhaka, are being transformed into schools without regard for the outdoor environment. Even if outdoor spaces surround the school building, these areas are underutilized. Unfortunately, this is a worldwide trend. For example, large open spaces dedicated to physical activities in Australia do not have a proportional number of users or intensity of use concerning the distribution of students (Malone & Tranter, 2003)

However, research conducted by neuroscientists all around the world shows that the design of a school has a significant impact on the learning experience (Eberhard, 2009). When a lesson involves the outdoors, students learn better (Lieberman & Hoody, 1998; Malone & Tranter, 2003; Tai, Haque, McLellan, & Knight, 2006). According to a poll of 30 students from three different schools in Dhaka, children prefer to be in the natural environment (Khan M. , 2012). Children love places with enough environmental variation and natural components such as grass, trees, gardens, and parks (Broda, 2007). Nature provides rich sensory experiences and materials that assist children's development (Bento & Dias, 2017; Bilton, 2010; Clements, 2004; Kernan & Devine, 2010; Spiteri, 2020). Children benefit from engagement with nature in all aspects of their development: physical, mental, moral, and emotional (Tai, Haque, McLellan, & Knight, 2006).

The National Curriculum and Textbook Board (NCTB)'s Quality-Based Curriculum Implementation Program aims to make students' learning processes easy, enjoyable, and appealing through the practice of multiple activities in the classrooms (Directorate of Primary Education, 2015). However, primary school classrooms are not designed to hold these multiple activities. Bangladesh's National Education Policy of 2010 stipulates that science knowledge should be instilled in students at a young age, exposing them to nature, the environment, and the surrounding events (Ministry of Education, 2010). These policies reflect the government's concern for children's outdoor learning.

Outdoor play spaces should not be separated from the educational experience because they can play a distinctive role in knowledge development (Dudek, 2007). According to the National Environmental Education and Training Foundation in the United States, academic performance improves across the curriculum when schools make a concerted effort to integrate natural environments into their education using either local areas or their own school grounds (Glenn, 2000). Students in classrooms that employed the *environment as an integrating context (EIC)* (Lieberman & Hoody, 1998) groups had considerably better achievement motivation, according to research of eleven Florida high schools specifically focused on the impact of environment-based education on students' accomplishment (Place-based Education Evaluation Collaborative (PEEC), 2005)

Due to the extreme uncertainties produced by the COVID-19 pandemic and beliefs about young children's potential vulnerability and involvement in disease spread, many governments, including the government of Bangladesh, have implemented precautionary measures such as school shutdowns. School closures have led to learning losses, which, if not addressed, would negatively influence children's educational and financial outcomes (Schleicher, 2020). The cost of school closures has been substantial for children, parents, communities, and the economy, and neither the economy nor society can fully recover without restoring schools (National Academies of Sciences, Engineering, and Medicine, 2020; Cooper & Blazar, 2020). In this backdrop, organizations like *Green Schoolyards America* are formulating National COVID-19 Outdoor Learning Initiative (Green Schoolyards America, 2021) as to ensure social distancing without building extra space by getting children into the landscape, similar to a contemporary version of Duiker open-air school in Amsterdam which include open-air classrooms to help physically weak children gain strength from sunlight and fresh air (Buxton, 2020; Marsh, 2020).

The number of research on children's outdoor environments is growing worldwide, but only a few are conducted in developing nations like Bangladesh. With this backdrop in mind, this thesis aims to investigate the influence of the school's outside environment on students' science knowledge.

1.2 Statement of the Problem

Education System

Bangladesh's education system is structured into three conventional levels: primary, secondary and higher. At each level, several educational programs are offered by different institutions. Government and government-assisted primary schools (catering to two-thirds of students) (Directorate of Primary Education, 2022), madrasas, and at least eight other types of institutions, including non-formal primary schools run by NGOs, provide primary education to students. Primary education (grades I through V) and general non-formal education are managed by the Ministry of Primary and Mass Education (MOPME), managed directly by the Prime Minister. The Ministry of Education (MOE), which is under the jurisdiction of the Minister of Education, is responsible for secondary education (grades VI through XII), technical and vocational education and training, higher education, and madrasah education. These two ministries are mostly responsible for primary education management and planning (Ministry of Education, 2023). More than 55% of schools are run by the government, and these schools educate roughly 65% of all children enrolled in primary school (Directorate of Primary Education, 2022). In Bangladesh, there are now 65,566 government schools with approximately 400,000 students enrolled (Table 1 & Table 2).

Dropout Rate`

According to the analysis of APSC data, the cycle dropout rate decreased 14.15 percent in 2021 as opposed to 17.2 percent in 2020 (Table 3). Although it’s in the decreasing trend it’s still high as the target dropout rate is 10% or less (Figure 1 & Figure 2).

Table 1 Enrolment of Students by School Type and Sex in 2021

SchoolType	Enrolment (Grade 1 to 5)			% of girlsin grade 1-5
	Boys	Girls	Total	
01. GPS	6,053,893	5,860,117	11,914,010	49.2%
02.Private School	204,568	213,264	417,832	51.0%
03. Ebtedayee Madrasa	197,442	193,971	391,413	49.6%
04. Kindergarten	1,189,343	1,158,695	2,348,038	49.3%
05. NGO Schools	184,666	184,760	369,426	50.0%
06. High Madrasa attached	248,685	244,251	492,936	49.6%
07. High Schools attached	287,131	306,231	593,362	51.6%
08. Shishu Kalyan School	15,746	15,827	31,573	50.1%
09 Other NGO Centers	48,635	49,041	97,676	50.2%
10. Others	153,214	155,487	308,701	50.4%
Total	**8,583,323**	**8,381,644**	**16,964,967**	49.4%

Table 2 Teacher and Student Information by type of School (Pre-primary to Grade 5) in 2021

SL.	Primary Institutions Type	No of School	Teacher			
			male	female	total	% Fem
01	Government Primary Schools	65,566	127,809	231,286	359,095	64.4%
02	Private Primary School	4,799	6,772	13,163	19,935	66.0%
03	Ebtedayee Madrasa	3,839	13,111	5,498	18,609	29.5%
04	Kindergarten	28,193	79,341	121,126	200,467	60.4%
05	NGO Schools (Garde 1- 5)	3,753	1,957	7,329	9,286	78.9%
06	High Madrasa attached primary section	3,534	13,142	2,972	16,114	18.4%
07	High Schools attached primary section	1,988	7,523	9,331	16,854	55.4%
08	NGO Learning Center	205	414	766	1,180	64.9%
09	Shishu Kalyan Primary School	1,614	269	2,071	2,340	88.5%
10	Others	5,400	3,674	9,649	13,323	72.4%
	Total	**118,891**	**254,012**	**403,191**	**657,203**	**61.3%**

Table 3 Primary Cycle Dropout Rate by Grade, 2019 - 2021

Grade	2019	2020	2021
Grade 1	1.4%	1.0%	2.59%
Grade 2	2.7%	1.5%	2.70%
Grade 3	3.2%	4.9%	2.89%
Grade 4	7.4%	7.6%	3.92%
Grade 5	3.5%	2.2%	2.59%
All	**17.9%**	**17.2%**	**14.15%**

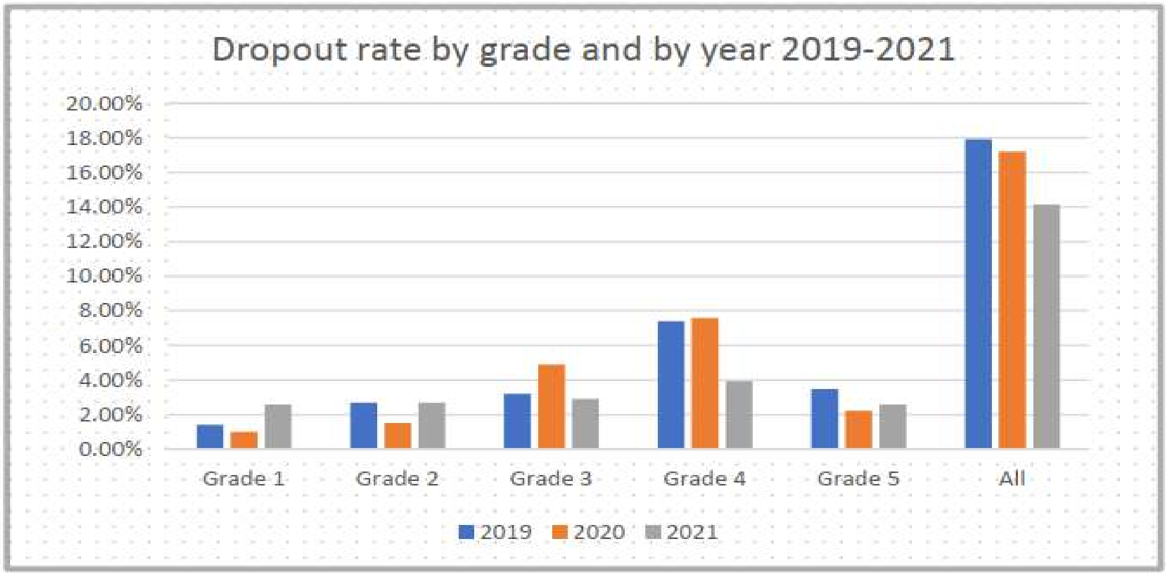


Figure 1 Dropout by Grade, 2019-2021

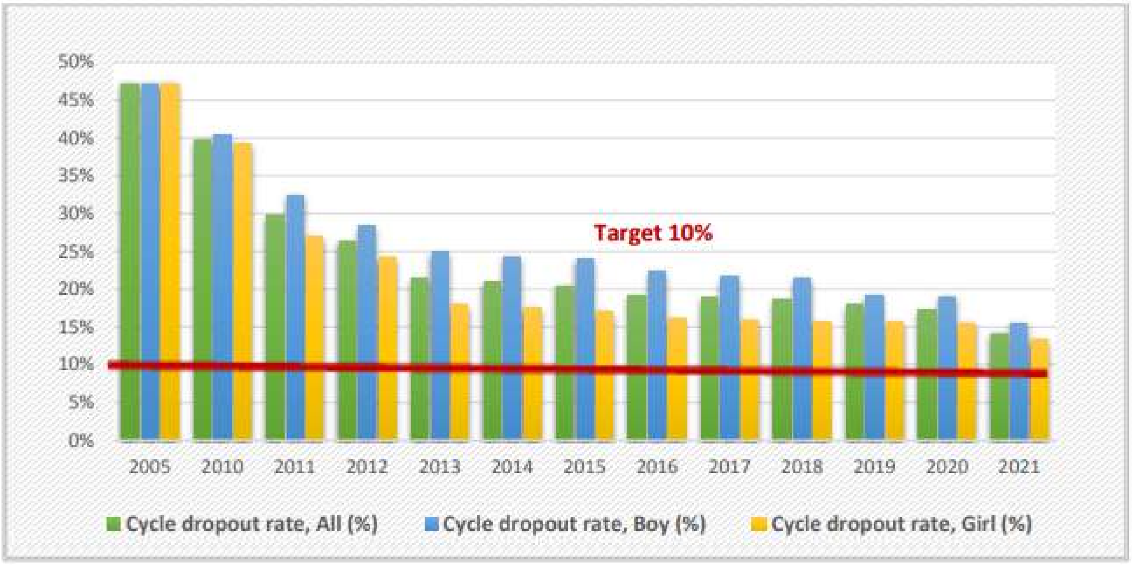


Figure 2 Trend of Cycle Dropout Rate 2010-2021

Infrastructure

Inadequate infrastructure is one of the various reasons for children to leave primary schools (Rozario, 2016). Most schools still need suitable facilities, even though establishing and improving new facilities are two of the key goals for governmental education (Bangladesh Ministry of Women and Children Affairs (MWCA), 2005). Large classes and poor physical conditions are common issues for teachers and students in Bangladesh. Government schools frequently have student-teacher ratios of up to 60 to 1 and do not prioritize having small classes. All Students need to be adequately seated or accommodated in classrooms. At Bangladesh's primary schools, there are just 332 square feet (17'x19'6") of classroom space available for more than 60 children (Figure 5, Figure 6 & Figure 7 Section A-A). LGED constructed these classrooms on an assumption of 7 square feet per student (Khan M. , 2012). The PEDP4 suggests classes of 517 square feet (19.5’x26.5’) for ideally 40 but up to 56 students (Directorate of Primary Education, 2018). Whereas, by the norm, a class of 50 students needs at least 1250 square feet (@25 sft per student) of space (Perkins & Cocking, 1957). These overcrowded courses significantly impact the effectiveness of education. Also, the classroom is entirely made up of benches, leaving no room for group projects, science class experiments, or other forms of exploration. The teacher has minimal opportunity in these classes to monitor each student's academic progress and areas for improvement (Rabbi, 2008). Also, there is little opportunity for students to engage in the teaching-learning process actively. There is hardly any room for teachers and children to walk around comfortably. But Texas Safety Guidelines state that a science classroom should be 700 square feet, or 45 square feet per student, with just 22 students (Collins, 2006).

Declining of science students

Enrolment in science in Bangladesh has significantly decreased at the secondary and higher secondary levels and, as a result, at the tertiary level. The percentage of science students taking the secondary school certificate (SSC) exams in Bangladesh from 1990 to 2015 was the lowest compared to humanities and business studies students (BANBEIS, 2019). Only 17% of students took the HSC exam in science in 2015, compared to 50% of humanities and 31% of business studies students (Chandan, 2017; Kabir, 2017; Ahmed K. M., 2016). Compared to other nations in the region, Bangladesh has relatively few students pursuing higher education in science, technology, engineering, and mathematics (STEM). STEM fields accounted for just 7.3% of all tertiary enrolment in 2019, while the average for the Asia-Pacific region was 23.6% (UNESCO, 2015). In 2018, the Program for International Student Assessment (PISA) reported that Bangladesh scored the second-lowest in science learning among 79 countries, indicating that students in Bangladesh are struggling to gain a strong foundation in science subjects (OECD, 2019).

Several factors contribute to this trend, including inadequate infrastructure. Many schools lack basic amenities such as laboratories and libraries, essential for teaching and learning science. Furthermore, there is a lack of emphasis on practical, hands-on learning. Many schools focus primarily on theory and rote memorisation rather than practical experiments and activities, which can make science education more engaging and effective.

The Bangladesh government has recognised the need to improve science education and is acting to address the problem. To raise the standard of science education, the government started a programme in 2017 to hire and educate 1,500 science teachers. However, school design guidelines that integrate science learning to improve student engagement, enhance understanding of scientific concepts, and provide with practical skills, need to be considered.

Schools losing outdoor spaces

Research on schools losing outdoor spaces in Dhaka is a critical area of study, given the potential impact on student's physical and mental health. Several studies have investigated this issue, revealing a concerning trend of limited outdoor spaces in schools in Dhaka.

For example, a study explored the relationship between the outdoor environment of schools and physical activity levels among students in Dhaka. The researchers found that most schools in Dhaka have inadequate outdoor spaces, leading to decreased physical activity levels among students (Islam & Biswas, 2017). Another assessed the outdoor play environment in preschools and kindergartens in Dhaka and reported that most schools lack adequate outdoor spaces and play equipment

(Rahman & Islam, 2018). Similarly, a critical review by Khan identified a lack of play spaces for children in Dhaka City (Khan M. N., 2019).

These studies suggest that schools in Dhaka are losing outdoor spaces, negatively impacting students' physical and mental health. The loss of outdoor spaces in schools can result in reduced physical activity levels, poor mental health, and limited opportunities for socialization and creativity among students. Some schools in Dhaka have tried to address this issue by creating rooftop gardens or using other innovative solutions to provide students access to outdoor spaces. However, there is a need for more concerted efforts by the government and other stakeholders to preserve and expand green spaces in the city, including those around schools. In future research on this topic, identifying the primary variables, including independent and dependent variables, is crucial in developing effective interventions and policies to address this issue.

Goals, Plans & Challenges

The Sustainable Development Goals (SDGs) of the United Nations (UN) titled "Transforming Our World: The 2030 Agenda for Sustainable Development", a set of 17 goals adopted in September 2015 that all nations must accomplish in order to guarantee a more sustainable future for all, includes education agenda, namely the stand-alone goal SDG4: "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all." Organizations like The World Bank and the United Nations Population Fund (UNPF) have assisted the Bangladeshi government in the implementation of several programs in order to achieve SDG 4 (Law, 2023). The persistently poor quality of primary education is the most significant obstacle Bangladesh must overcome to achieve its educational objectives. Most students have deficient levels of proficiency and achievement (Ministry of Women and Children Affairs, GoB (MWCA), 2005). It is one of the causes of the dramatic decline in science enrolment at the SSC and HSC levels. According to experts, science enrolment declined due to teaching standards and infrastructure (Wahab, Molla, & Afrin, 2021).

However, the desire to understand science develops from a very young age. The recommendations for improving the issue include training the teachers and expanding the infrastructure in the lab and other areas. Similarly, building infrastructure is constantly suggested as a strategy to improve the quality of education at the primary level (Nath & Chowdhury, 2010). However, there needs to be research on how to improve the school environment such that it is appealing to students.

Since 1991, the DPE has implemented several initiatives to advance elementary education in Bangladesh, such as the Primary Education Development Project (PEDP). The primary goal of PEDP2 was to rebuild or rehabilitate the deteriorated and decrepit schools. In order to increase enrolment and lower the rate of dropouts, it was planned to make the school building more appealing to students (Directorate of Primary Education, 2007). PEDP3 adopts a transparent, needs-based approach to infrastructure construction, which necessitates adequate studies and research on this subject to eliminate overcrowding and inequities in terms of school buildings.

Under the General Education Project, the School Attractiveness Program (Figure 3) was launched in 10 Upazilas of 5 Divisions nationwide (1991-96). The plan attempted to make schools more welcoming and encourage students to attend class consistently. However, the steps to make the institutions more student-friendly still need to be solved and require in-depth study.

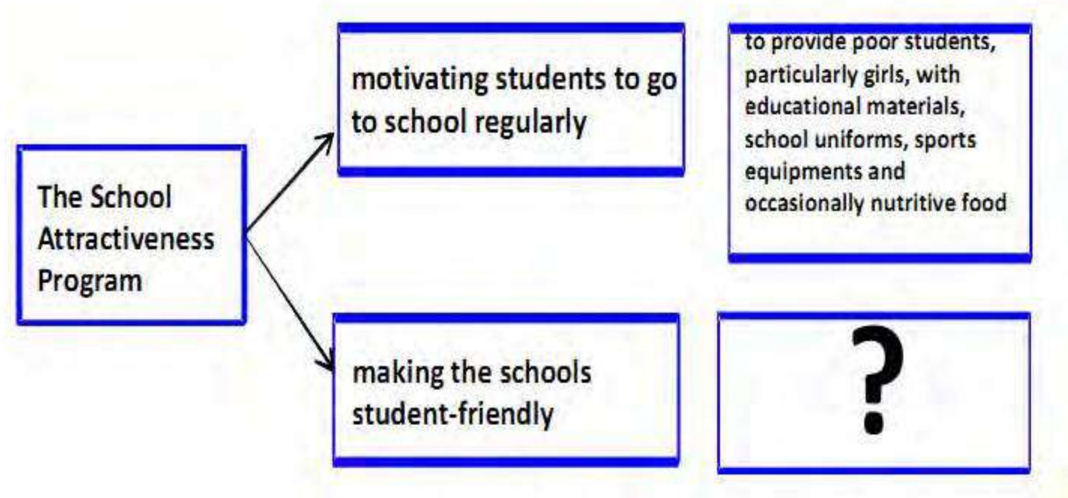


Figure 3 The School Attractiveness Programme adopted by DPE (Khan M. , 2012)

The current situation highlights the poor conditions in primary schools, which make it impossible to deliver high-quality education and draw students to them (Figure 4). Finding the proper steps to make the school environment conducive to learning requires in-depth research. Although the Bangladesh Primary Education Annual Sector Performance Report 2009 emphasizes studies and research on particular topics like infrastructure, it is yet to be conducted. Science learning goes beyond the classroom; students need opportunities to experience and explore the natural world. Outdoor spaces like gardens allow students to interact with nature, observe, and appreciate the environment. Since research has shown that children prefer locations full of activity, where interaction can take place, with enough variety in the environment, and with natural components like grass, trees, and gardens, it is time to determine whether building additional classrooms of minimal size is the solution (Andel, 1990).

1.3 Objective of the Study

The research explores children's behaviour from the standpoint of a designer. This study aims to determine the impact of the environment, specifically a school garden, on children's science knowledge. It observes the possibility of using the outdoors as a learning environment for Bangladeshi primary school children.

Specific aim: Improving the process of learning science for primary school children.

Objective: Identifying the role of a school garden for a primary school child in Dhaka in the following aspects.

1. Investigating changes in science knowledge due to garden intervention using tools (achievement test) developed by employing educational research theory like Bloom's taxonomy.
2. Exploring the treatment's qualitative outcome and its effects on the affective domain (the awareness and growth in attitudes, emotions, and feelings towards learning) using structured questionnaires, FGD and in-depth interviews.

3. Exploring self-taught (from observation, experience etc.) Natural Environmental Knowledge.

Possible outcome: Understanding the Importance of a garden in science knowledge as an outdoor design feature. In this approach, the value of the outdoors in the learning process can be understood, guiding the future primary school design in Bangladesh.

1.4 Significance of the Study

The study is one-of-a-kind because of its approach. This study aims to look into the impact of the environment on children's science knowledge. Bangladesh needs more development research in general, and educational research on learning environments, in particular, is scarce. There is essentially no research on the school environment (Nath & Chowdhury, 2010).

The study is also distinctive in terms of the target group. This study's sampling technique ensures that children from middle and low-income families are included. In contrast, children in extreme poverty are usually the subject of studies in developing nations like Bangladesh. Children from middle-class families and their physical surroundings remain absent from the discourse. Though issues like learning environments, children's right to play, autonomous mobility, physical movement, and many more are not as visible as health and hunger problems, they are no less severe regarding long-term consequences. When it comes to children's education, this is an issue that requires special attention. A country's children are its future leaders, whose formation depends on their education. "Whatever the economic indicators of a nation may be, if the children at all levels of society are not protected and nurtured, as a present good and as a foundation for peace and prosperity in the future, development in this basic sense of "good chance" is not occurring," says Louise Chawla, a developmental and environmental psychologist (Chawla L. , 2016).

Furthermore, the research can contribute to developing educational institution design and policy strategies. It argues that the outside environment of a school plays a crucial role in its overall design, and the children enjoy spending time outside while utilizing it in various ways. The study's findings could provide new perspectives to policymakers, educators, and architects involved in the development and planning of educational institutions. The importance of incorporating outdoor learning spaces in school design highlighted in the study may be used by policymakers and educators to advocate for more support to develop outdoor school spaces. On the other hand, architects may use the study's findings to design school buildings that seamlessly blend indoor and outdoor spaces to enhance students' learning experiences. The research findings could have far-reaching implications for the education sector, and stakeholders can use them to create better-designed educational institutions that provide students with a conducive learning environment.

Research related to environment-integrated learning is primarily conducted in industrialized countries. However, the behaviour of variables highly associated with this type of learning may differ in developed versus developing countries. Given the contextual differences from previous studies, the research in developing countries is particularly valuable and unique. Therefore, further investigation is necessary to understand these variations better.

1.5 Outline of the Thesis

The thesis is organized into six chapters.

Chapter 1, the preamble, introduces the topic and presents the problem statement, the study's objective, and the research's significance.

Chapter 2, the literature review, explores the concept of outdoor learning environments and their effects on children's well-being, motivation, engagement, exploration, and preference for outdoor spaces. This chapter also looks at variables influencing learning, such as socio-demographic, pedagogical, personal, built environment, and domain variables.

Chapter 3, the theoretical and conceptual framework, includes the conceptual and operational levels, hypothesis and research question, important vocabulary, and summary of the theoretical and conceptual framework of the thesis.

Chapter 4, the methodology, describes the research design, sampling strategy, pre-survey works, design, and intervention, experimentation, data collection methods, measurement techniques, and data analysis method.

Chapter 5, the analysis, presents the findings of the causal relationship analysis between the main variables, including academic results, attendance, achievement test, questionnaire survey, focus group discussion, and in-depth interview of the children. It also answers the research question and discusses the study's quality considerations and limitations.

Chapter 6, the discussion and conclusion, discusses the main findings of the study, including improved academic learning, the outdoor environment as a laboratory for learning science, increased science understanding and comprehension, participation, enthusiasm, and interest in learning science, and the vision for a new school landscape. This chapter also suggests steps to remove the gap between research and practice, directions for future research, and a conclusion.

The thesis ends with a bibliography and appendices.

Figure 4 Inside a classroom in a Government Primary School in Narayanganj (Dhaka Tribune, February 12th, 2020)

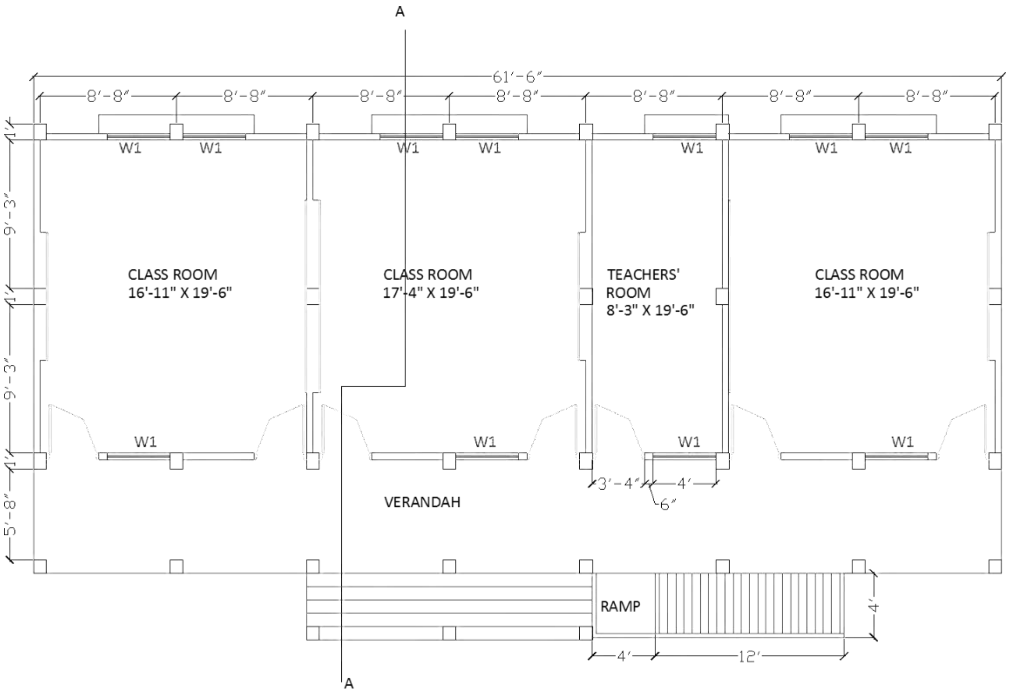


Figure 5 Plan of a Proto-type Primary School (Khan M. , 2012)

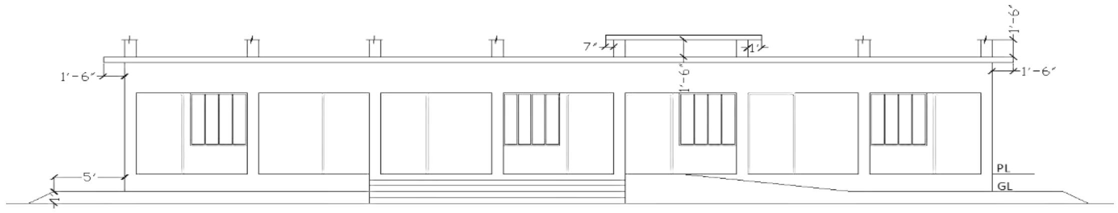


Figure 6 Front Elevation (Khan M. , 2012)

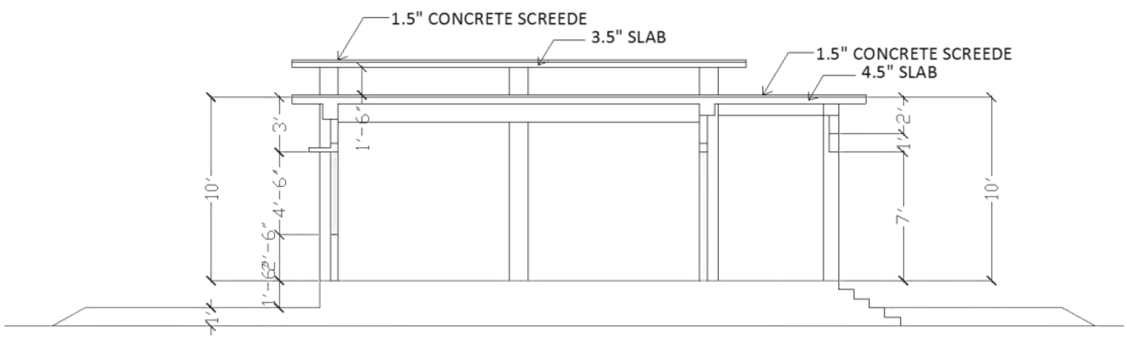


Figure 7 Section A-A (Khan M. , 2012)

Chapter 2: Literature Review

By exploring related studies on the subject, the literature review seeks to provide relevant definitions of the variables of the current study.

The study's literature review is organized in four ways (Figure 8).

First, related studies are investigated to determine an acceptable definition for **children's outdoor learning environments.** Learning is the dependent variable of the research, and this part of the literature review will drive the measurement procedures and other related methodological issues in later sections.

Second, a collection of recent studies will be reviewed to determine the value of outdoor learning environments in children's life. The outside environment is also addressed from the standpoint of children's right to freedom and preferences for places, in addition to learning concerns relating to child development.

Third, the literature research stresses the significance of outdoor learning space design in terms of learning and explores successful outdoor learning space design efforts conducted by concerned authorities in various nations to boost children's learning.

Fourth identifying the primary variables of the study, including the independent variable and the dependent variable(s). The independent variable, the garden, is the variable the researcher controls. It is considered the cause or predictor variable that influences the dependent variables. On the other hand, the dependent variable(s) is the variable being measured or observed and expected to be influenced by the independent variable. It is considered the effect or outcome variable in the research.

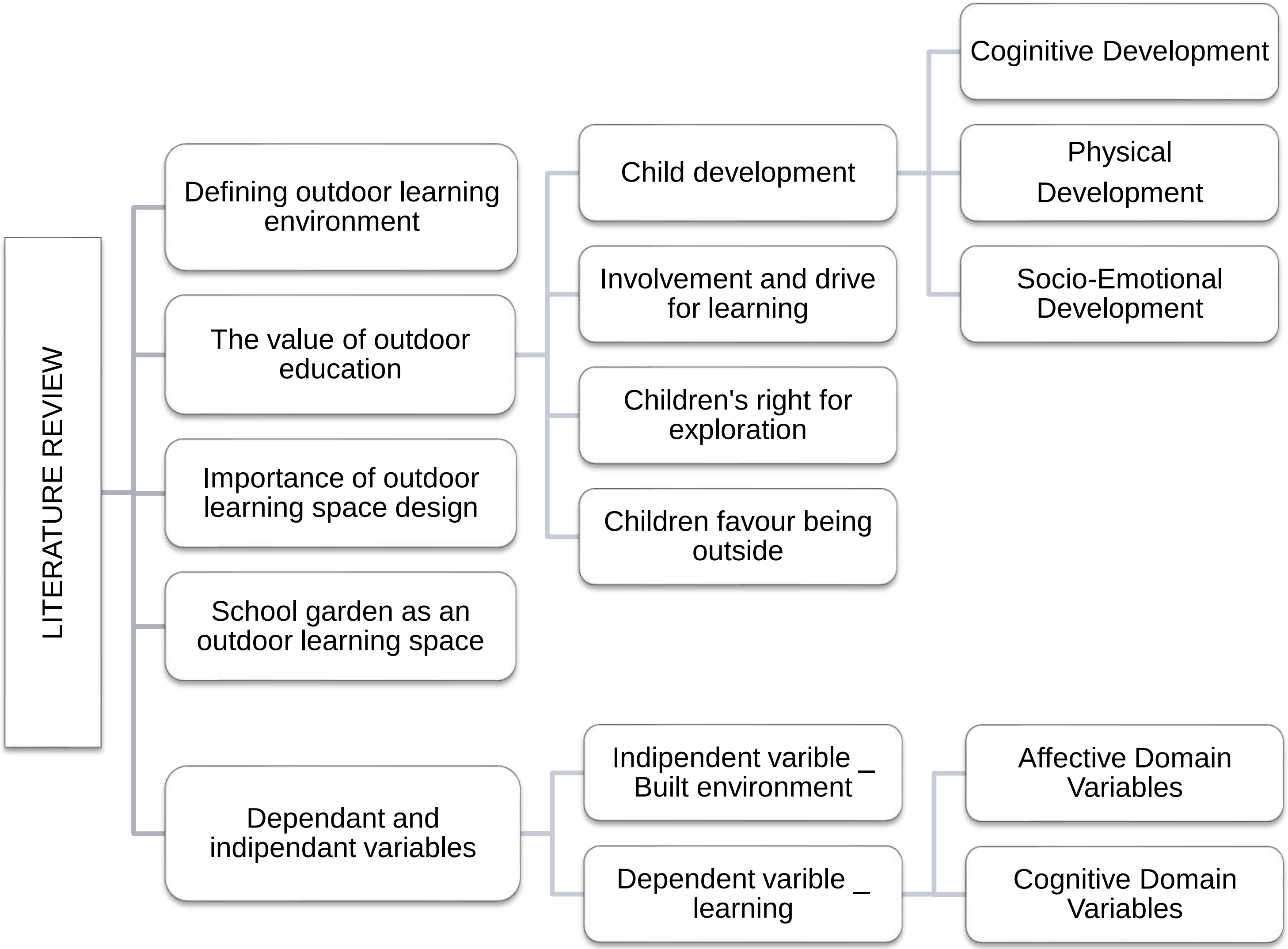


Figure 8 Organization of the Literature Review

2.1 Defining Outdoor Learning Environment

Learning, which depends on acquiring various knowledge supported by perceived information, is one of the most significant mental operations of people, animals, and artificial cognitive systems. It results in the growth of new abilities, competencies, values, comprehension, and preferences (www.dictionary.com, 2022). Learning in psychology refers to a generally long-lasting behavioural change brought on by experience (Domjan, 2015). From a social perspective, the objective of teaching and education should be learning. Learning opportunities can be provided in connection to the formal, informal, and hidden curriculum in a protected educational environment (Adams, 1993).

The term "**outdoor learning**" is broad and encompasses a variety of educational pursuits carried out in various environments. It can include everything from camping to working on environmental issues to composing a poem while sitting under a tree on the playground. Although it lacks a definite border, outdoor learning does have a common core. Excursions, team building, education for sustainability, adventure therapy, historical education, nature studies, agricultural education, recreational and adventure activities, school grounds projects, outdoor play throughout the school day, and more are all appropriate examples (Rickinson, et al., 2004).

Outdoor learning is the generic phrase used to describe learning that occurs outside. It is possible that "outdoor learning" lacks a specific definition because it is not a technical phrase. Instead, "outdoor education" refers to a broad idea—using the outdoors as a learning instrument (Broda, 2007). From the educator's perspective, outdoor learning is essentially just a smaller subset of the more significant idea of experiential learning. Utilising real-world situations and learning by doing are two critical components of experiential learning, which are also essential for outdoor education.

There are three aspects to outdoor or environmental learning. Environmental knowledge and comprehension are supported by learning *about* the environment. Environmental responsibility and action are the goals of learning *for* the environment. Interactions and experiences in the environment are encouraged by learning *in* the environment (Murdoch, 1994; Disinger, 1990). This study emphasizes *learning in the environment*, where students are taught lessons from the formal curriculum in outdoor settings or environments.

Therefore, the term "**Outdoor Environment**" in this context refers to any areas on the school grounds other than the school building owned by the school authorities. The vicinity around the school building is referred to as the "school grounds" in the UK but more usually as the "schoolyard" in the USA (Adams, 1993). Comparing the two names reveals minor variations in imagery:

Yard: an enclosed or semi - enclosed space, generally paved, used for many functions near or bordering a home, stable, or other building, often particularized in compounds such as stockade, pen, coral, or compound (Adams, 1993); a schoolyard is a space adjoining the school building. It is a school's "external environment", whether big or tiny, attractive or ugly, in use or entirely unused. The Schoolyard gives students and teachers a "laboratory" where they may interact directly with the phenomena they are studying, as the Boston schoolyard initiative observed (Boston Schoolyard Initiative, 2005).

Grounds: A flat surface from which figures stand out, a piece of land set aside for a specific purpose, or a place where something usually happens, usually sports or games. Examples include football fields, parade grounds, and breeding grounds (Adams, 1993). The primary purpose of a school's grounds is to provide a conducive atmosphere for learning.

Schools have three primary uses for their grounds (Funnell, et al., 1997):

- Using the outdoor learning space in addition to the traditional curriculum
- Through the experiences presented at lunch and break periods – as part of the informal curriculum
- Through the "hidden curriculum"—the messages and meanings that children "read" into how the grounds around their school are utilised, created, and maintained.

Educators in the United States and elsewhere are realising the value of outdoor learning for both formal and casual learning. Even though the majority of public schools in the United States take place in classrooms and students' minds, related studies show that all children can benefit from "hands-on" learning, and some children need experiential learning to reach their full potential (Boston Schoolyard Initiative, 2005)

2.2 Outdoor Learning and Well-being of the Children

Schoolchildren spend a significant portion of their life, about six hours daily and more than one thousand hours annually, at school, and they frequently interact with the physical environment of their schools (Ghaziani, 2010). School-age children between the ages of six and thirteen face brand-new incentives and obstacles. However, in this part, child development will be explored in relation to children's well-being related to outdoor learning. Children have three growth stages: 1. Cognitive, 2. Physical, and 3. Socio-emotional (Halliburton & Gable, 2003; Snowman, McCown, & Biehler, 2014). Children's healthy growth and learning can benefit significantly from the outdoors. For instance, a 2006 Canadian research discovered that children who interacted in varied natural environments on school grounds were more physically active, creative, conscious of nutrition, and cooperative. According to research, children who spent more time outside in nature had better outcomes for their physical, emotional, and spiritual welfare (Johnston, 2007).

2.2.1 Cognitive Development and Outdoor Learning

Children between the ages of six and twelve are aware of the elements of their physical surroundings and are motivated to challenge them physically and mentally. Their physical activity in their surroundings significantly impacts their cognitive development. Therefore, it is crucial that the built environment and open spaces both promote educational ideals (Sebba & Churchman, 1986).

Children learn best when they are motivated and guided by their interests. They actively "construct" their understanding of the world through interaction with things in space and time. This is based on Piaget's Constructivism Theory, which emphasizes the role of children as intellectual explorers who create their knowledge. According to the Constructivism Theory, students construct knowledge based on their experiences (Dietz, 2002). They are "active agents" who learn, not "passive learners" (Halliburton & Gable, 2003). Jean Piaget labels this development period as the "Concrete Operational Stage," during which children engage with concrete, directly perceptible information. When applied to abstract concepts, their mental functions are inadequate. Most young children at this age are materialistic and like to learn by doing through experimentation (Haq & Jahan, 1999).

The constructivist viewpoint has emerged as one of the most influential educational theories and a major scientific driving force (Treagust, 1996). When this framework is combined with several concrete experiences that allow students to engage with the concepts being taught, learning is maximized. This comprises scientific ideas that need to be applied to actual situations (Caine & Caine, 1994). In kindergarten through sixth grade, concrete science experiences are particularly crucial because they lay the groundwork for subsequent abstract learning in high school and college (Caine & Caine, 1994). Piaget claimed that children under the age of twelve reason by actual, observable occurrences. Piaget claimed that children under twelve reason by actual, observable occurrences. The notion that individuals construct their version of meanings of events and phenomena gives rise to a constructivist model of science learning in which the evolution of concepts results from the interaction between pre-existing conceptions and new experiences (Millar, 1989). Children learn much independently as they play, observe, inquire, conduct experiments, and try to make sense of the environment. The nature, design, and laws governing the usage of school grounds significantly impact how children can learn, mainly through play (Moore R. C., 1989; Moore & Wong, 1997).

Vygotsky also highlighted children as active learners (Mehta, 2002). The central idea of Vygotsky's theoretical system is that social contact is crucial to cognition growth. Each function in children's cultural development emerges twice: first on the social level and then on the personal level, initially between individuals (inter-psychological) and then internally (intra-psychological). Children connect more with peers and society when they engage in outdoor learning. Vygotsky asserted that a scientific concept's shortcoming is its verbalism or inadequate saturation with the concrete world (Vygotsky, 1978). Learning in an outdoor setting is a powerful illustration of Vygotsky's educational philosophy. Presenting scientific concepts without their authentic context denies the child an opportunity to make complex connections and form relationships about the concept to its environment, facilitating generalization. Vygotsky acknowledged the significance of interpersonal interactions and the environment's involvement in concept creation. Compared to Piaget, Vygotsky placed a greater emphasis on the roles that adults and peers with a higher level of maturity have in affecting the mental development of children. While Piaget emphasized children as intellectual explorers who freely construct knowledge through their discoveries, Vygotsky emphasized the Zone of Proximal Development (ZPD) as the level of development achieved when children engage in social activity (Mcleod, 2022). The ZPD is the region of a child's mental development between where the child is now functioning independently and where they might go with aid from an adult or more mature child (Figure 9). According to Vygotsky, children are capable of more remarkable accomplishments when working together than when acting independently (Vygotsky, Thought and Language, 1962). Numerous concepts can be acquired through peer-to-peer cooperative learning, making the outdoors an ideal place for education. According to Vygotsky (Vygotsky, Thought and Language, 1962), teachers will be able to tell when they have found the perfect balance when children respond with enthusiasm, curiosity, and active involvement which would most likely be seen in children who are actively engaged with observing and learning concepts in the outdoor classroom.

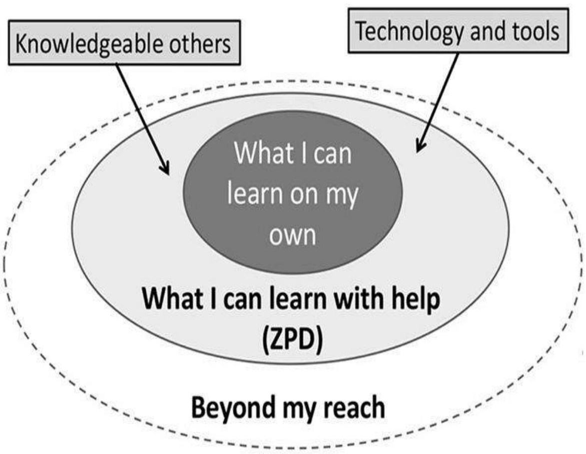


Figure 9 The Zone of Proximal Development (Wheeler,

Howard Gardner's theory of multiple intelligences offers one perspective on the elements that could affect children's learning. Gardner's model and Vygotsky's theory are complementary to one another. Gardner used biological and cultural research to develop a list of eight bits of intelligence (Figure 10), musical-rhythmic, visual-spatial, verbal-linguistic, logical-mathematical, bodily-kinesthetic, interpersonal, intrapersonal and naturalistic., based on the definition of intelligence as "the capacity to solve problems or to fashion products that are valued in one or more cultural setting" (Gardner & Hatch, 1989). In 2009, he also suggested two additional types of intelligence, namely, existential and moral. Gardner claims that every child learns and assimilates knowledge differently and that schools need to address this (Smith, 2002). According to Gardner, children usually have a biological predisposition to certain types of learning and problem-solving (Mehta, 2002). Gardner also stresses the significance of culture and environment and how they support a child's natural learning style.

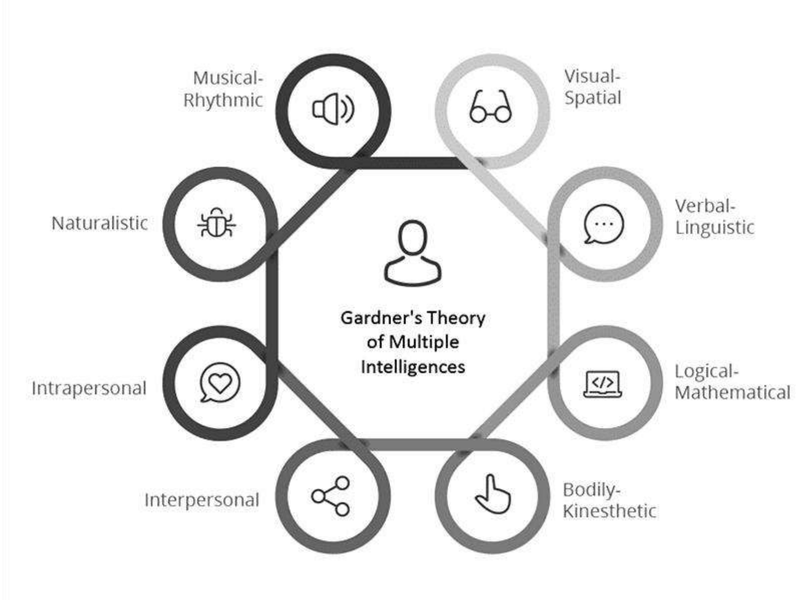


Figure 10 Gardner's theory-8-multiple-intelligences. (slidemodel.com)

This part of Gardner's model aligns with Vygotsky's theory, reinforced by outdoor learning that children develop in a social context or their immediate environment. In the outdoors, children can continue to learn by doing (Figure 11 & Figure 12). To make sense of the world around them, they continue to build on the knowledge, skills, and understanding they have already attained (The Early Years Foundation Stage, 2007). The outdoor learning space provides students and teachers with a "laboratory" to interact first-hand with the phenomena they are studying. Incorporating outdoor learning into the core curriculum introduces students to the scientific method by giving them opportunities for the "real world" application of classroom knowledge (Boston Schoolyard Initiative, 2005). Students must be able to detect what is happening around them. They should first note what is typically present, growing, or happening in their environment, then note the changes. They start to be astonished by the unexpected once patterns start to appear. Queries and investigations follow (Bourne, 2000).

Figure 11 Children learning by doing in a naturalized Outdoor Learning Environment (hope-education.co.uk/outdoor-learning-activity)

Figure 12 Second-Grade Scientists at a School in Boston observe plants in their school yard (Spencer and Metz 2008)

Science Learning in Outdoor: Outdoor settings that double as science, agricultural, or environmental sustainability laboratories are beneficial for students in all grade levels (French, Contag, & Sundharam, 2012). Complex outdoor experiences are frequently a part of effective environmental science instruction (Building Excellent Schoolyards: A Guide for Primary Schools, 2011). According to a UK study, 47% of nine-year-old students stated they like science because they can apply what they learn to their daily lives (The Daily Telegraph, 2008). Using experiential teaching techniques, the primary need for science learning is possible in the outdoor setting. Learning by doing has frequently resulted in excellent student retention rates, which is very much applicable to science knowledge. This is in addition to addressing children's occasionally diverse learning styles. Instead of learning through the osmosis of words and images produced by texts and other media, children in the outdoor setting gain knowledge through interacting with primary source materials (Figure 13). This is firsthand knowledge (Meyer, 2010).

Gonzalez-Mena claims that children learn about nature at a young age because nature is especially interesting. The best way to learn about nature is to explore it outside. Also, children must develop a fundamental appreciation for nature (Gonzalez-Mena, 1998). In the hands-on environment of the outdoor setting, they can actively develop knowledge about subjects like biology and ecology, as well as the relationships between nature and humans. The outdoor learning space allows students to see natural phenomena up close. For all subject areas, not just science, the school grounds form a great setting for an outdoor learning space because they are regularly accessible.

Figure 13 LEARNING ABOUT SOIL _ digging in the soil of a raised planter in a school garden (naturalearning.org)

Teachers frequently mention that exposing the class to real-world situations helps the students understand subjects better. They are eager to instruct outside (Spencer & Metz, 2008). Teachers, initially reluctant to teach science, employed this method to interest children in learning and established a real-world learning environment. After participating in a week-long residential outdoor education program for at-risk youth, Hispanic adolescents in a program targeted at minorities demonstrated improvements in their capacity to resolve conflicts, care for the environment, and knowledge and grasp of scientific concepts (American Institute for Research, 2005).

Studying outside promotes children's environmental education in addition to aiding in acquiring science knowledge. Environmental education aims to create a population that is concerned about the environment and its problems, aware of them, and equipped with the knowledge, skills, attitudes, and commitment necessary to work both individually and collectively toward finding solutions to existing issues and preventing the emergence of new ones (UNESCO-UNEP, 1976; UNESCO-UNEP, 1978). The main goal of environmental education is to provide people and communities with the knowledge, values, attitudes, and practical skills they need to participate responsibly and effectively in managing the environment's quality and in understanding the complexity of the natural and built environments as a result of the interaction of their biological, physical, social, economic, and cultural aspects. Children naturally gravitate towards intentional involvement with their material surroundings. According to research studies from around the world, they have strong emotions and a wealth of implicit information about the places they interact with daily (Hart, 1997; Chawla L. , 2016).

2.2.2 Physical Development and Outdoor Learning

Physical development refers to the biological changes in the human body during its life, physical growth, and motor development. (Halliburton & Gable, 2003)

Children go through many physical changes between the ages of 6 and 11. Children continue to develop their physical abilities during this period, and these abilities are frequently utilized in a variety of physical activities. Around this time, fine motor abilities are also continuing to improve. Children can participate in art, science, or crafts projects that call for intricate fine motor coordination (Snowman, McCown, & Biehler, 2014). It is well-established in several literary works that exposure to nature and the outdoors significantly influences children's physical development (Tai, Haque, McLellan, & Knight, 2006; Charles, 2010).

An increasing number of studies indicate that exposure to nature is as crucial for children as healthy eating and enough sleep: time spent outdoors is associated with increased physical activity and fitness in children. Being around greenery also lowers crime, improves overall well-being, and sharpens attention (Holmes, 2007).

Children and youth participating in outdoor education are directly exposed to the natural world in ways that foster strong, informed and lasting relationships necessary for a healthy and sustainable future (The North American Conservation Education Strategy, 2010). Additionally, studies demonstrate that early, sequential, and repeated outdoor encounters enable a bond with nature that can lead to lifelong stewardship of our natural environment.

The relationship between the outside environment and the learner has been articulated in different ways than indoor spaces. However, as society has changed, the ability of the outdoors to enhance children's educational experiences has shrunk (Herrington, 2007). The "surplus energy theory," significant in play theory, has been used to design outdoor environments and understand how children perceive and interact with their surroundings (Malone & Tranter, 2003). The outdoors has always been associated with recreation and sport rather than learning and other vital aspects of education. Herbert Spencer, a psychologist of the nineteenth century, originally put forth the "surplus energy theory" in his 1855 book Principles of Psychology. Spencer thought that children play mostly to burn off excess energy. Since their inception more than a century ago, his theories have acquired a strong following among educators. They have been profoundly ingrained in school culture, despite being criticized by numerous researchers and developmental theorists. We can distinguish between outdoor learning environments that are a part of the formal curriculum and those where learning through environmental interaction occurs through unsupervised play and exploration. The outdoors is better utilized in the official education curriculum.

Children with issues like Attention Deficit Hyperactivity Disorder (ADHD) especially need outdoor classroom activities. Research has shown that when children engage in outdoor activities in natural environments, their symptoms of ADHD significantly diminish, even in children as young as five (Holmes, 2007). To better address the demands of an ADHD student in the classroom, there is not only a more considerable need for hands-on learning and more physical exercise, but it is also possible that other students with other learning styles would benefit from this healthy approach (Moore R. C., 2003)

2.2.3 Socio-emotional Development and Outdoor Learning

When a child first starts school, they are at a stage in their development where performance and intellectual curiosity rule their behaviour. "He now understands how to gain attention by creating stuff... He gains an understanding of industry" (Erikson, 1963). The industry benefits when a child is applauded for trying and encouraged to make and do things well. The milieu in which this is cultivated and promoted is outdoors. Teaching young people how to interact with others in a group is essential to any learning process. Students get the chance to form groups, come to agreements, and work on developing their critical thinking and problem-solving skills with their classmates in well-designed and supervised outdoor classrooms (Boston Schoolyard Initiative, 2005). Their interactions with peers and teachers greatly influence their social development. Another benefit of outdoor education is developing various social skills, such as collaboration, effective communication, decision-making, problem-solving, task leadership, and social competency (Johnston, 2007).

Moreover, Kellert refers to this process of complicated emotional growth as "affective maturation" in nature. The children begin to see nature separate from themselves while simultaneously seeking affinity with it. (Kellert, 2002). A child's "earth" period has also been used to describe this time in their development (Tai, Haque, McLellan, & Knight, 2006). Some children find that connecting with nature can be a spiritual experience that has a profound, long-lasting effect on their life.

The outdoors was cited as the most important environment of a diverse group in their youth by 96.5% of respondents in a poll by Sebba (Tai, Haque, McLellan, & Knight, 2006). Similar encouraging findings were obtained from a survey that polled 700 past (those who had attended over the previous 25 years) and present members of well-known outdoor programs like Outward Bound, the National Outdoor Leadership School, and the Student Conservation Association. The vast majority of people said it was one of the most significant experiences of their lives and said it impacted their personality and development (Kellert, 2002). The majority said that the experience improved their self-confidence, problem-solving skills, capacity for coping with stress and overcoming obstacles, and ability to function in a metropolis. That one unique adolescent encounter in nature positively influenced their appreciation of nature, support for conservation, and their future level of outdoor activity (Kellert & Derr, 1998; Kellert, 2002; Tai, Haque, McLellan, & Knight, 2006).

2.3 Children’s Motivation and Engagement in Learning

According to research, academic accomplishment and cognitive engagement are related, and motivated students are more likely to "engaged in learning in a deeper, more self-regulating fashion" (Athman & Monroe, 2004). According to studies, learning outside might boost students' motivation and participation in the classroom (Lieberman & Hoody, 1998; Meyer, 2010). It is obvious how student motivation and success are related. Students will perform well in a subject if motivated to acquire the material (Marzano, 2003). Teachers can encourage learning by engaging students in entertaining yet instructive activities. Such activities can encourage children to investigate admirable concepts and ideas while promoting the first-hand experiences necessary for developing and integrating knowledge (Tsao, 2002).

Outdoor learning should be considered one of several options for educational reform, and outdoor settings should be focused on with prior consideration in built environment design. Outdoor education can increase student engagement and motivation, improving academic achievement. Many studies on the engaging qualities of outdoor learning, similar to those on the academic benefits, highlight the authentic, hands-on components as the primary factors in the engaging character of these programs and teaching methodologies (Lieberman, Hoody, & Lieberman, 2000; Charles, 2010). 400 ninth and twelfth-grade students, some of whom were in classrooms that employed the environment as an integrating context (EIC) and others in traditional classrooms, participated in a comparison of achievement motivation. Place-based education and student accomplishment (2006) found that the EIC groups had considerably greater levels of achievement motivation after adjusting for gender, grade point average, and ethnicity.

2.4 Children's Right for exploration

This section intends to comprehend the significance of outdoor learning as child behaviour from the standpoint of national and international conventions. All children enrolled in primary education level institutions have access to activities that ensure a healthy learning and living environment for a better life, which can be associated with outdoor learning environments, according to the National Plan of Action for Children (Ministry of Women and Children Affairs, GoB (MWCA), 2005). However, in the more recent National Child Policy 2011 (Ministry of Women and Children Affairs, 2011) released by the Ministry of Women and Children, Government of the People's Republic of Bangladesh, "total protection of the child," "highest welfare of the child," and "participation of the child and giving an opinion" are declared as the main objectives. These goals, on a theoretical level, are compatible with outdoor learning.

The 2010 National Education Policy strongly emphasizes fostering a fun and exploratory environment for children's safety and healthy development. It claims that science knowledge should be started at a very young age and gives clear, explicit instructions about acquiring science while surrounded by nature. Instead of overloading the students with the knowledge, scientific instruction should focus on introducing them to nature, the environment, and nearby events.

Bangladesh was one of the first countries to ratify the Convention on the Rights of the Child (CRC) in August 1990, following the approval of the CRC by the United Nations General Assembly in 1989 (UN, 1989) (Islam M. Z., 2008). Every child has the legal right to get an education, according to the CRC (Article 28). Article 29 specifies that the child's education shall be "the development of the child's personality, talents and mental and physical abilities to their utmost potential" and "the development of respect for the natural environment." The quality of the child's physical environment is specifically mentioned in the guidelines for implementing the Convention as being relevant to these rights, which are also directly tied to learning outdoors and during exploration.

Other sections, such as Article 6, mandate that state parties "...must ensure to the fullest degree the survival and development of the child," also imply children's rights to education in their ideal environments, which may include the great outdoors. "The right of the child to enjoy the maximum attainable quality of health" is stated in Article 24. The right of every child to a standard of living appropriate to their physical, mental, spiritual, moral, and social development is recognized in Article 27. The right of every child to "rest and leisure," to "play and recreational activities," and "to participate freely in cultural life and the arts" is addressed in Article 31. Governments must support the creation of outdoor learning environments that support children's education and their engagement in their communities' social and cultural life to uphold the spirit of these Articles.

2.5 Children’s preference to be in Outdoor

According to Chawla, most children like being outside even if they do not grow up to be a naturalist (Nixon, 1997). A long-term study on children and their environments is being conducted to get insight into the particular locations that children inhabit. Research on outdoor environments was conducted in the Netherlands, with 140 children of the same age participating in the main and pilot studies. The majority of the children named playgrounds or green spaces as their favourite spots. Natural components are the most alluring to many of them. They adore being in environments that are vibrant with movement and variety, abundant with natural elements, and where the conversation is easy to have (Andel, 1990). Students participated in the design of Carlton School in Kentish Town, London. They were asked to sketch and paint images of their school on the street frontage, and a new, bright entrance wall was suggested that would lead to a garden with trees, ponds, race tracks, slides, swings, movement tubes, and a swimming pool, demonstrating children’s love of nature and natural elements (Koralek & Mitchell, 2005). A field study in 2011 with 50 students from four different schools discovered that 100% preferred being outside (Khan, 2011). They attend classes so they may interact with their classmates and be outside. Figure 14 & Figure 15 depict where children hang out during class. The dots indicate the number of children who like to occupy that place in the plans.

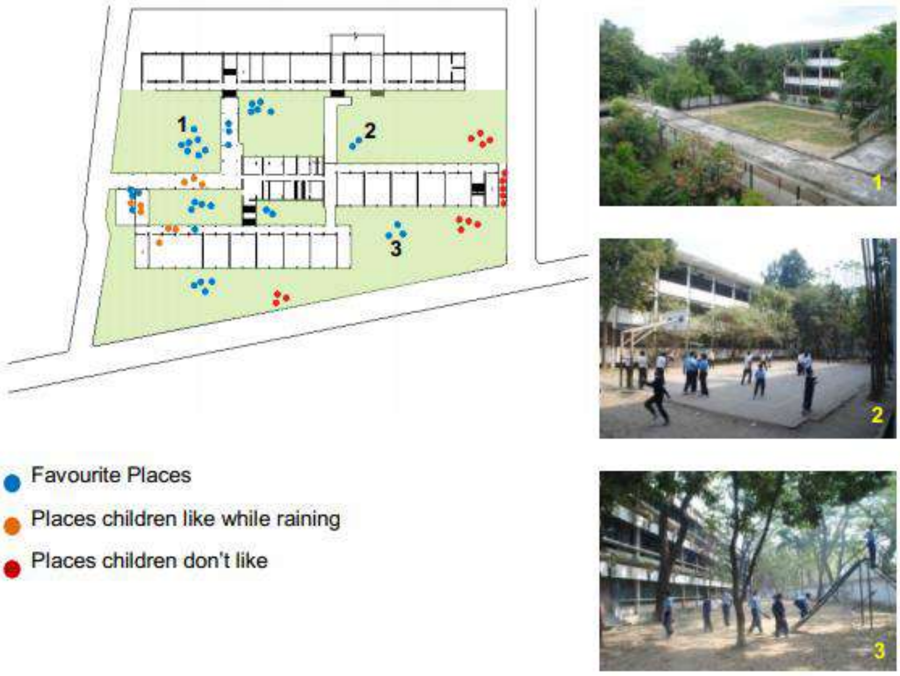


Figure 14 University Laboratory School, Dhaka (From Field Survey by Khan 2011)

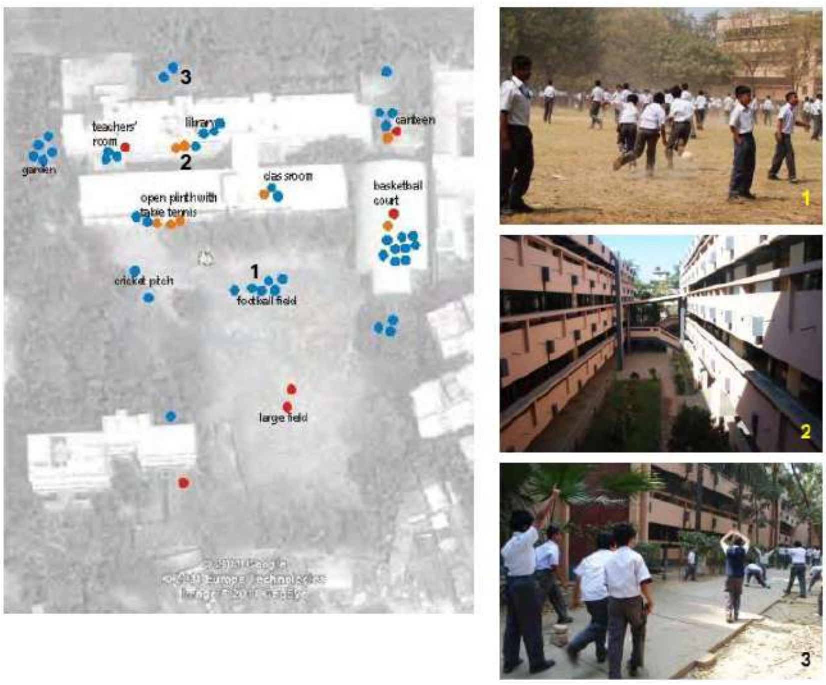


Figure 15 St. Joseph School, Dhaka (From Field Survey by Khan 2011)

2.6 Outdoor Space Design for Learning

Children may get familiar with, connect with, and experience a feeling of ownership towards a public building for the first time at school. This emotion contributes to developing sympathetic and environmentally conscious attitudes (Adams, 1992). According to Kirk Meyer, executive director of the Green Schoolyard Network, every schoolyard should include an outdoor learning space for thousands of reasons. Among his justifications are (Meyer, 2010):

- *Changes the emphasis of education from secondary to primary sources*. Textbooks, lectures, and visual aids are all common instructional methods in traditional classroom education. The outdoor classroom gives students first-hand exposure to natural settings and living demonstration models, including actual trees, water bodies, and soil.
- *Engages students by utilizing practical teaching techniques*. The outdoor classroom promotes inquiry-based, active learning in a natural environment. Students enjoy the learning process and aim for goals through group problem-solving exercises. The examples in Figure 16 and Figure 17 illustrate how two schools manage their outside spaces differently.

Figure 16 Use of Schoolgrounds: Structured Play, Baherchar Govt Primary School. (Khan, 2008)

Figure 17 Marked Playground, Gillespie Primary School.
A class of nine years olds worked with their teacher and an artist to create painted markings on the playground to extend the range of activities.
(Khan M. , 2012)

- *Creates a multimodal learning environment*. Students keep a close-knit bodily memory of enduring and synergistic events by using their senses of touch, smell, hearing, and sight. The Biophilia Hypothesis by E.O. Wilson reminds us that the human species needs to connect with and identify with nature since it has developed within the natural world.
- *Encourages using systems thinking.* The outdoor classroom highlights the interconnection of all things by acting as a miniature ecosystem. Students learn that complex natural and cultural systems frequently call for holistic rather than linear solutions via exposure to the intricate web of life.
- *Favours multidisciplinary research*. Using several academic disciplines is sometimes essential and desirable in the quest for comprehensive knowledge of the outdoor learning space. Math abilities are needed to plan a planting bed. Social studies lessons can be incorporated into separating native from non-native plants. Making a scarecrow is an artistic endeavour. Keep a garden notebook to improve your writing and artistic abilities.
- *Acknowledges and values the many learning methods*. People have a range of aptitudes and learning styles, as popularized by Howard Gardner's idea of multiple intelligences. While some students do well in a text-based

setting, others gain more from a more hands-on approach. Children on the wrong side of success gaps, such as English language learners, special education students, and children whose families do not prioritize education, may be able to contribute more in the outdoor learning space.

- *Ties the community and the globe at large to the school.* Through stewardship and learning activities, students discover that the difficulties facing the environment worldwide are reflected in the microcosm of their playground. Nearby neighbourhoods frequently inspire service-learning initiatives that prioritize civic engagement and responsibility. Programs that take place outside of school hours are made possible by the outdoor classroom's accessibility. Local volunteering is encouraged by high visibility and interest.
- *Needs a small capital investment for design and implementation*. Budget constraints make it difficult for school districts to prioritize activities. The objective of establishing and maintaining an outdoor classroom in every schoolyard is attainable, and the cost-benefit ratio for doing so is appealing (Meyer, 2010).
- *Conveys a favourable image of public education*. Schoolyards may be run-down and dangerous or lively, energetic, open areas. In any case, it communicates to residents and students how important it is to invest in their education. The outdoor learning space is a reminder that public education is still open to innovation.
- *Blurs the distinction between creative play and academic study*. The outdoors is a favourite among students. Every hand is raised when a teacher asks whether anyone wants to go outside. On days when classes are held outside, absences decrease. The lifelong active pursuit of information is encouraged by keeping a child's intrinsic sense of wonder and curiosity. Such a child will be aware that education may be enjoyable.

Also, the outdoors provides a number of affordances. The ability of an environment to facilitate children's development is measured by its affordance. According to Gibson (Gibson, 1979), an environment's affordances are the things it delivers or offers the user. The concept of affordances is also used by

Wohlwill and Heft (Wohlwill & Heft, 1987), who describe the environment-child connection in outdoors in terms of three characteristics:

- *Sensory stimulation:* Environmental elements and surroundings can stimulate the senses through colour, shape, pattern, depth, and texture differences. According to John Fabelo, AIA, "One of the advantages of outdoor learning space is that children learn by experience — touch, sight, sound, and scent. It's a much more comprehensive experience regarding what they're absorbing. Students' senses and awareness are significantly more acute while they are outside.
- *Responsive feedback*: the process of making an environment that is pliable and sensitive to the child's actions, giving children continuous input about their abilities, capacities, and behaviours. Schoolyards that encourage and get children to move more are good for their development.
- *Affordance*: An affordance is a feature of the environment that a person perceives as having functional relevance; it is a connection between some structural and functional characteristics and a person's objectives (Heft, 2001). The possible affordances of the physical environment are referred to by Chawla (Chawla L. , 1992) as intrinsic traits that assist children in developing place attachment. Children can interact with their environment continually and dynamically thanks to actualized place affordances.

Using findings from neuro research to understand how children learn, this study supports the notion that the environment plays a significant role in the educational process. Children should be encouraged to use both brain hemispheres during learning rather than just one. In contrast to the traditional sitting and learning approach, which occurs primarily in the left hemisphere, Sheikh and Sheikh (Sheikh & Sheikh, 1985) claim that outdoor education achieves its greatest impact on a person through experiences that are likely sensed interpreted in both the right and left hemispheres.

From Khan's undergraduate thesis (Khan 2009) it is observed that children’s learning depends on their developmental stages in various classroom settings. It is clear from the analysis of these places and child development that an outdoor space can house all of these locations, promoting children's overall development (Table 4).

Table 4 Outdoor learning space and Types of Spaces it serves based on Child development (Khan 2009)

Name of Spaces (Khan, M 2009)	Types of development	Whether occurs in outdoor?
Interactive Space	Socio-Emotional, Cognitive	√
Passive Places	Socio-Emotional	√
Personalized Spaces	Socio-Emotional	√
Building as an Image of Culture and Tradition	Socio-Emotional	√
Space for Playing	Socio-Emotional, Physical	√
Space for Exploration and Experiment	Cognitive	√
Active Spaces	Cognitive, Socio-Emotional, Physical	√
Space for Large Group Activities Space for Group Learning	Cognitive, Socio-Emotional	√
Spaces having Connection with Nature	Cognitive, Physical	√
Rich-Stimulating Environment	Cognitive, Socio-Emotional, Physical	√

Cognitive development (orange)
Socio-Emotional development (purple)
Physical development (green)

The presence of "architects" in education has allowed educators to take on subjects they had not previously been able to and has had a particularly positive impact on the growth of critical and design studies (Adams, 1993). Many teachers and students now have a new vocabulary to explain their experiences because architects understand the environment. This has enabled them to deal with the intricate web of relationships between buildings, spaces, and people by utilizing architects' skills in comprehending and interpreting built form and space, developing standards of judgment, and managing change (Adams, 1990).

When it comes to the development of outdoor learning environments, the most effective developments have been connected to using the curriculum (Adams, 1993). Qualitative research on the benefits of better schoolyards as a teaching tool shows that children's attitudes, actions, and academic abilities are enhanced (Moore R. C., 1989; Moore & Wong, 1997). For instance, the Boston Schoolyard Initiative has been working with Boston schools for over ten years to design and construct schoolyards that offer a rich environment for teaching and learning (Boston Schoolyard Initiative, 2005).

Some recent U.S. studies have also attempted to evaluate learning outcomes, which have focused on the quantitative and qualitative markers of increased learning outcomes from Outdoor learning by quantifiable changes in learning skills indicators, grade point averages, and results on standardized tests. These studies (Lieberman & Hoody, 1998; Lieberman, Hoody, & Lieberman, 2000; Place-based Education Evaluation Collaborative (PEEC), 2005; Place-based Education Evaluation Collaborative (PEEC), 2011; Jones, Klosterman, & Mesa, 2006; Lopez, Campbell, & Jennings, 2008; Paisley, Furman, Sibthorp, & Gookin, 2008; Lopez & Daly, 2009) show beneficial relationships between learning that occurs outside of the classroom and improved learning. Unfortunately, there has yet to be much research on how children learn in developing nations. Here, research primarily concentrates on the health and poverty of children living in slums. However, more research is needed on the quality of schooling for children from middle-class or lower-middle-class households. An outdoor classroom was built by 3rd-year students of SABA in the village of Gujrat in India for the Centre for Environmental Education (Arch Daily, 2012) (Figure 18), while on a field trip in India.

The custom of attending courses dates back centuries in this subcontinent when the guru (the teacher) instructed his students in the conventional maqtab or tole while sitting beneath a big tree. The majority of classes in Shantiniketan are held outdoors (Figure 19).

Figure 18 Outdoor Class at Children's Corner, Center for Rural Knowledge. Halwad,Saba (www.archdaily.com)

Figure 19 Santiniketan Ashram, Birbhum, West Bengal (www.alamy.com)

2.7 Garden as an outdoor learning space

As a teaching tool, school gardens are nothing new. School gardens go way back in several educational theories, such as those of Rousseau, Montessori, and Dewey. In schools with gardens, students have the chance to recreate real-world scenarios while learning and applying new information. The facts of growth, the chemistry of the soil, and the functions of light, air, and moisture can all be studied through gardens (Dewey J. , 1916). The founder of modern education, John Amos Comenius (1592-1670), argued in favour of having "A garden associated with every school, where children can occasionally gaze upon trees, flowers, and herbs, and be taught to enjoy them." (Weed & Emerson, 1909). he Nature-Study Movement initiated the early school garden movement. its primary goal was to make learning interactive by utilising nature. Although school gardens were promoted in the late 1800s and early 1900s in Britain and the USA to address city beautification, public health, and the development of good citizens, with relatively little focus on educational outcomes (Hayden-Smith, 2014). Dewey promoted gardening as part of his "object teaching" pedagogy, emphasising experiential learning rather than rote memorisation. School gardens are one approach to extending learning outside the classroom and use nature-based experiential learning as a learning strategy (Subramaniam, 2002) (Figure 20). Recently, the potential of garden-based learning has been defined as "encompassing programmes, activities, and projects in which the garden is the basis for integrated learning, in and across disciplines, through active, engaging, real-world

Figure 20 Students from Brookline elementary, Massachusetts work at the school garden, 1916 (Source: The Brookline connection)

experiences" (Desmond, Grieshop, J., & Subramaniam, A., 2002). However, despite this, school gardens have been relatively dormant since World War I, except for a brief comeback as part of World War II victory garden activities (Hayden-Smith, 2014).

The importance of school gardens has increased globally in the twenty-first century (FAO, 2010). School gardens are seen in thousands of schools around the world, enlisted in Edible Schoolyard Project inspired by Alice Water's 'edible schoolyard' in Berkeley, CA, Michelle Obama's White House Garden, the Royal Horticulture Society's 'Campaign for School Gardens', the EduPlant program in South Africa, the GATE program in Belize, and the Stephanie Alexander Kitchen Garden Foundation in Australia. The school gardens movement is also very much visible in Asia and the subcontinent. Guidelines for establishing School Nutrition Gardens or kitchen gardens have been distributed to all Indian schools by the Ministry of Human Resource Development (MHRD). These gardens will allow children to practise growing their food and learn about agriculture. The intention is to demonstrate to all Indian students that production leads to independence and is possible even in densely populated urban areas (Appel, 2019) (Figure 21). Agricultural experiences (AEs) in school gardens through school organisations are essential for children to remain connected to agriculture and nature. In Japan,

Figure 21 School Garden (Hindustan Times)

government school gardens are set up for children to acquire experiences with nature as they spend a significant amount of their daily lives in school. The students and staff largely maintain the gardens (Ito, 2013) (Figure 22). To enhance children's nutrition and the learning environment, FAO and Japan built school gardens in the Syrian Arab Republic (FAO, 2021). The prominence of gardening in general—and school gardens in particular—has also expanded due to numerous municipal and regional initiatives.

Figure 22 Children's activity in the school biotope finding small insects and herbs, 2005. Photo K. Hidaka

Many convergent goals are driving the current resurgence of school gardening, including the advancement of environmental sustainability (FAO, 2010), environmental education and the promotion of public health through diet. Current efforts to establish school gardens are also related to the broader effort to strengthen children's ties to nature. Since networking, technological development, and other indoor activities have taken up increasing time in children's days in recent decades, the amount of time they spend outside has decreased. Despite the well-documented advantages of nature access and exposure, there is a tendency towards children becoming less connected to it (Wells, Myers, & Todd, 2015). Children who spend time in nature benefit from improved cognitive functioning and academic performance, decreased symptoms of attention deficit disorder, a decreased risk of weight gain, and a decreased risk of myopia (Subramaniam, 2002; Wells, Myers, & Todd, 2015). Because school gardens are a means of getting children outside and fostering their connection to nature, the now available research points to a wide range of potential advantages for school gardening.

Given the recent emergence of school gardens, exploring how gardens affect children's behaviour and learning is especially interesting. Science, maths, language, arts, and the overall grade point average, have been the focus of studies exploring how students' involvement in school gardens affects learning or academic achievement.

2.8 Variables of Learning

Although this study focuses on the interaction between the built environment and children's learning, a list of all learning variables is covered in this section. Often learning is described as a function of personal and environmental factors (Sharma, Pathak, & Sinha, 2009).

$$L = f\ (EF \times PF)$$

L = learning; f = function; EF = environmental factors; PF = personal factors.

Equation 1 Learning as a Function of Environmental and Personal Factors

Environmental variables are contextual aspects that emphasize the significance of the environment in learning, such as the pedagogical, socio-emotional, sociological, cultural, and built environment factors. Personal factors include socio-demographic and psychological factors. The combination of both environmental and personal factors is necessary to fully comprehend the learner and the learning process.

2.8.1 Socio-Demographic Variables

Several studies assert that certain socio-demographic factors impact children's learning. Children of different ages learn in various ways. While children at the concrete operation stage do not yet have an abstract way of thinking developed, they learn best when it is connected to concrete objects (Haq & Jahan, 1999; Snowman, McCown, & Biehler, 2014). In contrast, children in the adolescent stage can memorise something after listening to or reading about it. In addition to age, gender is a crucial factor in learning styles.

According to research by educational psychologists, girls tend to hold themselves to higher standards in the classroom and judge their performance more seriously. Also, girls perform better in school than boys (as determined by students' grades) across all topics and age groups (Algoe, 2012). A busy, noisy classroom is perfect for many boys, but girls learn better in calm settings (Adcox, 2012).

2.8.2 Pedagogical Variables

Teaching, curriculum, instructional resources, and learning time are four classroom aspects essential to learning (Anderson, 2000). Much research (Anderson, 2000; Nath & Chowdhury, 2010; Chowdhury, Chowdhury, Hoque, Ahmad, & Sultana, 2009; Traylor, 2010; Rose, 2010) has found that teacher traits and teaching or classroom style determine factors affecting education quality and grade repetition. The environment has an impact on educational aspects. Teachers are excited about teaching outside because they believe the environment allows them to teach better (Lieberman, Hoody, & Lieberman, 2000; Spencer & Metz, 2008).

2.8.3 Personal Variables

Most of the elements that could influence children's learning had to do with outside factors.

However, a very significant factor—some could even argue the most crucial one—is the student's readiness to learn. Personal characteristics are psychological or intra-individual variables such as drive, aptitude, hobbies, intelligence, openness to learning, maturation, etc. Students are likelier to learn if they are eager, motivated, or goal-oriented (Sharma, Pathak, & Sinha, 2009; Traylor, 2010). Socioeconomic elements like students' backgrounds, parents' educational levels, and families' financial situations might occasionally impact children's characteristics. Children from wealthy neighbourhoods will likely have more educational resources and assistance to help them succeed in school. These areas frequently have more education-related businesses, after-school programmes, and tutoring centres than working- or poor-class areas. The built environment has an impact on these human characteristics as well. Improved educational facilities encourage students to pursue higher education (Tai, Haque, McLellan, & Knight, 2006).

2.8.4 Built Environment Variables

A vast body of literature spanning several decades corroborates, with quantitative data, a positive relationship between the conditions of the school's-built environment and both student achievement and behaviour (Earthman & Lemasters, 1998). It has been repeatedly documented that students' learning outcomes (often measured by standardized tests) improve when the physical conditions of their classrooms and school buildings are improved (Weinstein, 1979; Earthman & Lemasters, 1998). McGuffey concludes from his review of 232 articles that improved facilities enhance the learning process, although the particular impact on the learner varies with the grade level and subject area (McGuffey, 1982).

The traditional classroom and internal school facilities are generally referred to as the primary elements of the built environment in the research described above. The conclusions about the built environment can, however, be taken into consideration about the outdoors because it can be concluded that if the conditions of the indoor learning environment have such a clear and consistent impact on learning outcomes, then the conditions of the outdoor learning environment must also have a similar impact on these outcomes.

School grounds—here, "school grounds" refers to outdoor areas within the school environment—are a part of the built environment, even though much of the literature views the internal classroom as the built environment (Boston Schoolyard

Founders' Collaborative, 2000). However, the effects of school grounds cannot be applied to all students who use them. School grounds can be improved for outdoor instruction (Brett, Provenzo, & Moore, 1993). Care is taken to use space creatively and create welcoming hallways and classrooms inside the school. The children are expected to receive specific concepts, attitudes, and values through this indoor care.

Oddly, nevertheless, the school's exterior could be more frequently a neglected area (Threlfall, 1986). This study treated the standard classroom and the outdoor learning space as two independent variables to examine the effect of the outside environment on students' learning.

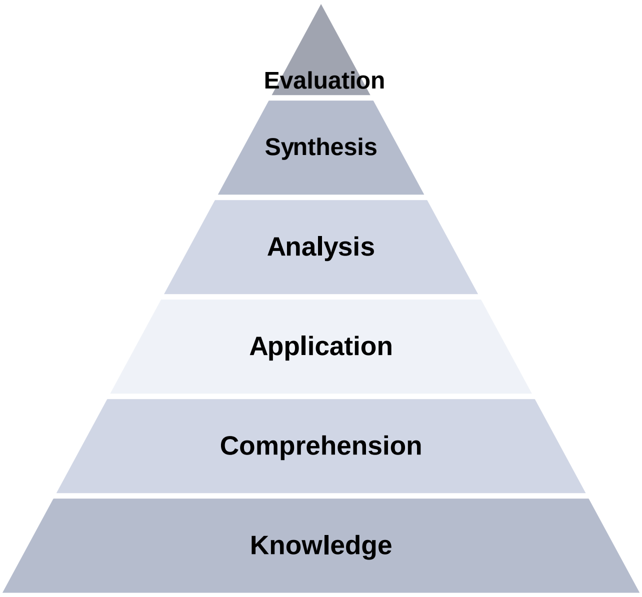
2.8.5 Domain Variables of Learning

The learning variables are covered in this section because the study focuses on the connection between children's learning and the outdoors. Bloom's taxonomy of learning objectives (Bloom, Englehart, Furst, Hill, & Krathwohl, 1956) is prioritised when categorising the learning factors of children. In the beginning, "Bloom's Taxonomy" was developed in and for an academic setting to create a system of categories for learning behaviour to aid in the planning and evaluating of educational learning (Chapman, 2011; Snowman, McCown, & Biehler, 2014). So, since 1956, Bloom's Taxonomy has served as a foundation for concepts that academics, educators, teachers, and trainers worldwide have utilised (and developed) to create learning evaluation materials. In Bloom's own words, "it is estimated that over 90% of test questions that American public-school students are now asked to answer deal with little more than information" (Benjamin, 1984).

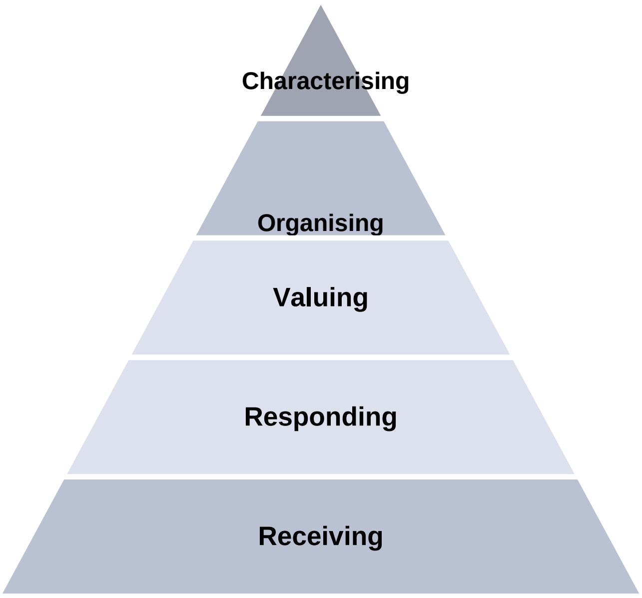
"A set of classification principles" or "structure" and category is what taxonomy and domain, respectively, mean. The three components of Bloom's Taxonomy are cognitive, affective, and psychomotor. (Snowman, McCown, & Biehler, 2014; Krathwohl, 2002). This study examines the learning variables in the cognitive and affective domains (Table 5) (Figure 23).

The achievement test paper in this study is created using Bloom's educational objectives, which were previously used in a study by Lieberman and Hoody in 1998. (Table 6).

According to data from both the Learning and Domain surveys, teachers and administrators have considered EIC-based learning to be an effective method of assisting students in developing their science knowledge and abilities.



The Cognitive Domain _ Knowledge Based



The Affective Domain _ Emotion Based

Figure 23 Bloom's taxonomy Pyramid

Table 5 Taxonomy of Educational Objectives- Cognitive and Affective Domain (Snowman, McCown, & Biehler, 2014)

Cognitive Domain	
Knowledge	Remembering previously learnt information, such as facts, terms, procedures and principles
Comprehension	Grasping the meaning of information by putting it into one's own words, drawing conclusions or stating implications
Application	Applying knowledge to actual situations
Analysis	Breaking down concepts or ideas into simpler parts and seeing how the parts are interrelated and organized
Synthesis	Rearranging component ideas into a new whole
Evaluation	Making judgments based on internal evidence or external criteria
Affective Domain	
Receiving (Attending)	Willingness to receive or attend
Responding	Active participation indicating positive response or acceptance of an idea or policy
Valuing	Expressing a belief or attitude about the value or worth of something
Organizing & conceptualizing	Organizing various values into an internalized system
Characterizing by a value or value complex	The value system becomes a way of life

Table 6 Summary of Learning and Domain Surveys on Science (Lieberman and Hoody 1998)

Learning Survey Items	% of Educators Reporting Student Improvement	# of Educators Responding to this Survey Iten
Learning of science	100%	150
Problem-solving and strategic thinking	97%	167
Systems thinking	89%	142
Completion of extra activities or projects	90%	164
Domains Survey Items		
Knowledge: content, concepts, and principles	99%	125
Skills: processes and application to real situations	99%	121
Retention of knowledge and skills	97%	118
Attitudes: engagement, enthusiasm, and interest	98%	126
Opportunities: context and content for learning	98%	122
Average for Science Domains Survey	98%	123

2.9 Summary of Literature Review

Some critical advantages of outdoor learning are improved academic performance, better science grades, and meaningful interpersonal and intrapersonal relationships. Developing more environmentally sensitive people and communities and advancing environmental consciousness and stewardship ethics are indirect benefits for the natural environment that are not as immediately apparent. Benefits to health and education were noticeable in the physical, psychological, and spiritual realms, particularly in terms of enhancing one's sense of self-worth, intellectual pliability, interpersonal abilities, and relationship-building. The advantages of learning outside can be increased by providing the proper facilities, allowing students access to natural resources, and designing an effective outdoor learning space. It has been discovered that outdoor environments are constructed per formal curricula on the theory that exposure to nature increases children's interest in and motivation for science learning when learning occurs in an outdoor learning space

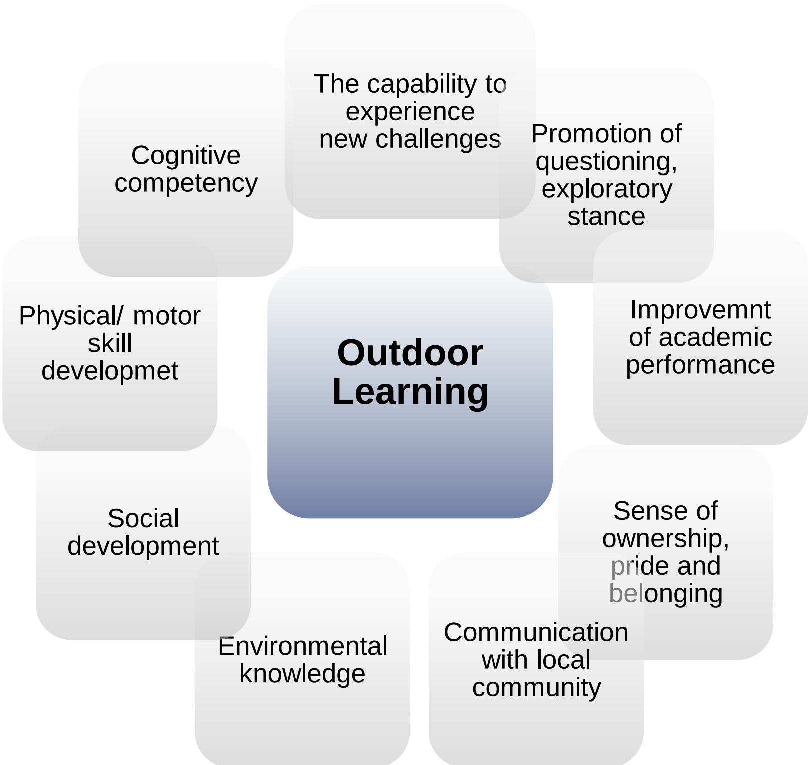


Figure 24 Positive Impact of Outdoor Learning

For school-aged children, along with theories (Table 8) outdoor learning has been proven to have several advantages in extensive studies and empirical data. Table 7 summarises and Figure 24 gives a graphic representation of these advantages. In a word, Broda (Broda, 2007) says it best: "*Learning that takes place outside of the classroom has been linked to increased academic accomplishment, excitement for learning coupled with fewer discipline issues. Activities for outdoor learning are also highly compatible with the ideas of various bits of intelligence and learning styles. The simple fact that outdoor learning adds interest and variety to our teaching and provides a change of pace and location makes it a sensible addition to our educational arsenal.*"

These studies are primarily carried out in the setting of industrialised nations. This elucidates the need for such research in our setting. In this research, the cognitive and affective domains of a test based on Bloom's taxonomy of educational objectives are used to determine learning outcomes.

Table 7 Learning in outdoor and its consequences (Summary from Literature Review)

	Consequences	References
Learning in outdoor	Promotion of questioning, exploratory stance of the child	(Lieberman and Hoody 1998, Malone and Tranter 2002, H. Broda 2007, Tai, Haque, et al. 2006)
	Physical/motor skill development of the child	(Adams 1993, Malone and Tranter 2002, Charles 2012)
	Cognitive competency of the child	(Haq and Jahan 1999, H. Broda 2007, French, Contag and Sundharam 2012)
	Social development of the child	(Malone and Tranter 2002, H. Broda 2007)
	Creative development of the child	(The Early Years Foundation Stage 2007)
	Environmental knowledge of the child	(L. Chawla 2002, Adkins and Simmons 2003, Tai, Haque, et al. 2006)
	Sense of ownership, pride and belonging in the child	(Malone and Tranter 2002)
	Improvement of Academic Performance	(Place-based education and student achievement 2006, Kollie 2012)
	The capability to experience new challenges, assess risk and develop the skills to manage difficult situations	(Lieberman and Hoody 1998, The Early Years Foundation Stage 2007)
	Communication of local community with children	(Moore and Wong 1997, H. W. Broda 2011)
	What school environments will look like in the future	(Adams 1993, H. W. Broda 2011)

Table 8 Theories (Summary from Literature Review)

Theories	By	Statement	Key terms	References
Piaget's Constructivism Theory	Piaget	Students construct knowledge based on their experiences	Active agents, Concrete Operational Stage	(Dietz, 2002)
Sociocultural theory	Vygotsky	Social interaction plays a fundamental role in the development of cognition.	Zone of Proximal Development (ZPD)	(Mcleod, 2022), (Mehta, 2002), (Vygotsky, 1978)
Theory of multiple intelligences (biological and cultural research)	Howard Gardner	Definition of intelligence as “the capacity to solve problems or to fashion products that are valued in one or more cultural setting” - different children learn and grasp information in different ways	The eight types of intelligence: musical-rhythmic, visual-spatial, verbal-linguistic, logical-mathematical, bodily-kinesthetic, interpersonal, intrapersonal and naturalistic. two additional types of intelligence, namely, existential and moral.	(Smith 2002), (Mehta, 2002)
Theory of Learning by Doing	John Dewey (Educational Theorist)	People learn best through a hands-on approach		(Dewey, 1916)
Bloom's Taxonomy			Cognitive, affective, and psychomotor.	(Bloom, et al., 1956), (Snowman, et al., 2014)

Chapter 3: Theoretical and Conceptual Framework

This chapter outlines the conceptual framework for the exploration, which directs the research question and methodology in later sections. The study's basic theory is based on environmental psychology, arguing that the environment shapes people's behaviour. The study asserts a conceptual link between the environment and children's behaviour. The environment shapes the child, who, in turn, shapes the environment (Björklid, 1982) (Figure 25).

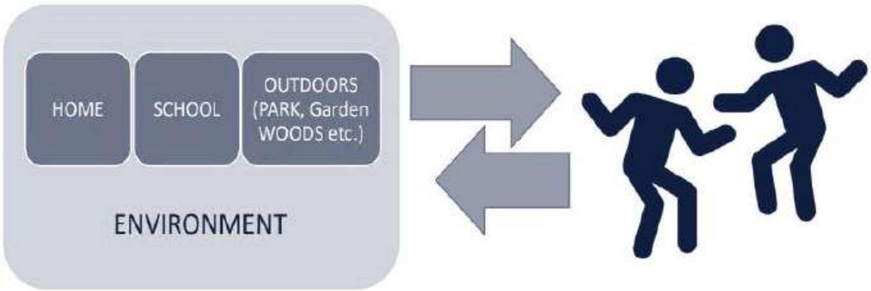


Figure 25 The Child Shapes the Environment and in Turn Shaped by It

Children's behaviour is a highly complicated construct comprising many variables, including the multifaceted concept of "environment". Children are thought to learn through various environmental factors, but this study focuses on the built environment. To be more precise, the study aims to discover how a garden affects children's learning. The literature review (see Chapter Chapter 2:, Section 2.2.1) established that children's science knowledge is correlated with "learning by doing" and "exploration of real-world materials," which is why this study concentrated on science learning.

The study's primary conceptual perspective was Kurt Lewin's Equation (Lewin, 1936). According to Lewin's Equation, **B = f (PE)**, where B stands for behaviour, P for person, and E for the environment, behaviour is a function of the relationship between person and environment. It was initially stated in Lewin's 1936 book titled Principles of Topological Psychology, which defied most accepted beliefs of that period. It emphasises a person's current circumstances more than the past while attempting to interpret their behaviour. This theory is essential to this research because it highlights the importance of the environment in shaping human behaviour. Both built and social settings influence children's behaviour. This study focuses on the outdoors, a subject that should be addressed by architects, landscape architects, urban designers, and planners.

The taxonomy of educational objectives defined by Benjamin Bloom is studied to comprehend the concept of learning (Bloom, Englehart, Furst, Hill, & Krathwohl, 1956). The Bloom concept of educational objectives impacts the dependent variables of this study and the methods used to measure them.

3.1 Conceptual Level

Conceptually, the study intends to determine whether there is a correlation between a child's behaviour and their environment. This research is only concerned with investigating the influence of the environment on children's learning behaviour and, as a result, comprises a unidirectional relationship, even though numerous studies (Björklid, 1982) (Moore R. C., 1989) have suggested that the link in question is reciprocal. As a result, all learning-related aspects are covered at the conceptual level.

Discussing all four categories of variables—psychological, educational, environmental, and demographic—has also aided in methodological decisions about sampling techniques and other matters, Figure 26.

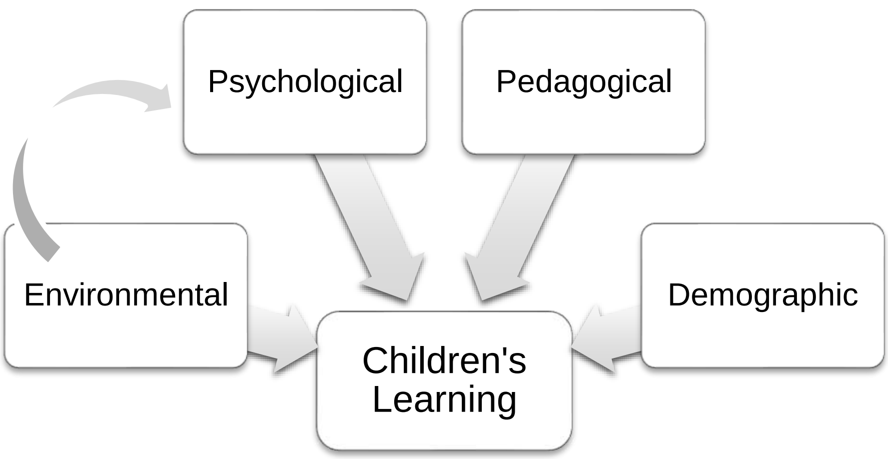


Figure 26 Conceptual Level of the Study: Four categories of factors that can influence children's learning

3.2 Operational Level

At the operational level the study evaluates the impact of environmental variables on children's learning by neutralizing demographic, pedagogical, and psychological variables. Age and gender were determined to significantly impact children's learning among the demographic factors (Adcox, 2012; Anderson, 2000; Kreitler, Zigler, & Kreitler, 1984). These variables are controlled by assigning children of the same age group and the same teacher for both indoor and outdoor environments, Figure 27. Thus, the demographic and pedagogical factors being eliminated, the study can examine the role of environmental variables on learning behaviour, assuming that environmental variables and psychological factors are related.

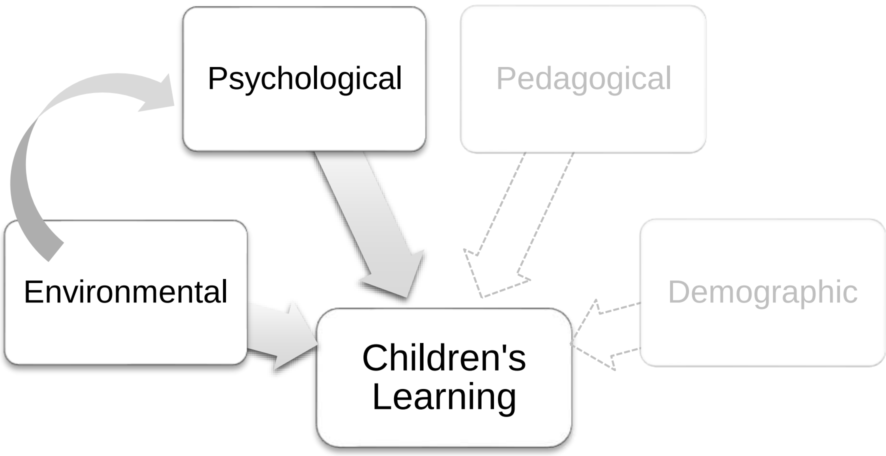


Figure 27 Operational Level: Demographic and Pedagogical Variables Neutralized

Children’s learning is measured by scores obtained in an achievement test based on cognitive domain variables. The environmental factors are limited to only types of the built environment- the garden and classroom. The personal variables are considered a construct of the built environment and eliminated from the experimental part of the research. Measurement of personal variables for the experimental part is considered to be beyond the scope of this research, which is limited to the genre of architecture or design. This research limitation forces a qualitative part in the operational stage.

The qualitative part of the research, includes focus group discussions (FGD) and in-depth interviews with children and their teachers. This qualitative phase describes the participants' views regarding outdoor classes and children's learning. (Figure 28)

The conclusion is formed based on the results of both the quantitative and qualitative stages. Consequently, the research approach encompasses all factors of children's learning and highlights the impact of the outdoor environment on children's science knowledge.

Figure 29 summarizes the conceptual framework and its operational interpretation.

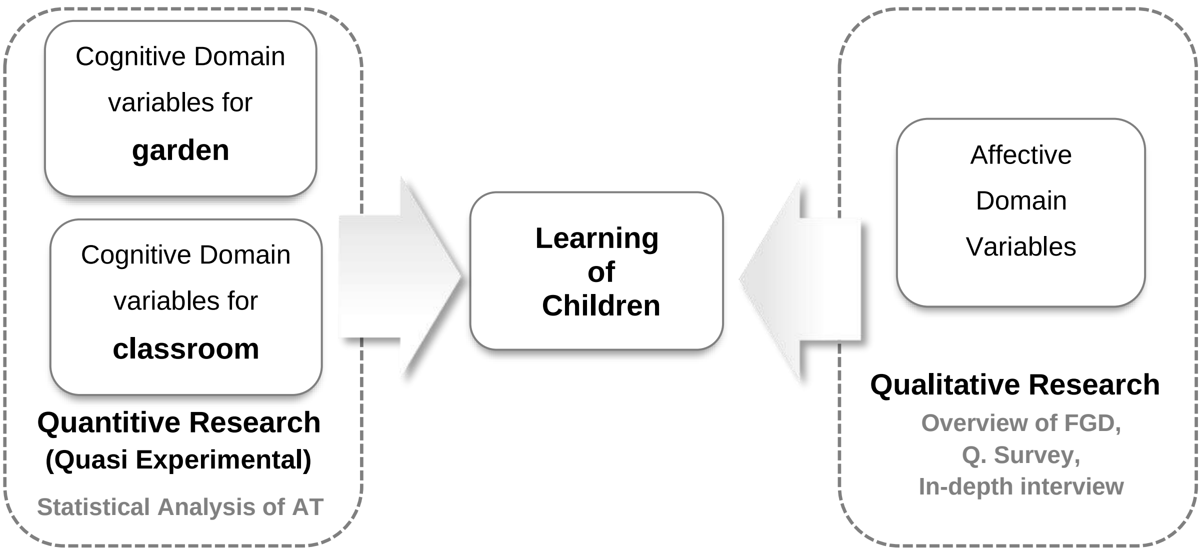


Figure 28 Operational Level: Impact of Environment on Children's Learning

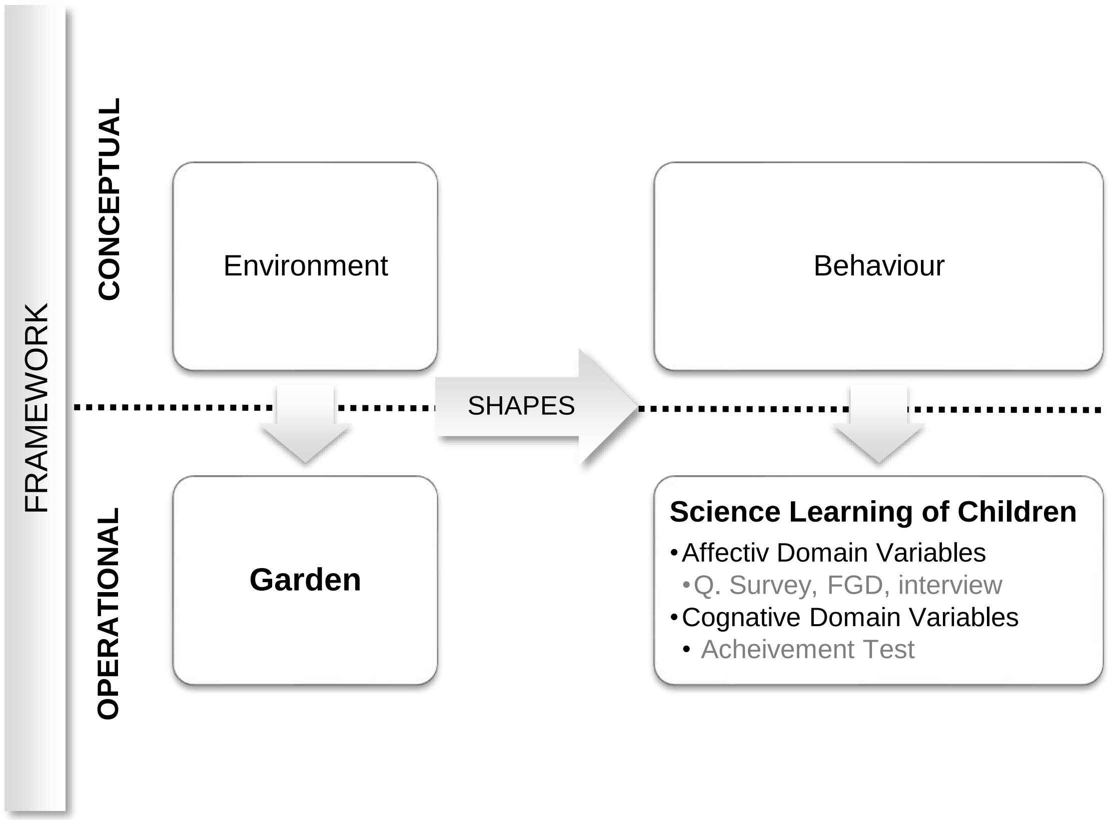


Figure 29 Conceptual and Operational Framework

3.3 Hypothesis and Research Question

The background literature poses the research question, which directs the research towards its hypothesis (Figure 30). An assessment of the literature revealed that exposure to outdoor environments benefits children's science knowledge (Chapter 2:, Section 2.9). The literature study illustrates the need for this specific research by demonstrating the relative shortage of prior work in the context of developing nations.

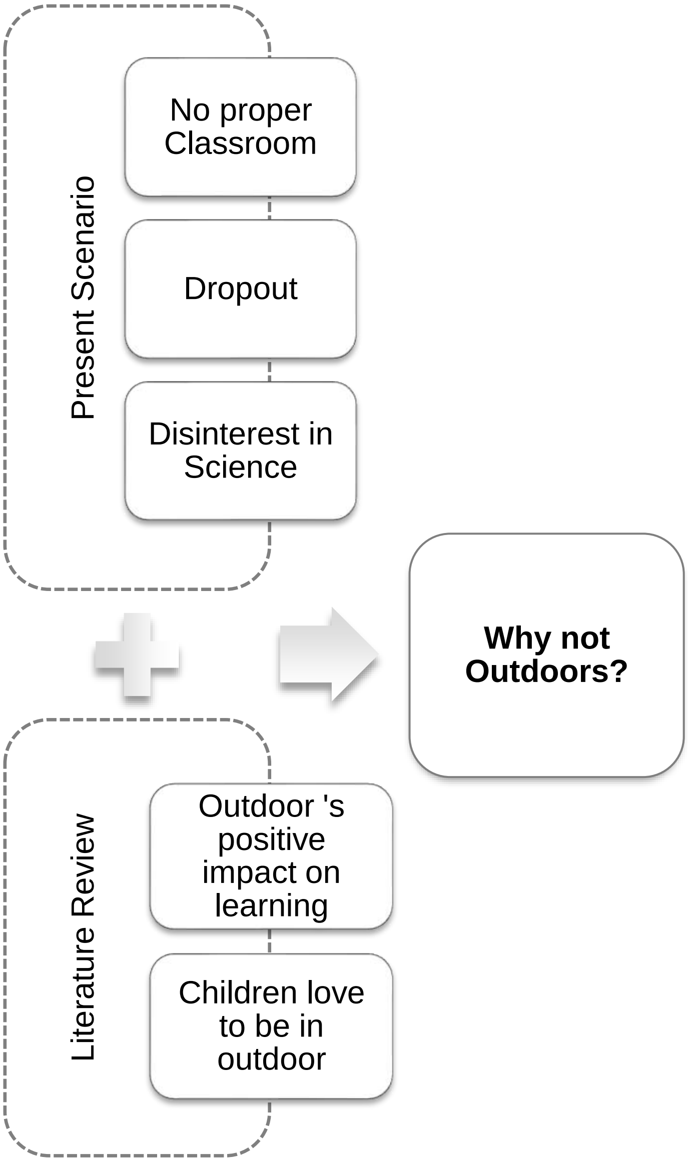


Figure 30 Formulation of Research Question

Hypothesis

The study hypothesizes that there is a notable distinction between learning outcomes in indoor and outdoor environments.

To validate this hypothesis the study builds on earlier works that claimed there was a significant difference between learning in indoor and outdoor environment (Lieberman & Hoody, 1998; Lieberman, Hoody, & Lieberman, 2000; Place-based Education Evaluation Collaborative (PEEC), 2005; O'Brien, Jones, & Rustin, 2000; Jones, Klosterman, & Mesa, 2006; Lopez, Campbell, & Jennings, 2008; Paisley, Furman, Sibthorp, & Gookin, 2008; Lopez & Daly, 2009; Place-based Education Evaluation Collaborative (PEEC), 2011). However, these studies have mainly been conducted in developed countries, and thus, their results need to be verified in the context of developing countries.

Research Question

Are there any significant differences between indoor (classroom) and outdoor (garden) environments for children's science knowledge?

3.4 Important Vocabulary

General Terms

Children: Children refer to Bangladeshi school-going children between the ages of 7 and 11. Definition of children for this study is elaborated in Chapter 4.

Learning*:* Only the cognitive (knowledge, comprehension, application, analysis, synthesis, and assessment) and affective (receiving, responding, valuing, organising, and conceiving characterised by value or value idea) domains of learning are acquired. It is assessed in this study using the results of an achievement test.

Environment: Environment refers to a primary school's physical surroundings and features.

Intervention: In this specific study, intervention refers to setting up a garden in a primary school.

Terms related to Dependent and Independent Variables

Indoor Environment/ Classroom*:* The Class V classroom in the school building is called the indoor environment or the classroom because it is where the regular classes are held.

Outdoor Environment*:* The term "outdoor environment" describes all areas of the school grounds outside the school building that are under the control of the school administration. In this study, the term "outdoor environment" mainly refers to the garden the researcher had built on the school grounds.

The Control Group: The control group comprises the students who received instruction in their regular classroom.

The Treatment Group: The students who took science classes in the garden are referred to as the treatment group.

Achievement Test: An achievement test was created to assess children's cognitive learning. In Chapter 4, Section 4.6.3, this definition is elaborated.

Cognitive Domain: Knowledge acquisition, comprehension, application, analysis, synthesis, and evaluation all fall under the cognitive domain, and progress in these areas is measured by the achievement test mentioned above.

Affective Domain: The measure of receiving, reacting, appreciating, organising, and conceptualising, characterised by value or value idea, is known as the affective domain and is investigated using structured questionnaire surveys.

Knowledge: Knowledge is the numerical gain in the section of the achievement test designed to measure children's retention of previously learned material.

Comprehension: The term "comprehension" refers to the numerical gain in the section of the achievement test designed to measure how well students understood the information.

Application: Application is the numerical gain in the section of the achievement test designed to evaluate children's capacity for applying the information to real-world circumstances.

Analysis: Analysis is the numerical gain in the section of the achievement exam designed to gauge a child's aptitude for dissecting concepts or ideas into their component components, analysing those pieces, and establishing the connections between them.

Synthesis: In the section of the achievement exam where there was a numerical gain, this is referred to as synthesis.

Evaluation: Evaluation refers to the numerical gain in that part of the achievement test, which was developed to assess children's ability to make judgments.

3.5 Summary of Theoretical and Conceptual Framework

This chapter outlined the conceptual framework of the study. The study is based on environmental psychology, which argues that the environment shapes people's behaviour. The research aims to explore how gardens affect children's science knowledge. Kurt Lewin's Equation, B = f (PE) is the primary conceptual perspective, highlighting the environment's importance in shaping human behaviour. Benjamin Bloom's taxonomy of educational objectives is studied to comprehend the concept of learning. The study is concerned with investigating the influence of the environment on children's learning behaviour and comprises a unidirectional relationship. The research question is whether there are significant differences between indoor (classroom) and outdoor environments in children's science learning. A mixed methodology of quantitative and qualitative methods is used. The quantitative part of the research measures children's learning using achievement tests, while the qualitative part includes focus group discussions and in-depth interviews with children and their teachers. The conclusion is formed based on the quantitative and qualitative stages' results, highlighting the outdoor environment's impact on children's science knowledge.

Chapter 4: Methodology

The conceptual framework articulates the research question of the study. This section describes the techniques utilized to address the research question.

Three parts make up this section. The first part describes the general study design and explains why it was chosen. The second outlines the selection criteria for the research topic and the participants. The third section elaborates on the methodology utilized for the study.

4.1 Research Design

The ideal study approach optimizes generalizability, enhances precision in controlling and measuring variables, and assures the existential realism of the participants. (McGrath & Joseph E. , 1994)

The current study has applied a mixed methodological research approach to investigate the association between the outside environment and learning.

The quantitative aspect of the research design adopts a quasi-experimental strategy, combining an intervention with data collection to evaluate the effects of the intervention on the main variables.

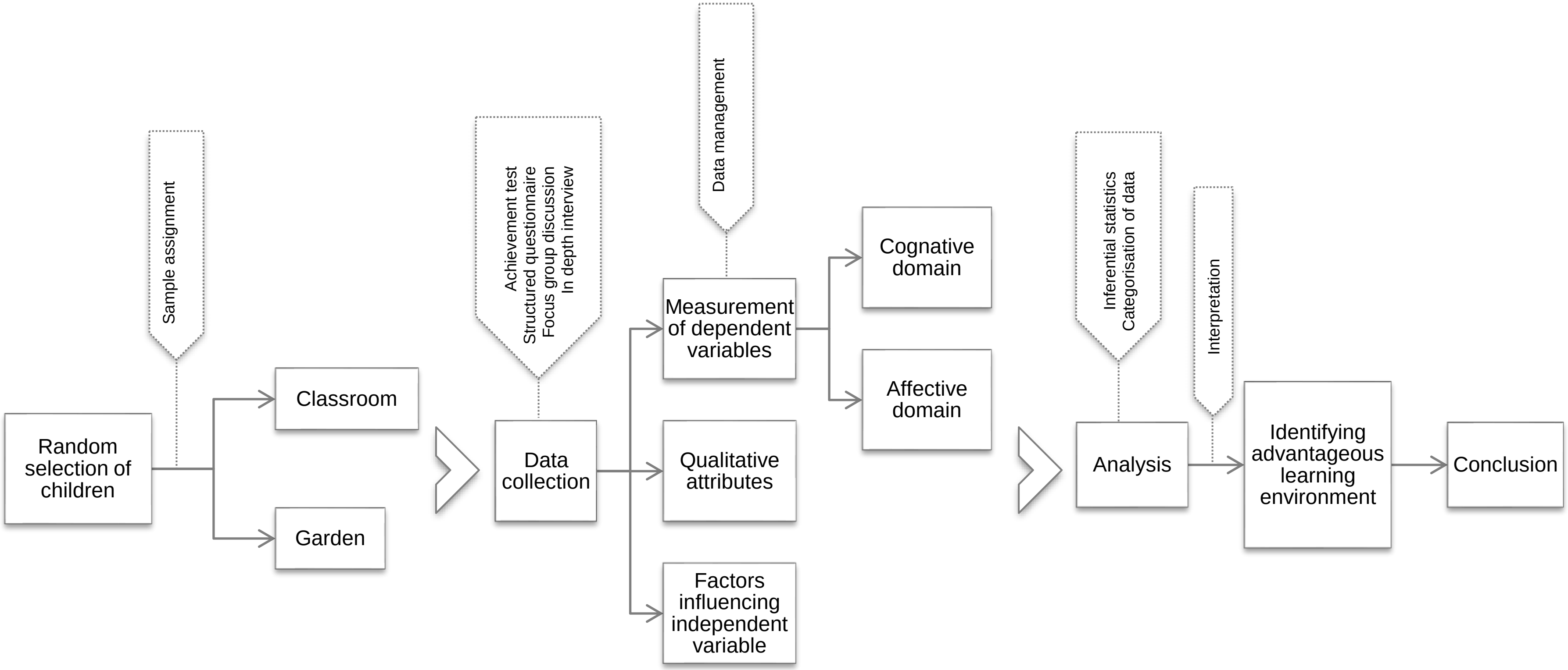
The study employs convenient sampling of a primary school and assigns purposively selected class V students to either the treatment or control group based on parental consent. It aims to investigate if there is a causal relationship between children's learning and the school's outdoor surroundings by applying a treatment or independent variable. The independent variable being tested is the garden, and its effect on children's science knowledge is the dependent variable. The study assesses the impact of the garden intervention by comparing the scores of the Achievement Test of the treatment group of children who have access to the garden to that of a control group who do not. The designated assignment unit is a student, and the study focuses on determining cause and effect by measuring the garden's impact on the student's learning in a specific research setting.

In this study, a qualitative technique is being used to gather information and gain insights into children's behaviour and knowledge. This approach is considered particularly suitable because it allows to observe and analyse children's actions in their natural environments, providing a deeper understanding of the reasons behind their behaviours.

This study's qualitative part focuses on exploring and interpreting the purposes and processes of people's actions, rather than quantifying data through numerical measurements. By using qualitative methods, such as a Structured Questionnaire Survey, Focus Group Discussion (FGD), and in-depth interviews, the researchers aim to gather rich and detailed information about the experiences, perspectives, and thoughts of both students and teachers.

Figure 31 potrays Methodological Sequence of the research.

Are there any significant differences between indoor (classroom) and outdoor (garden) environment for science knowledge?



Dependant variable: *Science Learning of Children*: Cognitive domain: knowledge, comprehension, application, analysis, synthesis and evaluation

Affective domain: receiving, responding, valuing, organising and conceptualizing

Independent variable: Classroom, Garden

Figure 31 Methodological Sequence Diagram

4.2 Sampling Strategy

4.2.1 Convenient Sampling of School

The researcher chose to conduct her intervention and study at Engineering University Girls School and College on Dhakeshwari road (Figure 32) since it is conveniently located just over a kilometre from BUET, her place of study, and only over a kilometre and a half from her residence (Appendix 5). Regarding social class, economic standing, and ethnicity, the student body at the participating school was a good fit for the elementa`ry student population demography in the whole region.

Figure 32 Engineering University Girls School and college

4.2.2 Purposive Sampling of Class

The National Child Policy 2011 of Bangladesh defines a child as anyone under 18 years old. However, this study focuses on children's learning behaviours and participants are expected to be between 7 and 11 years old, the age range associated with the Concrete Operational Cognitive Developmental Stage according to Jean Piaget's theory of cognitive development (Ginsburg & Opper, 1979). At this age, children are more likely to explore outside and have a solid cognitive process that is more logical and structured (Moore R. , 1986; O'Brien, Jones, & Rustin, 2000). Older children, therefore, perceive the mind as an active, productive agent capable of choosing and modifying information, in contrast to pre-schoolers who see it as a passive container (Halliburton & Gable, 2003). hey develop their knowledge by interacting with their physical and social environment, and can think abstractly (Kahn & Keller, 2002).Therefore, the age range of 7 to 11 years old has been chosen for the sample assignment since before this age, children do not have the capacity to think and study independently, and they are not familiar with knowledge of science. Science lessons in primary schools begins in class three (NCTB, 2022) when students are between the ages of 7 and 8.

Class V students range in age from 8 to 10, which is the middle of the concrete operational stage. Class V students are already familiar with learning science because, in primary school, science lessons begin in class III. This is the rationale behind the choice of this class. The researcher thoroughly examines the science textbook. After an honest talk with the school's science teacher, it is discovered that most of the book's elements come from nature, necessitating the children to spend time in it. In addition to the DPE data, it has been found that class V has the most dropout rates. In this class, children are less likely to attend school routinely. As a result, the students' average attendance is also relatively low.

4.2.3 Random Sampling of Children

In the school under investigation, class V was attended by 55 children (Appendix 1 Class V Students). Initially, it was determined to randomly choose members of this class for the control group (the group that will not receive the treatment) and the treatment group. About half of the class will be randomly chosen to receive treatment, while the remaining students will comprise the control group.

Later on, it was decided that children with parental consent would be selected as the treatment group.To this end, the researcher prepared a consent form (Appendix 3 Consent Form) which was supplied to the students through the school teacher to be filled up and signed by the parents (Appendix 4 Sample Signed Consent form from parents), who would allow the children to attend classes in the garden. In this process, a total number of 24 students out of the 55 were put into a treatment group. The parental consent was a random selection.

The sampling method is shown in a flow diagram in Figure 33.

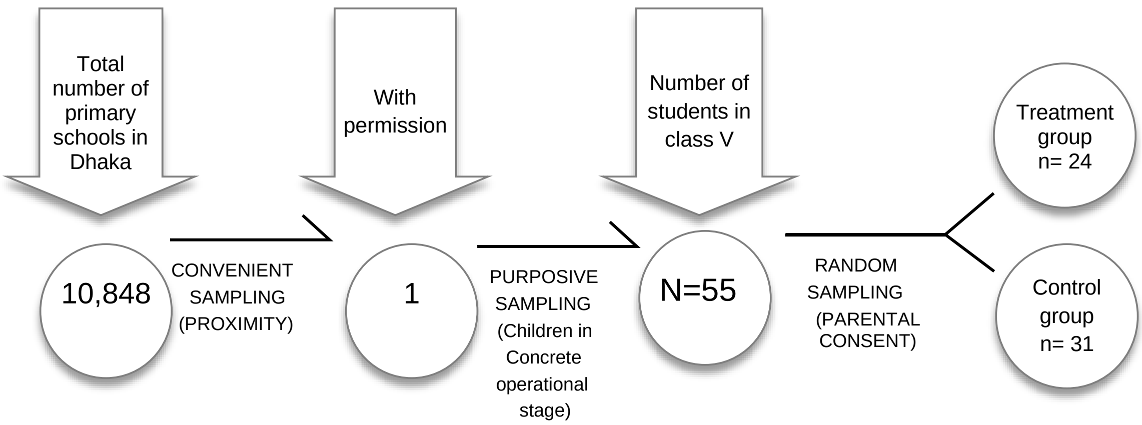


Figure 33 Sample Summary

4.3 Pre-Survey Works

4.3.1 Obtaining Permission from School

Once the Engineering University Girls' School and College had been chosen, the school's Headmaster was approached in November 2019 with the help of the researcher's supervisor. A verbal agreement was reached to immediately carry out the intervention in the schoolyard so that a garden would be prepared by the beginning of the academic year 2020 for the students of class five to take science lessons in the garden. Later, the school Headmaster was approached with a formal permission letter (Appendix 2 Official permission letter), seeking cooperation in the research project. The target age group, the selection procedure, the intervention, and the research was briefly explained to the Headmaster and the teachers of the chosen school. They valued the research and assured to provide any assistance requested. It was agreed that the Headmaster, with the help of the school teachers, would inform the school management committee members and the parents of the students about the research process. The date and time for the introduction with the students were set on January 2020 at the beginning of the academic year.

4.3.2 Setting up of a winter garden

To ensure the successful establishment of a winter garden for the classes to be taken within, it was required to commence the garden work at least 2 to 3 months prior to the anticipated introduction day. This ensured that the winter garden would be fully prepared and conducive to providing a suitable learning environment for the classes that were scheduled to take place there.

The specific details regarding the design and intervention processes are provided in the corresponding Design and Intervention section. Figure 34.

Figure 34 Setting up a winter garden

4.3.3 Briefing session at the school

As per the decision, at the beginning of the academic year, in the first week of January 2020, the researcher and her supervisor met the children of class V at their schoolyard. Two assigned science teachers of their class, Ms Rajia Sultana and Ms Shaila Parvin, were present during the introductory session. All the present class V children were informed about the intervention. In groups, the children visited the garden set up at their schoolyard, assisted by the researcher and their science teachers. The children were then told about the lessons (chapters 1 to 3 from the general science book) to be taught in the garden instead of the indoor classroom. In this context, each child was given a consent form (Appendix 3 Consent Form). They were instructed to complete the form by their parents if they were allowed to participate in the research process by participating in science classes in the garden. They were asked to deliver the completed consent form to the assigned school teacher within the next week. The students returned the consent forms within the following weeks, and it was found that 24 out of 55 students had their parents' consent to take part in the experimentation. Figure 35.

Figure 35 Treatment group children with the science teacher

4.4 Design and Intervention

Under the supervision of the supervisor, a garden that served as the experiment's lab was created in a suitable location on the school premises with ample space to house the children, considering the necessity of sunlight and irrigation (proximity to a water source). The place had to be unobtrusive to the school's outdoor activities like assembly, physical training etc. The researcher then proceeded to the intervention. The units of assignment, or the students, were taught there for the experiment after the garden's completion.

4.4.1 Intervention in School

Growing conditions and ripening cycles differ depending on the plant and the season. In order to start the experimentation at the beginning of the school year, the garden needed to be prepared before the school session started. A gardener was employed for six months with an arrangement for a monthly salary to set up the garden. He, at the beginning of November 2019, soon after the intervention permit from the school authority, was started the preparation for a winter garden in the following phases:

Determining location for the school garden:

A garden to flourish needs plenty of sunlight, proper ventilation, and good soil quality with access to a nearby water source. The schoolyard was surveyed by the researcher to determine a suitable location for setting up the garden with enough space to house children having science lessons in it (Figure 36). Initially three places were selected (Figure 37). Finally, one opted as it matched all the requirements for the garden (mark 01 in Figure 37).

Figure 36 Schematic Location of the Garden.

Figure 37 options for garden site

Aquiring garden equipments and seeds:

A list of products were bought for the purpose of setting up of the garden that include:

	Gardening equipments	**Fertiliser and Pestisides**	**Seeds and samplings**
1.	Gloves	TSP	Broccoli
2.	Pruning Shears	Urea	Cabbage
3.	Garden Fork	Cow dung	Cauliflower
4.	Hand Trowel	Pesticides	Tomato
5.	Spade		Beans
6.	Rake		Radish
7.	Shovel		Corriander
8.	Garden Hose with		Spinach
9.	Watering can		
10.	Rope		
11.	Ties		
12.	Threads		

Preparing the garden site:

Once the site for the garden was selected, it needed to be prepared. The site was predominantly covered in debris (Figure 38 Site before cleaning up.). Within a few days, debris from the garden site was cleared out, and the soil was prepped by removing unwanted weeds and sod. Vegetation and surface debris were removed by clearing and grubbing the landscape. Rocky soil creates a multitude of problems. Not only do they damage equipment, but rocks can also make it difficult for deep-rooted plants to grow and interfere with building a new addition. Planting a garden requires even more stone removal. Slowly loosening the soil with a shovel broke up the dirt and exposed large rocks. A garden rake was used to pull any stones from the soil into a pile.

Figure 38 Site before cleaning up.

Garden Layout:

The prepared site in the pre-determined location in the school premises was now ready for plantation. A layout plan (Figure 39) was drafted, modified and finalized after consulting with supervisor. The layout was drafted considering the requirements of easy movement through the garden and ample space to provide lessons to around 30 students.

Preparing the Seed beds

The garden gear, fertilizer, and a variety of winter vegetable seeds that were brought earlier were put to use. The site's soil was conditioned by mixing compost and natural fertilizers. Saplings were planted, and seeds were sowed. It was then covered to protect it from excessive sun exposure. The work continued till January 2020. After the initial setup of the garden, only essential weekly maintenance like watering and weeding was required.

A collage of the chronological development of the garden is shown in Figure 40 and a flow diagram of work progress timeline is given in Figure 41 Work progress Timeline

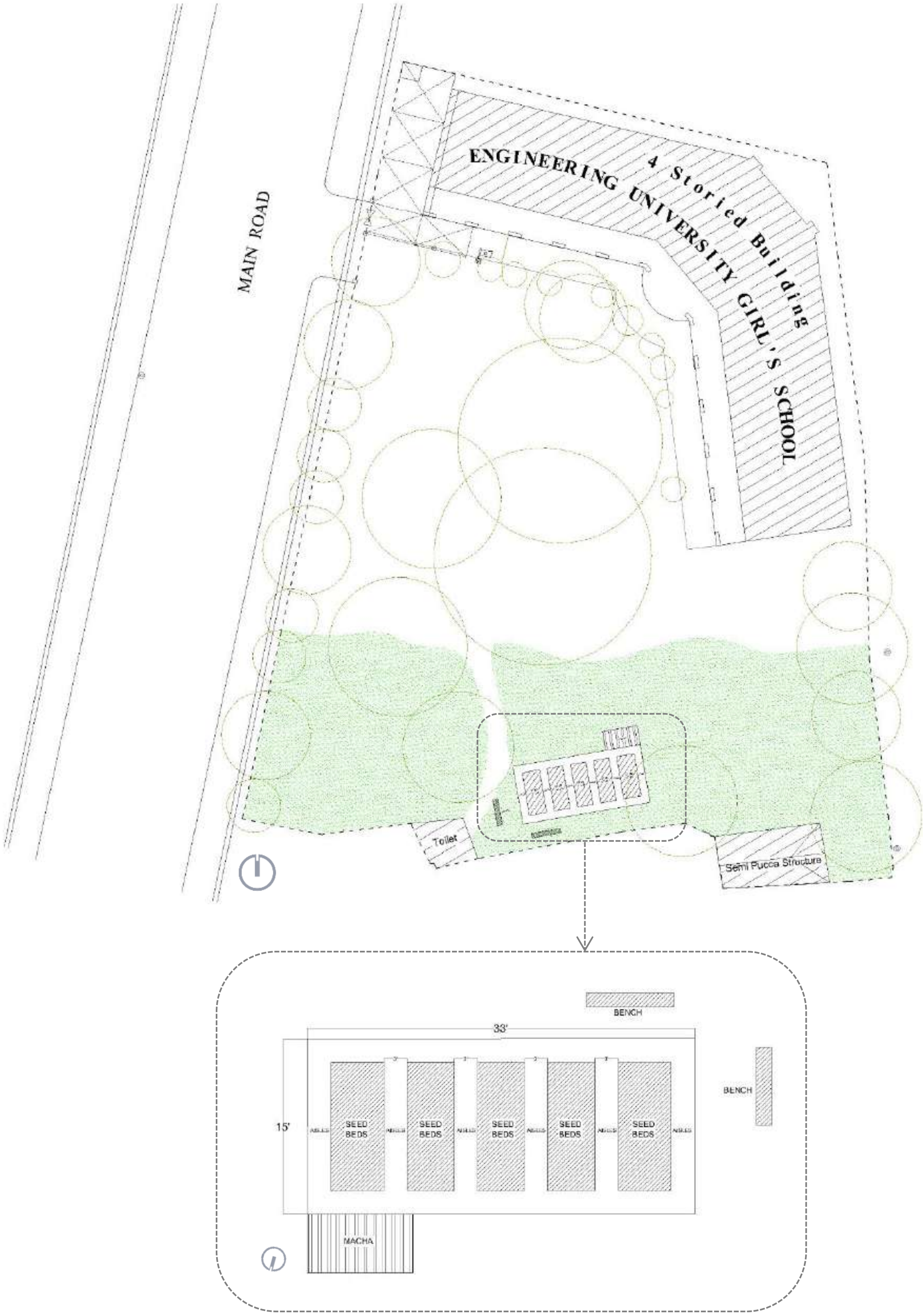


Figure 39 Garden Layout

Figure 40 Growth of the garden

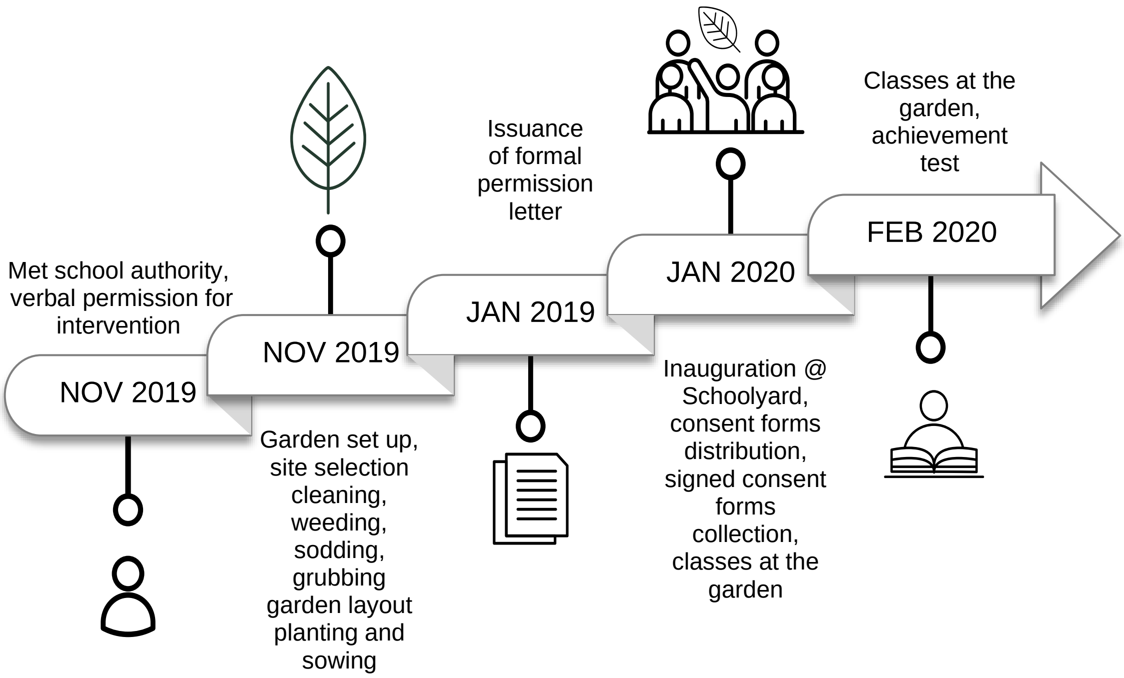


Figure 41 Work progress Timeline

4.5 Experimentation

Lessons from chapters 1 to 3 (Chapter 01: Our environment, Chap. 02: Environmental Pollution, and Chap.03 Water for life) (Appendix 7 NCTB's class V science book contents of chapter 1-3) of NCTB's science book (Appendix 6 **NCTB's** class V science book) were taught to both the treatment group (n=24) and the control group (n=31) in the garden and classroom respectively.

Overview of the syllabus

The Class 5 Science Syllabus of Bangladesh is designed to provide students with a fundamental understanding of science and its application in everyday life. The syllabus comprises various topics that cover different aspects of science, including environmental science, living organisms, natural resources, rocks and minerals, air and atmosphere, and many others.

In Chapter 1, "Our Environment," students learn about the differences between living and non-living things, Animals and Plants, Energy Transfer, and Food Net.

They are introduced to the characteristics of living things. The importance of preserving the environment and living things that depend on it is also discussed. It also highlights the human body and its functions. The chapter covers the diversity of animals and plants. They are introduced to the different types of plants, their parts, and the importance of plants to the environment and human life, including oxygen and food production.

Chapter 2, "Environmental Pollution," delves into the different types of pollution, such as air pollution, water pollution, and soil pollution. Students learn about the sources of pollution, both natural and human-induced, and the measures that can be taken to control and prevent pollution. They also learn about the importance of proper waste management and planting trees to reduce pollution.

Chapter 3, "Water for Life," focuses on the importance of water and its uses. Students learn about the different sources of water, such as rivers, lakes, and groundwater, and the water cycle, which explains how water is continuously circulated in the environment. Students also learn about the need for water conservation and how they can contribute to saving water.

Following the lessons, data was gathered from multiple procedures, namely achievement test, produced through a rigorous approach, attendance, questionnaire survey and focus group discussion.

4.5.1 Use of the control group

With the commencement of the schoolyear the experimentation began in January 2020. The control group students were taught in the regular indoor classroom during their science classes.

4.5.2 Use of the treatment group

Among the four weekly science classes on Saturday (9.10-9.50 AM), Sunday (9.10-9.50 AM), Monday (8.30-9.10 AM), and Wednesday (10.30-11.10 AM), the treatment group students were taught twice weekly in the garden on Saturdays and Mondays (Appendix 10). These two weekly sessions were chosen because they aligned with the researcher's availability. The researcher was able to attend the science class sessions on Mondays and Saturdays because they were scheduled before her work hours and on her day off, respectively.

The same lessons (Chapter 01: Our environment, Chap. 02: Environmental Pollution, and Chap.03 Water for life of NCTB’s class V science book) were being taught in the garden to the treatment group (Figure 42, Figure 43, Figure 44) and in the classroom to the control group by the same science teacher Ms Rajia Sultana. Since the same teacher taught the treatment and control groups, the indoor classes were taken in the religion classes on Saturdays and Mondays (Appendix 8 Class Routine). The religion classes were adjusted accordingly.Classes were held in 2020 from January 21 through February 8. In order to reduce the memorising effect, the achievement test was scheduled on February 12.

Figure 42 The science teacher teaching the students at the garden

Figure 43 Students participating in planting seeds

Figure 44 children learning by doing in the garden

4.6 Data Collection Methods

To gather information about children's learning (the dependent variable), the following techniques were initially intended to be used: **Academic results**, **achievement test** to assess the cognitive domain, **attendance**, a structured **questionnaire survey** to gather information about the affective domain of children's learning. Following the questionnaire survey and achievement test, a **focus group discussion (FGD)** and **in-depth interview** with the students and teachers provided detailed information about the research.

4.6.1 Method 1: Academic Results Evaluation

The experimentation was intended to continue until the half-yearly exam, and the academic result was to be compared between the treatment (n=24) and control (n=31) groups. It was also intended to compare the academic result of the treatment group to see the changes in their results from the previous year and their results after they went through the treatment. It would have been a two-fold measurement of the treatment outcome according to academic performance.

4.6.2 Method 2: Attendance Evaluation

School attendance and absenteeism were among the first areas of study for emerging disciplines such as education. Many factors contribute to a student's performance, and attendance is one of them. Regular attendance can benefit students in various ways, from improving academic achievement to fostering a sense of dedication.

Research by the American Educational Research Association found that students who miss just ten days of school per month perform poorly academically and receive lower maths test scores.

School attendance is typically linked to positive student outcomes, while school absences are linked to adverse student outcomes. In numerous child developmental domains, regular school attendance and completion have been associated with adaptive functioning (e.g., academic, behavioural, health, psychological, and social) (Rocque, Jennings, Piquero, & Ozkan, 2017; Ehrlich, Gwynne, & Allensworth, 2018). Both immediate (like a high academic achievement) and long-term (like increased lifetime earning potential) positive outcomes can be attributed to these effects. Conversely, it has been discovered that school absence and dropout are linked to lessening adaptive performance in these areas, with both short- and long-term detrimental effects (Ansari, Hofkens, & Pianta, 2020; Rumberger, 2020).

In this study, class attendance of all the children, N=55, was observed (Appendix 9 Attendance) and a simple comparison of the tabulated data was made to see any differences.

4.6.3 Method 3: Achievement Test

A Single subject achievement test is a standardised test designed to assess learning or achievement in a particular primary school subject. (Snowman, McCown, & Biehler, 2014). In this study, an achievement test was utilised to assess the children's learning after they had been taught in an indoor and outdoor classroom. The test offered a uniform method of gathering data for comparison later in the analysis stage. Due to the absence of standardised tests in our country for primary school students (Haq M. N., 1994), an achievement test was formulated with the help of the school science teacher specifically for this study.

Achievement Test Instrument

The acheivement test consisted of 7 essay-type questions (Appendix 10 Achievement test). All the questions had the same weight. Out of the 7 questions, 3 were from chapter 01, 1 from chapter 02 and 1 from chapter 03. The rest 2 were complimentary to the subject matter. The formulation of the test followed the process adopted by Md Haq and Matluba Khan. At first, the teacher of the selected school was asked to formulate a test paper. The researcher went through the test paper, and under the guidance of the resource person, the researcher further modified the test paper.

Process of the Achievement Test

On 12 february 2022 the test took place. It took 25 minutes to complete the test. Both the treatment (n=24) and control (n=31) group took the test together in a classroom. However 2 and 7 students from the treatment and control group respectively were absent.

4.6.4 Method 4: Questionnaire Survey Evaluation

A survey questionnaire was utilised to gather information about each respondent's perspective on learning in an outdoor setting. The questionnaire gave a standardised method of information gathering for later comparison in the analysis stage. This study surveyed children using a questionnaire based on the affective domain learning objectives (receiving, responding, appreciating, organising and conceptualising, characterising by value or value idea) (Bloom's taxonomy: Learning domains, 2022). A study can collect both the manifest and latent content of the respondent's answers through an interview (Sommer & Sommer, 2002).

Structured Questionnaire

The questionnaire survey was adopted from Matluba Khan (Khan M. , 2012), the basis of which was the significant variables discovered in this study's literature research served as the foundation for the questionnaire (Table 5). The questionnaire was created in a way that ensured the data collection of all the essential emotional domain variables. There were 16 items on the questionnaire (Appendix 13 & Appendix 14), including 8 for input on the classroom (filled by all the children, N=55) and 8 for the outdoor class (filled by treatment group children, n=24). The inquiries were all closed-ended.

4.6.5 Method 5: Focus Group Discussion

Focus group discussions (FGD) were held among treatment group children, n=24, to get open feedback regarding learning outside versus indoors. Because it can make the children feel awkward or shy to express their views in front of their teachers, focus group with the students exclude the teachers. Separate questions were posed to the teachers in another group. The FGD proceedings were recorded in writing and video, and a summary report was created.

Why Focus Group Discussion?

Focus groups are assisted group talks with planned questions often attended by a homogeneous audience of researchers' interest. Most of the time, focus group studies are qualitative (including this one). Analysing qualitative data can reveal a variety of viewpoints and themes on a particular topic. The findings may describe "a dominating" or "widely held or stated" opinion when there is consensus over a particular idea or subject. Focus groups produce significant insights into subjects and enable the facilitator to elicit the group's opinions on pre-planned topics, which naturally develop during the discourse. It is a more versatile technique than quantitative surveys because of this property. Focus groups are also more beneficial than one-on-one interviews because they enable participants to build on one another's ideas and generate insights that might not have been discovered otherwise (Holsman, 2002).

Questionnaire Instrument

The students were asked the following questions during the FGD (Appendix 15):

- What do you think of how do you learn best?
- What is your view about learning/ doing classes in indoor and outdoor?
- What is your view about the environment (light/air/sound) of indoor and outdoor class?
- What is your view about seating arrangement of the indoor and outdoor class?
- Which subjects can be taught in outdoor class?
- What is your view about learning science in outdoor?
- Do you participate actively during science class and to what extent in indoor/outdoor?
- Do you want to continue your science classes in outdoor?
- Do you use the outdoor class for any other purpose except your classes?
- What is your view about introducing outdoor class in other schools?

Teachers were asked the same questions and to respond from their point of view.

Figure 45 FGD with children

Process of FGD

Due to the Covid lockdown, the researcher had to wait for the school to reopen for the FGD. It was not until mid-2021 that the FGD could take place (Figure 45). The students were told about the focus group discussion method after introductions and small talk on the prescheduled day. The researcher, as the moderator, asked ten open-ended analytical questions. Every single group member has the opportunity to answer the questions. The FGD with the teachers was held the next day.

4.6.6 Method 6: In-depth Interview

This supplementary session was held to improve the qualitative part of the study. For this session, there were neither organised nor closed-ended sets of questions. When the FGD finished, the researcher started discussing. The researcher recorded pertinent data when the children voluntarily participated. The focus was on the students' feelings about the outdoor learning environment and what they learned there.

4.7 Measurement Techniques

Table 9 Variables' Data Collection Method and Measurement

Variables		Name of Variable	Data collection method	Type	Coding/Unit
independent variable		Learning Environment			1= Outdoor, 0= Classroom
dependent variable	cognitive domain	knowledge	Achievement Test	Scale	Number
		comprehension			
		application			
		analysis			
		synthesis			
		evaluation			
	affective domain	receiving	Questionnaire	Categorical	2=very good, 1=good, -1=bad, -2=very bad
		responding			
		valuing			
		organizing and conceptualizing			
		characterizing			

4.8 Data Analysis Method

All variable measures were analysed in a Master file in Microsoft Excel. Microsoft 365 and SPSS 25 were used for data analysis (mean calculation, frequency analysis, chi-square analysis, t-test and co-relation).

Chapter 5: Analysis- Looking for the Advantageous Environment

This study's research question focuses on the association between children's science learning and the outdoors. It thrives on determining whether there are any discernible differences in how children learn indoors and outdoors. The study has used a variety of measurements to illustrate children learning. The analysis has been done on several different levels. Achievement tests' descriptive statistics for each measurement were analysed. Frequency analysis of the children's replies within the affective domain was part of the second step. The achievement test results for the samples and the affective domain factors are summarised statistically as the quantitative part of the study. The qualitative measures (FGD) used in the study are covered in the later part. The results of these two segments provide an answer to the research question.

5.1 Findings: Causal Relationship analysis between main variables

This study aimed to see if there was any connection between the environment and children's learning. The study found that holding classes outside was good for children's learning. Children were assumed to study science more effectively outside the classroom than within, which was supported by the findings.

5.1.1 Findings 1: Academic Results Evaluation

The student's academic results as a tool to measure the garden's impact on the student's science knowledge had to be discarded due to the worldwide covid-19 situation. As a result of the pandemic, schools and educational institutions worldwide had to shut down, and Bangladesh was no different. Students were initially unable to attend classes before shifting to online lessons. In light of these circumstances that decision was made to auto-promote students to the next grade, and no assessment was made of their academic performances.

5.1.2 Findings 2: Attendance Evaluation

Among 31 students, seven were absent from the control group during the achievement test, while 2 out of 24 were absent in the treatment group (Table 10). For January 2020, the absence rate per person among the attendees of the achievement test was significantly lower for the treatment group than for the control group (Figure 46 Absence per person), and the trend was tracked in the following month (Appendix 16 Analysis of Attendance). However, due to the Covid lockdown, further data could not be collected and analysed to assert any conclusion.

Thus, this random observation could be enhanced as a tool for future investigation where more comprehensive data can be collected and analysed to see the connection of willingness to learn with the rate of regular attendance in case of such intervention.

Table 10 Presence during Achievement test

	number of students	absent	Percentage
Treatment Group	31	7	22.6
Control Group	24	2	8.3

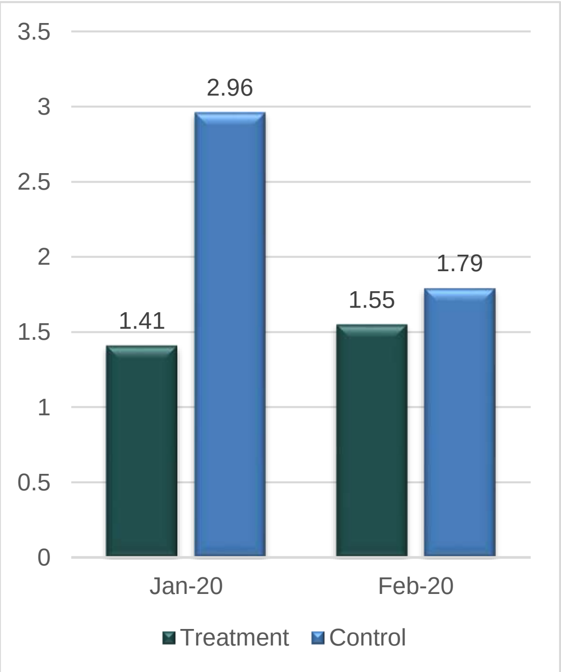


Figure 46 Absence per person

5.1.3 Findings 3: Achievement Test

The achievement test results, designed using the cognitive domain of learning, supports effectiveness of science learning outdoors. Descriptive statistics (comparing means), the standard distribution curve, frequency analysis, and chi-square analysis are used to achieve this. All variable measures were analysed in a Master file in Microsoft Excel.

Descriptive Statistics:

The results of the achievement test, conducted after the students had learned the same chapters in the classroom by the control group and in the outdoor garden by the treatment group, are shown in Table 11 and Table 12. The table displays the test results for the control group (students taught inside) and the treatment group (students in the garden), referred to as Ti and To, respectively. The test Z scores, or Zi and Zo, were also shown in the table. The Z score is a standardised test result that indicates, in standard deviation units, how far a particular raw score deviates from the mean.

Table 11. Score of Achievement Test taken in the classroom

	sl	Rl	Achievement test (Ti)	z score (Zi)
Control group	1	2	12	0.2629
	2	3	12	0.2629
	3	4	12	0.2629
	4	7	13	0.6341
	5	13	12	0.2629
	6	16	13	0.6341
	7	18	ab	
	8	19	11	-0.1083
	9	20	13	0.6341
	10	21	7	-1.5929
	11	22	13	0.6341
	12	25	12	0.2629
	13	26	13	0.6341
	14	27	12	0.2629
	15	30	ab	
	16	31	14	1.0052
	17	37	ab	-4.1910
	18	38	8	-1.2217
	19	39	13	0.6341
	20	40	ab	
	21	41	ab	
	22	42	10	-0.4794
	23	43	ab	
	24	44	13	0.6341
	25	49	8	-1.2217
	26	50	13	0.6341
	27	51	10	-0.4794
	28	52	13	0.6341
	29	53	ab	
	30	54	2	-3.4487
	31	55	12	0.2629

Table 12. Score of Achievement Test taken in the Garden

	sl	Rl	Achievement test score (To)	z score (Zo)
Treatment group	1	1	13	-0.37936
	3	5	14	0.81292
	2	6	14	0.81292
	4	8	14	0.81292
	5	9	13	-0.37936
	8	10	13	-0.37936
	6	11	14	0.81292
	7	12	14	0.81292
	9	14	14	0.81292
	10	15	14	0.81292
	11	17	13	-0.37936
	12	23	12	-1.57165
	13	24	11	-2.76393
	14	28	13	-0.37936
	15	29	13	-0.37936
	16	32	13	-0.37936
	17	33	14	0.81292
	18	34	14	0.81292
	19	35	13	-0.37936
	20	36	12	-1.57165
	21	45	14	0.81292
	22	46	14	0.81292
	23	47	ab	
	24	48	ab	

According to the descriptive statistics (Table 13), there is a significant difference between Ti (Score of the Test Taken in a Classroom) and To (Score of the Test taken in garden) in terms of mean, minimum and maximum score, and standard deviation. The mean for the control group is 11.292, whereas it is 13.318 in the treatment group. It has been noted that Ti has a greater standard deviation than To. The superior academic performance of students in To is indicated by the higher mean and smaller standard deviation.

Table 13. Descriptive Statistics of the Achievement Test taken in the Classroom and the Garden

	N	Min	Minimum frequency	Max	Maximum frequency	Mean	Std. Deviation
Ti Score (Test Classroom)	24	2	1	14	1	11.292	2.694
To Score (Test Outdoors)	22	11	1	14	11	13.318	0.839

Frequency Analysis:

Z-Score analysis and chi-square tests are conducted. The scores were converted to Z-score (standard score) for comparison, where the mean of the Z-score is always zero for any test. The difference can be seen if we compare the scores below and above the means of Zi and Zo. In the test 29.17% children of the control group scored below the mean, compared to 50% for outdoor classes (Table 14 & Figure 47). However, the mean for the treatment group was significantly higher than the mean for the control group.

Table 14 Analysis of Z-score in Classroom and Garden

Classroom

	Frequency	Cumulative %
Below Mean	7	29.17
Above Mean	17	70.83
Total	24	100.00

Garden

	Frequency	Cumulative %
Below Mean	11	50.00
Above Mean	11	50.00
Total	22	100.00

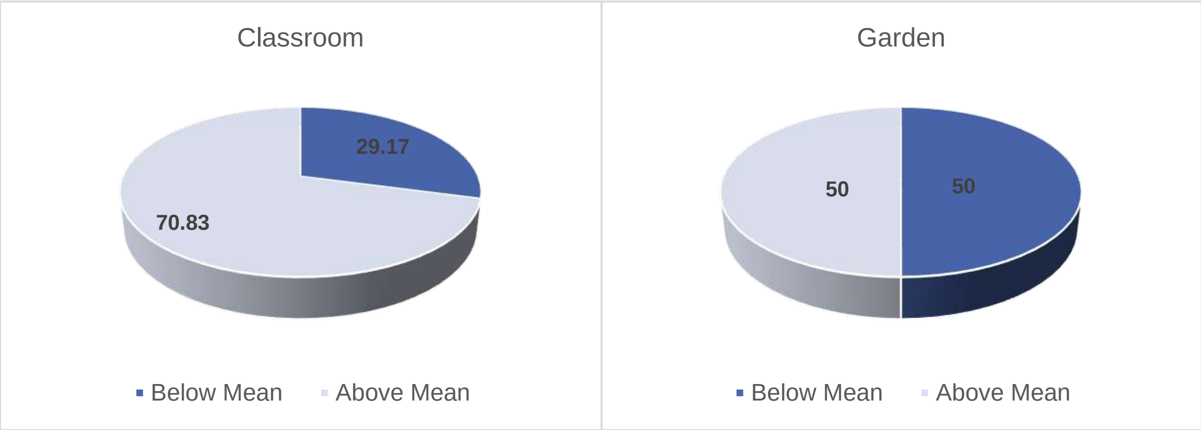


Figure 47 Analysis of Z-score

From the analysis of low, medium, and high scores, it is noted that the frequency of students receiving indoor classes is lower in the high score category, and 20% of them received low scores. However, none received low scores from the group of students taking classes in the garden. Moreover, 86.36% of the students from the latter received high marks (Table 15 & Figure 48).

Table 15 Frequency analysis of Low, Medium and High Score

Classroom

	Frequency	Cumulative %
Low (0-8)	5	20.83
Medium (9-12)	9	37.50
High (13-14)	10	41.67

Garden

	Frequency	Cumulative %
Low (0-8)	0	0.00
Medium (9-12)	3	13.64
High (13-14)	19	86.36

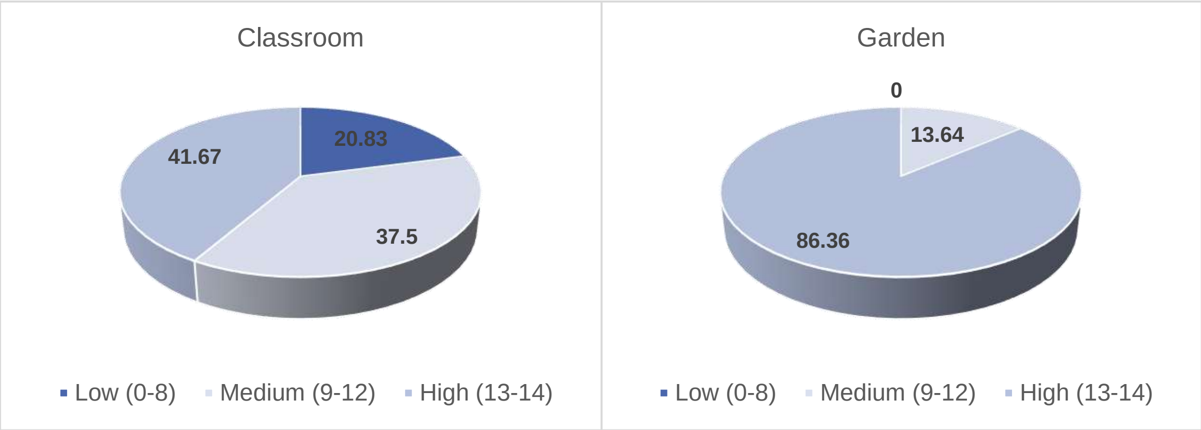


Figure 48 Frequency analysis of Low, Medium and High Score

Chi-square Analysis:

The chi-square test examines the size of any discrepancies between the expected and actual results in connection with the size of the sample and the number of variables. According to the total number of variables and samples used in the experiment, degrees of freedom, df= (number of rows, r-1) (number of columns, c-1), are employed in these tests to assess whether a particular null hypothesis can be rejected. It is a practical way to compare experimental data with what is theoretically predicted based on a particular hypothesis. Using the test, it can be determined if two variables are dependent or independent. The following is the chi-square equation:

Equation 2 Chi-square Equation

$$X^2 = \Sigma \frac{(\text{Observed frequencies} - \text{Expected frequencies})^2}{\text{Expected frequencies}}$$

$$= \Sigma \frac{(Fo - Fe)^2}{Fe}$$

A theoretically predicted frequency from an experiment is called an expected frequency. It is assumed to be valid unless statistical evidence in the form of a hypothesis test proves it to be false. On the other hand, an observed frequency is the actual frequency discovered during the experiment. The projected occurrences must be incompatible with one another.

Expected frequency = (row sum * column sum) / table sum

Table 16 Observed Value (O)

	Frequency (Test score_ Classroom)	Frequency (Test Score_ Garden)	Row Total (r)
Low (0-8)	5	0	5
Medium (9-12)	9	3	12
High (13-14)	10	19	29
Column total (c)	24	22	46

Table 17 Expected Value (E)

	Frequency (Test score_ Classroom)	Frequency (Test Score_ Outdoor)
Low	2.61	2.39
Medium	6.26	5.74
High	15.13	13.87

This analysis aimed to examine the relationships between the dependent variables (the children's learning, measured by test scores) and the independent variables (environments, such as indoor or outdoor classrooms). According to the research hypothesis, the two variables are interdependent or connected, meaning that the learning environment impacts the children's test scores. This will be the case if the observed frequencies (Table 16) for the sample's categories of variables diverge from the expected frequencies (Table 17). According to the null hypothesis, there is no relationship between the learning environment and test score, which states that the two variables are independent. This will be the case if the sample's observed frequencies are consistent with the expected frequencies. The difference equal to the alpha level of significance, which will either be 0.05 or 0.01, is the quantity required to determine whether a difference or similarity exists. The null hypothesis will be rejected, and the research hypothesis will be inferred from the data if the probability of the test statistic is less than or equal to the probability of the alpha error rate. We get to the conclusion that there is a correlation between the variables. We cannot reject the null hypothesis if the test statistic's probability exceeds the alpha error rate's probability. We conclude that the variables are independent, i.e., no relationship exists between them.

Table 18 Chi-square analysis

O	E	O-E	$(O-E)^2$	$\{(O-E)^2\}/E$
5	2.61	2.39	5.71	2.19
9	6.26	2.74	7.51	1.20
10	15.13	-5.13	26.32	1.74
0	2.39	-2.39	5.71	2.39
3	5.74	-2.74	7.51	1.31
19	13.87	5.13	26.32	1.90
			x^2	**10.72**

Table 18 shows the Chi-square analysis. If degree of freedom, df=(r-1) (c-1) = (3-1) (2-1) =2, **probability of the test statistics is less than the probability of alpha error rate, it is significant at 0.01 level** (from Chi-square Table in Appendix 11)

We can reject the null hypothesis and assert that the variables are dependent, i.e., that children's learning is influenced by their environment because the likelihood of test statistics is lower than the probability of alpha error rate. **It establishes significance at the 0.01 level.**

The claim is that children did substantially better in the garden than classroom, according to the theory.

t-test

The *t-test* is a statistical test employed to compare the means of two groups. In a t-test for independent samples the general question is: *Is there a* ***statistically significant difference*** *between the mean values of two groups?* It is frequently employed in hypothesis testing to establish whether a procedure or treatment truly affects the population of interest or whether two groups differ. The *t-test* estimates the actual difference between two group means using the ratio of the difference in group means over the pooled standard error of both groups. In this way it calculates the t-value illustrating the magnitude of the difference between the two-group means being compared. It estimates the likelihood that this difference exists purely by chance (p-value). If the difference in means is large enough, it is assumed that the two groups differ. A larger t value shows that the difference between group means is greater than the pooled standard error, indicating a more significant difference between the groups. The calculated *t* value can be compared against the values in a critical value chart to determine whether the calculated *t* value is greater than what would be expected by chance. If so, the null hypothesis can be rejected and conclude that the two groups are different.

Equation 3 Equation for t-test

t-value

$$t = \frac{\bar{x}_1 - \bar{x}_2}{s_{\bar{x}_1 - \bar{x}_2}}$$

Standard deviation of the mean value difference

$$s_{\bar{x}_1 - \bar{x}_2} = s_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}$$

Estimated value for the standard deviation

$$s_p = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}}$$

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}} \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

$$df = n_1 + n_2 - 2$$

$\bar{x}_1$: Mean value of the first group
$\bar{x}_2$: Mean value of the second group
n_1 : Size of the first group
n_2 : Size of the second group

Table 19 t-test

	Treatment group	Control group
population size	22	24
means	13.318	11.292
standard deviation	0.839	2.694
standard error	0.17882	0.54996

t-value, t	3.378
degree of freedom, df	44
Significance (2 tailed), P	**0.002**
mean difference	2.026
standard error difference	0.59986

The critical value at df 44 and significance level P, 0.002 =3.29.

As the t value 3.37 is greater than the critical value 3.29 (Appendix 12), the null hypothesis can be rejected and it can be assumed that the difference between the two means is significant.

Comparative Analysis between Individual Cognitive Domain Variables:

If we examine the scores made by the children in the cognitive domain, the significant distinction between the control and treatment groups is in the children's knowledge and application levels (Table 20 & Figure 49). While learning in their outdoor class, the children perform significantly better in these two levels; there are also noticeable differences in their knowledge gain and synthesis levels. However, the two groups' gains in comprehension and evaluation are essentially equivalent. Even though the sample size is relatively small and the test was not based on a nationally recognised standardised test, it supports the findings in the literature on children's gains in domain variables (Lieberman & Hoody, 1998; Jones, Klosterman, & Mesa, 2006). Students who received their science instruction in the garden showed improved knowledge and comprehension of the subject matter. They are also better able to make connections between what they learn in science classes and applications in the real world.

Table 20 Comparative Analysis of means of Cognitive Domain Variables

Independent Variable	**Dependent Variable (Cognitive Domain)**						
Environment	**Knowledge**	**Comprehension**	**Application**	**Analysis**	**Synthesis**	**Evaluation**	**Total**
Indoor (Classroom)	1.60	1.54	1.25	1.63	3.33	1.83	5.13
Outdoor (Garden)	2.00	1.77	1.73	1.91	3.86	2.00	10.07
Differences	0.40	0.23	0.48	0.29	0.53	0.17	4.94

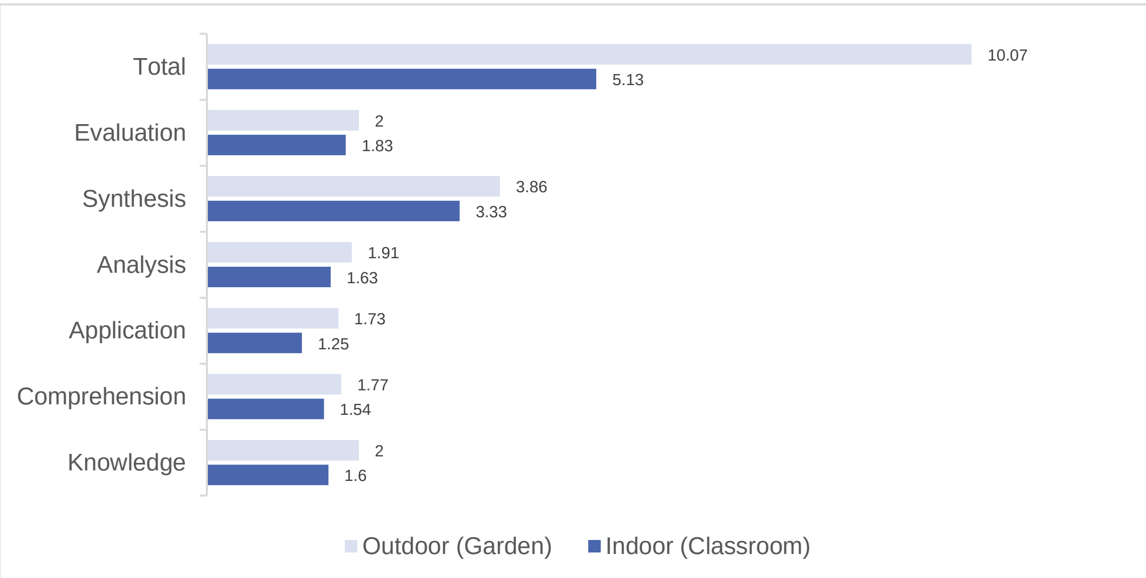


Figure 49 Comparative Analysis of Cognitive Domain Variables

Response Analysis

This section discusses the findings from the study that compared the responses of two groups of students, one attending classes in the garden and the other in a traditional classroom setting. The analysis found significant differences in the responses between the two groups of students.

The study revealed that the students attending classes in the garden showed a greater sensitivity towards their surroundings and used all their senses to observe their environment. Their responses were more detailed and included size, shape, smell, and visual significance descriptors (Table 21). In contrast, the control group students' responses lacked this level of detail and were less observant.

Another key finding of the analysis was that the questions related to the garden received better responses, particularly from the treatment group students. However, the students showed the least grasp in their responses to question number 3, which was unrelated to the garden plants. Questions 2 and 5, related to the garden and the textbook, received the best responses from the children of the treatment group—details in Appendix 10 and Appendix 21.

These findings highlight the potential benefits of outdoor learning environments, such as gardens, in promoting a more observant and engaged approach to learning. The study suggests that students who learn in natural environments may be better able to use their senses and develop a deeper understanding of their surroundings. The results also underscore the importance of designing learning activities directly related to the environment, as these appear more effective in promoting learning in these settings.

Table 21 Detail of Achievement test answers

	Treatment Group		
	Roll 9	**Roll 24**	**Roll 28**
Ans to Q 1			additional information Appendix 20
Ans to Q 2	sign of better usage of olfactory senses Appendix 17 Appendix 18	acute observation, descriptive answer Appendix 19	
Ans to Q 3		perception of shape & sizes Appendix 19	

5.1.4 Findings 4: Questionnaire Survey Evaluation

Relationship between Independent Variable and Affective Domain Variable

The questionnaire adopted from the studies of Khan (Khan M. , 2012) based on the affective domain of learning is analysed to determine how children receive, respond to, value, organize, and internalize values regarding science learning in the classroom and outdoors. Instead of scoring the children's responses, the questionnaire was designed to elicit their perspectives on learning in two distinct situations.

Significant differences between the children's environmental attitudes were identified in the affective domain. The students were questioned about their opinions of their science lessons in the classroom and outside. 82% of them said that learning in outdoor classes is very good, and 14% said that outdoor learning is good. Only 13% said that learning in classrooms is good, and 75% think that learning in classrooms is bad. Figure 50.

Figure 50 Feedback about learning Science in Classroom and Garden

In response to the question concerning their class participation, 58% of students said they occasionally but infrequently participate. 8% of students participate in science class, compared to 13% who never do, and when learning science in the classroom, 82% of students frequently participate in outdoor classes, and the remaining 18% occasionally (Figure 51).

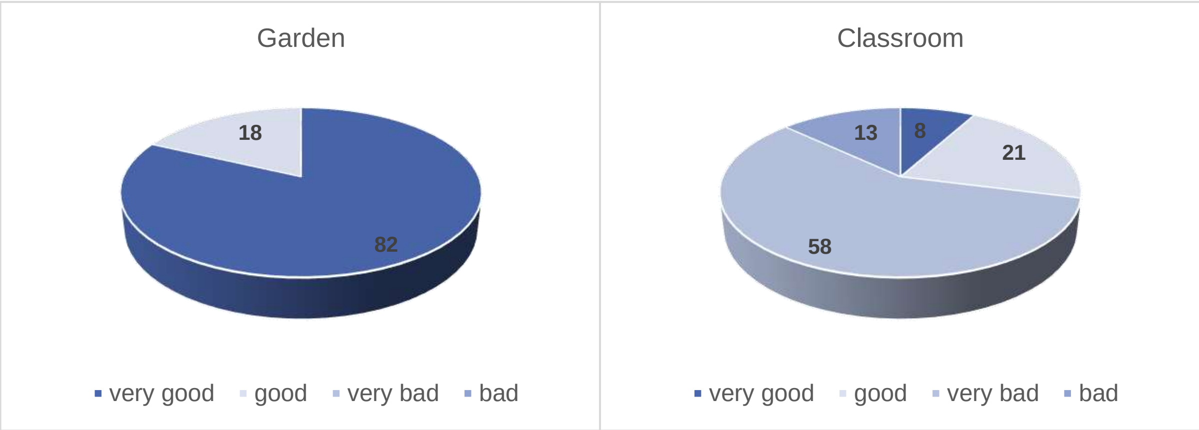


Figure 51 Feedback about active participation in Science Class

The children's willingness to learn in either their regular classroom or the garden is shown in Figure 52. 86% of them strongly desire to learn science in the garden, while 100% agree that they do not want to continue taking their science classes indoors. Via focus group discussions, the reasons behind the participants' opinions are examined.

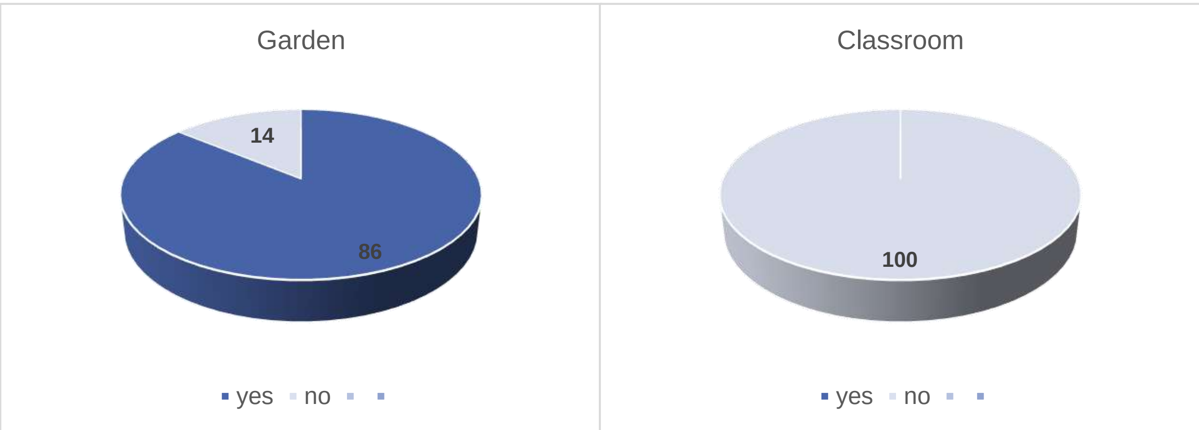


Figure 52 Feedback about willingness to learn Science in Classroom and Garden

100% of the control group students want their science classes to change, specifically the physical environment. They all wanted to continue their session outdoors because they were passionate about learning there. 96% of treatment group students think other schools should likewise build outdoor classrooms (Figure 53).

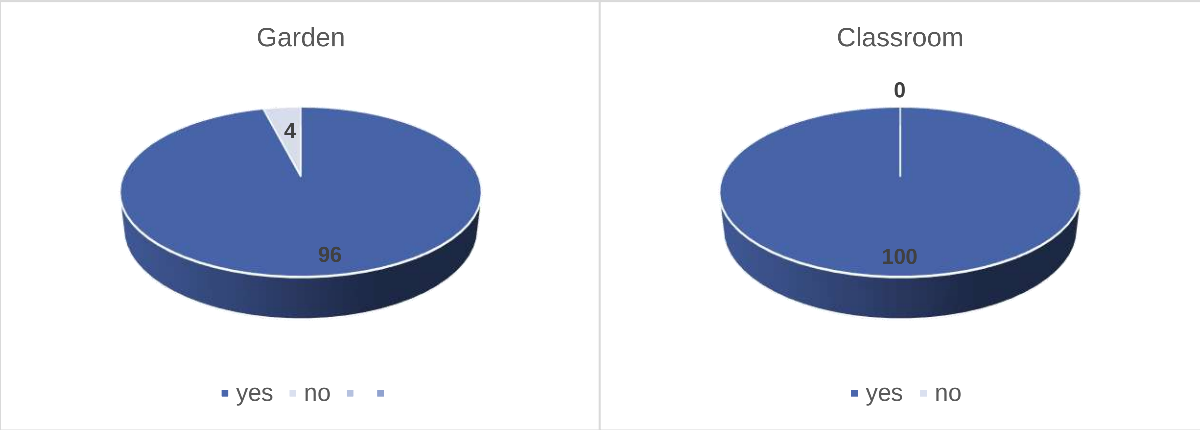


Figure 53 Feedback about their desire about change of space

When asked whether they wanted other subjects to be taught in the garden, 96% of them thought it was an excellent idea. 77% of the children were unhappy about their classroom classes (Figure 54) and opined to have all their classes outdoors.

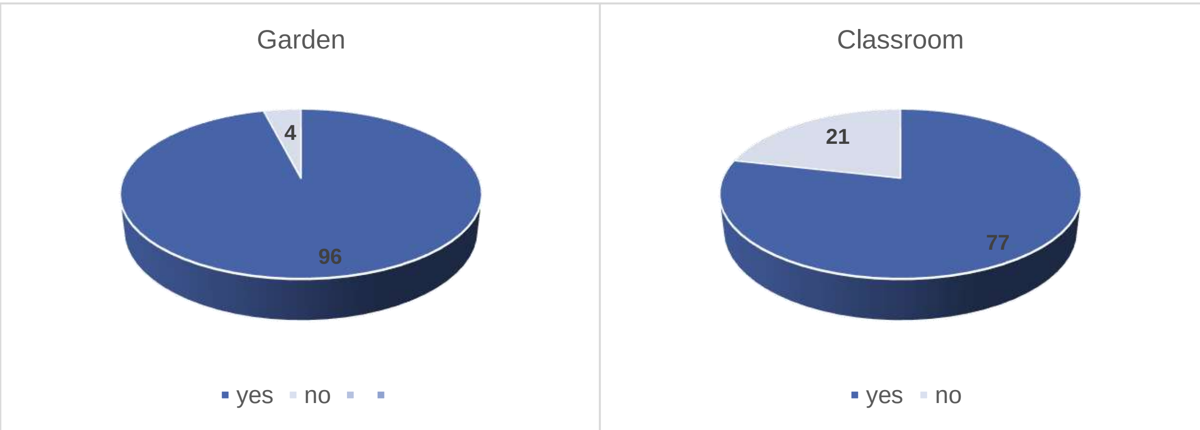


Figure 54 Feedback about willingness to learn other subjects in Classroom and Garden

Relationship between Independent Variable and Some Built Environment Variables

The hypothesis that children learn better outdoors was based on the idea that it provides a delightful, engaging, secure and rich learning environment (Tai, Haque, McLellan, & Knight, 2006). The children consider outdoor open spaces their favourite places. They like the ample light, airflow, and ease of movement. While the students were asked about their indoor and outdoor learning, they spontaneously spoke about different built-environment variables: ample light, natural air, ease of movement and seating arrangement. Each rated the outdoor light as very good (Figure 55), but they could have been more enthusiastic about the light in the classroom. 58% said that the classroom lighting is good, and 25% said it is awful. But 100% of them agreed that one of the reasons they like their outdoor class is ample light.

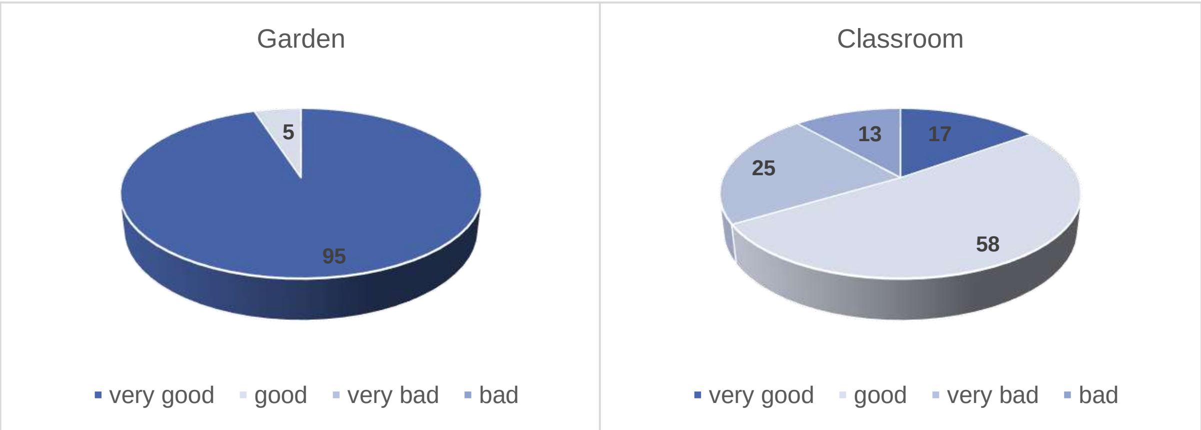


Figure 55 Feedback of Lighting condition in Classroom and Garden

33% of the children said that the acoustical condition is very bad in their classroom- they cannot listen to their teachers, and sound travels from the adjacent room. However, 86% of them were very happy about the acoustical condition of the garden. They rated it very good. Moreover, 14%, said it was good, and they could listen to their teacher clearly (Figure 56).

Figure 56 Feedback about acoustical condition in Classroom and Outdoor Class

Most of the children were unhappy about their seating in the classroom. 67% of the students think their seating in the classroom is bad, whereas 78% of them rated the seating in outdoor class very good, and 18% said the seating in outdoor class is good (Figure 57)

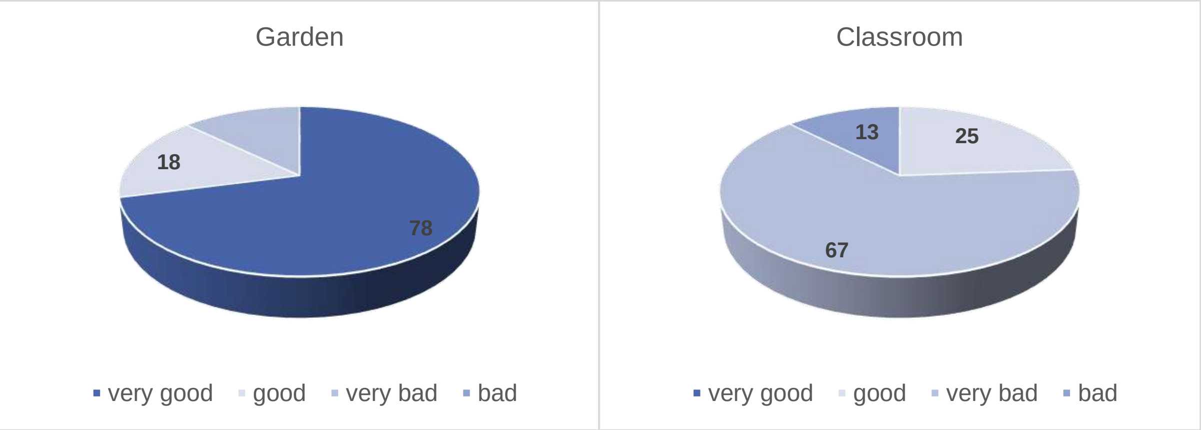


Figure 57 Feedback about seating in Classroom and Outdoor Class

Table 22 Summary of Findings from all Statistical Analysis

	Type	Terms	Classroom	Garden
Cognitive Domain Variables	**Total Achievement Test Score**	**Mean**	11.292	13.318
Cognitive Domain Variables	**Total Achievement Test Score**	**Median**	12	13.500
Cognitive Domain Variables	**Total Achievement Test Score**	**Mode**	13	14
Cognitive Domain Variables	**Total Achievement Test Score**	**Standard Deviation**	2.69	0.83
Cognitive Domain Variables	**Total Achievement Test Score**	**Minimum**	2	11
Cognitive Domain Variables	**Total Achievement Test Score**	**Maximum**	14	14
Cognitive Domain Variables	**Total Achievement Test Score**	**Count**	24	22
Cognitive Domain Variables	Knowledge	**Mean**	1.6	2.00
Cognitive Domain Variables	Comprehension	**Mean**	1.54	1.77
Cognitive Domain Variables	Application	**Mean**	1.25	1.73
Cognitive Domain Variables	Analysis	**Mean**	1.63	1.91
Cognitive Domain Variables	Synthesis	**Mean**	3.33	3.66
Cognitive Domain Variables	Evaluation	**Mean**	1.83	2.00
Affective Domain Variables	Receive	Opinion about learning Science	Bad (75%)	Very Good (82%)
Affective Domain Variables	Respond	Active Participation	Seldom (58%)	Frequent (82%)
Affective Domain Variables	Value	Willingness to learn science	No (100%)	Yes (86%)
Affective Domain Variables	Organise or Conceptualize Values	Change	Change Required (96%)	Required every in school (97%)
Affective Domain Variables	Internalize or characterise values	Opinion about learning Other Subjects	Bad (77%)	Very Good (97%)
Built-Environment Variables	Light	Remarks	Good (58%)	Very Good (95%)
Built-Environment Variables	Sound	Remarks	Very Bad (33%)	Very Good (86%)
Built-Environment Variables	Seating	Remarks	Bad (67%)	Very Good (78%)

5.1.5 Findings 5: Focus Group Discussion (FGD)

The researcher's primary tool for the study's qualitative results was the focus group discussion. It gave comprehensive information on how children's learning and the outdoors are related. It assisted in overcoming the inherent bias in all questionnaires and provided explanations for variables that statistical analysis cannot quantify.

There are certain shared beliefs about learning outside among teachers and students. Intergroup discrepancies in replies generally decreased, and most respondents expressed similar views on the study. Several topics can be covered in the summary of the focus group discussion based on the questions (Appendix 15).

Qualitative Attributes of Outdoor Learning

The purpose of this section is to incorporate the children's perspectives on learning outside that were absent from the statistical analysis and to wrap up the study by attempting to address the quantitative analysis's unsolved issues.

The reasons underlying the opinions students expressed in structured questionnaires—which were quantitatively analysed—were not known. Thus, FGD and in-depth discussions were used to address them. The researcher's notes from the FGD, along with information from a photographic survey and informal conversations with parents and children, all contribute to this section. It is anticipated that a thorough response to the study question about the connection between the outdoor environment and the learning of children in Bangladeshi primary schools will be discovered via this part.

Children learn while experimenting and exploring in the nature:

FGD commenced with learning, specifically how science is taught to children. When asked about this, most students agreed that the best way to learn is through experimentation and exploration of the topics covered in their science textbooks.

Others claim that learning occurs when students pay closer attention to what their lecturers say and when they are in a natural setting while attending lessons. The teachers' views on the learning of the students were largely congruent.

The outdoors offers the chance to learn more effectively:

Where is it easier to learn science? Most students who responded to this question said they could learn more effectively in the garden.

They are more focused in the garden than in their regular classroom. They were questioned about the causes of their better learning outside. They claimed that they quickly lose focus in class because most of them have trouble seeing the chalkboard well, and some even have trouble hearing the teacher. They believe that there is less room for experimenting in the classroom. The students also spoke of their classmates and teacher having a better connection in the garden. They believe they are a part of nature, their friends, and their teacher.

The teachers claim that the students are more engaged, enthusiastic, and interested when learning outside. Most claimed they feel more at ease and energetic when teaching outside.

Better acoustics and adequate light and air flow characterise the outdoor environment

Before they were asked about the light, sound or airflow, the students spontaneously described the structural state of the built environment. According to them, there is no sufficient light in all the working levels of their traditional classroom. The children sitting near the windows have better light, but the condition is poor in the middle of the class. The children feel suffocated because of insufficient airflow. They cannot hear their teacher clearly as sound travels from the next class. The teachers also complained about the poor acoustical condition of the classroom, as they could not hear the children sitting at the back. On the contrary, the outdoor class is full of light, they feel comfortable because of the natural airflow, and there is no noise, no travelling of sound from the other classes; instead chirping of birds makes them feel good.

Comfortable seating, ease of movement, and improved visibility the outdoors

Some key elements for more significant learning are comfortable seats, mobility, better visibility, etc. The children complained that their typical classroom benches, which move back and forth, need more comfortable seats. Some students also remarked that the smaller ones sometimes could not see the teacher when she exhibited any content from their books if the taller students sat in front of the class. Due to glare, students seated near the window cannot see the blackboard as clearly as those in the centre of the room.

All children participating in the FGD claim they can move around quickly. They can all look their teacher in the eye and see each other and their teacher. Students can conduct experiments in the garden, which is accessible to all children. Glare is no longer an issue in the outdoor class because the blackboard is extensive, and all students can see it from anywhere in the room. The teachers claim they also feel more confident when teaching outside because they can see every child's facial expression, which is impossible to achieve inside due to poor lighting and seating arrangements. However, the teachers suggested sitting arrangements within the garden.

Exposure to nature fosters a natural curiosity for all subjects:

What can be taught in an outdoor setting? - In response to this enquiry, the students and the teachers agreed that any subject could be taught more effectively outdoors. The children are impulsive and eager in their outdoor lessons, according to Ms Rajia. With their outdoor class, inertia is never witnessed in the classroom. In addition to science, the teachers notably mentioned maths for classes I and II, where it is possible to gather leaves, seeds, or sticks outdoors to teach the children how to count, add, subtract, multiply, or divide, among other skills. Listing the garden yields taught the students accounting and managerial skills alike (Figure 58, Figure 59). Purposeful selection of plants per the textbooks, like the Hibiscus Rosa for the garden, can provide a lab facility for botany and zoology classes. The garden also provides scope for creative writing for the Bangla or English classes.

Figure 58 Making list of the produces

Figure 59 gathering the produces from the garden

Studying science involves being in nature and observing it:

The majority of the children agreed that participating in exploration and experiments during outdoor class is the best approach for them to learn science. They claim that the outdoor classroom provides them with the space and opportunity for exploration that their classroom lacks. "*All the elements we learn, such as trees, animals, soil, air, and water, are around us in nature*." stated Muskan and Nafisa. The teachers also spoke about how simple it is to access the natural elements they teach in science class. Their science teacher, Ms Rajia, explained that she could "easily show them dew" when teaching chapter Three: water for life.

Active participation: More chances for collaboration

The children claimed that the overflow of tables and seats made it impossible to complete group projects. Nonetheless, they claim that almost all of them attempt to respond in their outside class. Everyone is taking part, which was never the case in the classroom. Figure 60 shows children actively engage in their outdoor classroom's educational activities.

Figure 60 Active participation from children

Outdoor education is always essential for learning science.

The children want to carry on with their outdoor class. Children from other classes are as excited as class V students about taking their lessons outside. The teachers and students of the other classes have informed the researcher about this interest. Moreover, students have ownership over the garden and want to keep learning there because they enjoy it.

Outdoor education is essential in every school.

The children said, "We like learning outside in class. Every school should offer outdoor classes because all children should have this chance. The teachers believe that since the researcher's work in their school produced positive results, every school should have the opportunity to sample the fruit, which will benefit the children.

5.1.6 Findings 6: In-depth Interview

To ensure comprehensiveness, a thorough examination was conducted by engaging in extensive discussions with children to identify any potential gaps in the Focus Group Discussion (FGD) findings. Additionally, an in-depth interview was conducted to further validate the information gathered from the FGD. The in-depth interview affirmed the consistency and reliability of the initial findings by aligning closely with the insights gathered from the Focus Group Discussion (FGD).

5.2 Answer of Research Question

Based on the discussion above, the following is a solution to the research question posed in Chapter 3, Section 3.3.

Are there any significant differences between indoor (classroom) and outdoor (garden) environments for children's science knowledge?

Children's learning differs significantly in indoor and outdoor schools. At the **$\alpha = 0.01$ level, this difference is significant**.

5.3 Quality Consideration

The most effective study approach promotes generalizability, improves the accuracy of the controlling and measuring variables, and assures the participants' existential reality. In Bangladesh, a Proto-type Government School was the subject of this study. The following concerns are strictly taken into account while evaluating the research's quality:

Internal Validity

Internal validity's primary concern is whether the study's core ideas and procedures accurately depict the object of the study (Groat & Wang 2002). Many measures were used in this study to establish internal validity. The questionnaire was developed with the help of the school's science teacher with the aid of a number of sample test questions from previous studies. The structured questionnaire used by Kahn is used here; most of the questions were closed-ended, and their teachers confirmed the children's responses.

Most statistical analysis and descriptive statistics are produced by using Microsoft Office Excel 365 version, a statistical analysis application that is widely used. The intervention was carried out in a Government Primary School to ensure that the study might be helpful for the general public. In this manner, the sample plan also strengthened the study's internal validity.

External Validity

The primary issue with external validity is whether the study's findings are generalisable to other contexts or the world at large, or at the very least, whether there are clear contextual restrictions that define the validity of the findings (Groat & Wang, 2002). A model government primary school served as the site of the experiment. The Government Primary Schools in Bangladesh are constructed on a prototype design, with a 0.33-acre minimum site space required for each school (Directorate of Primary Education, 2018). This similarity increased the study's external validity. Schools follow the same curriculum and have comparable organizational structures with an equal number of faculty members. However, the experiment's limited external validity may result from its use in just one school.

Reliability

The consistency of measurements or findings is the main issue with reliability (Groat & Wang, 2002). This means that the results should be the same if the study were conducted using the same research methodology under the same circumstances at a different location, at a different time, or by a single researcher. A consistent data collection and analysis approach was used throughout the study to ensure reliability. The results are quantifiable and trustworthy because the measurement system is fixed, and the achievement test is scored.

Moreover, this study's Achievement Exam is written in Bangla. Any Bangladeshi primary school using the same curriculum can adopt this instrument.

Last but not least, the research was carried out by a single researcher, who also carried out the studies and gathered the data.

Objectivity

Research protocols aim to avoid any potential bias or researcher influence (Groat & Wang, 2002). This study accomplished this through stringent specification and application of the necessary methods. There are detailed diagrams of the test equipment and the outdoor garden available. The data can all be quantified.

Using these guidelines, another researcher could decide to do a similar study, offering yet another test of the findings.

5.4 Limitations of the Study

Time and finance limited the study to one school. This may pose an issue for the generalizability of the research. However, carefully choosing a representative of all primary schools in Bangladesh, a Government Primary School mitigates the effect of selecting a single school.

A class of 40 is ideal, although a class may be as large as 60 students. The class in concern had N=55 students, of which n=24 agreed to participate in the experiment through parental consent. This situation rendered a small size of n. However, the small n size is compensated by applying statistical tests.

The same teacher taught the treatment and control group the same lessons to ensure the treatment was limited to the outdoor environment. The control group were given the same science lessons at a later period, although on the same day. This may affect the learning process due to factors like exhaustion and impatience. However, since the alternate classes were taken during regular school hours, the time difference may not be addressed.

This study only examines the outside physical environment and children's learning. Other concerns relating to children's learning, such as teacher competency, teacher-student interaction, policy decisions, educational systems, and others, are outside the purview of the thesis due to time constraints and other factors.

Chapter 6: Discussion and Conclusion

The study was initiated in response to Bangladesh's alarming primary school dropout rate, decreasing interest in science learning and low environmental quality (Nath & Chowdhury, 2010). The primary goal was to determine whether the atmosphere outside supported teaching children. The goal was to look at the potential of outdoor learning for Bangladeshi primary school students. As a result, the study's initial target audience included policymakers, educators, researchers, landscape architects, and architects.

The study's findings highlight the importance of incorporating a school garden as a crucial element in school design. This addition creates a well-rounded learning environment that actively engages students in academic and non-academic activities. Additionally, the school garden offers opportunities for students to enhance their social, emotional, and physical skills, which are vital for their overall development.

Three sections make up the chapter. The key findings are covered in the first part. The second section explores potential methods for putting the findings into practice. The third section suggests a course for additional research on this subject.

6.1 Main findings

6.1.1 Findings consolidating literature review

Positive relationships between cognitive domain factors and the outdoor environment have been found in a number of notable discoveries, both conceptually and practically. Significant correlations between affective domain characteristics and outdoor class were discovered. Numerous built-environment factors were also discovered to be significant. A qualitative investigation that describes the underlying mechanisms was included in this study in addition to the statistical analysis. These results imply that the outdoor environment alone will have the greatest impact on Bangladeshi primary school children's learning. The problem requires interdisciplinary approaches to solve. However, it was firmly proven that the outdoor environment had a significant role in aiding children's learning. The following discusses the findings in relationship to the literature review summerised in section 2.9.

Cognitive Competency:

The research findings indicated that outdoor learning environments significantly enhanced children's cognitive competency. The hands-on experiences and real-life applications in the outdoor setting promoted critical thinking, problem-solving skills, and knowledge retention. Students demonstrated improved cognitive abilities, such as logical reasoning, information processing, and decision-making.

The Capability to Experience New Challenges:

Engaging in outdoor learning provided children with opportunities to experience and overcome new challenges. They were exposed to unfamiliar situations, requiring them to adapt, think creatively, and develop resilience. The outdoor environment fostered a growth mindset and a willingness to take risks, enabling children to embrace challenges and develop a sense of confidence in their abilities.

Promotion of Questioning and Exploratory Stance:

Outdoor learning environments encouraged children to adopt a questioning and exploratory stance towards their surroundings. They exhibited curiosity, actively sought knowledge, and engaged in independent investigations. The open-ended nature of outdoor activities prompted students to ask probing questions, make observations, and explore various solutions, nurturing their natural sense of inquiry.

Physical/Motor Skill Development:

The research findings highlighted that outdoor learning positively influenced the physical and motor skill development of children. Engaging in activities such as running, climbing, and playing games in the outdoor environment promoted gross motor skills, coordination, balance, and overall physical fitness. Students demonstrated improved motor control, spatial awareness, and dexterity through hands-on outdoor experiences.

Social Development; Environmental Knowledge:

Outdoor learning environments provided a conducive setting for social development and the acquisition of environmental knowledge. Collaborative activities, group projects, and team-building exercises in the outdoor setting fostered social interaction, cooperation, and communication skills. Additionally, children gained a deeper understanding of the natural environment, ecological concepts, and sustainable practices, promoting a sense of environmental responsibility.

Communication with the Local Community:

The research findings suggest that outdoor learning fosters communication and interaction between children and the local community. Although the research does not encompass the full extent of this phenomenon, it is evident that field trips, community visits, and engagement with local experts in garden activities among neighbouring schools, offer students valuable opportunities to connect with their surroundings and learn from community members. This experience has the potential to enrich their understanding of local traditions, cultural diversity, and community values.

Sense of Ownership, Pride, and Belonging:

The outdoor learning experiences instilled a sense of ownership, pride, and belonging among the children. Being actively involved in designing and maintaining garden created a sense of responsibility and ownership. Students took pride in their contributions, leading to a heightened sense of belonging within the learning environment.

6.1.2 Improvement of Academic Performance:

The research findings revealed a positive correlation between outdoor learning and academic performance. Students who engaged in outdoor learning demonstrated improved academic achievements, including test scores, and overall academic engagement. The hands-on, experiential nature of outdoor activities enhanced knowledge retention, critical thinking skills, and application of learned concepts, ultimately leading to academic success.

The study evaluated children's learning based on the results of an achievement test explicitly created for the study. There was a significant difference in learning outcomes at α =0.01 level between the control and treatment groups. Children's learning and outdoor environment were linked in earlier studies of the learning environment for children (Lieberman and Hoody 1998; Place-based education and student achievement 2011; Children and Nature Network 2010). The advantages of learning outside are supported by theory and evidence. Dewey (Dewey J. , 1963) noted that educators might affect children's experiences by creating natural environments that foster growth. Direct experience and exploration in this setting have been found to impact learning (Harvey 1989–1990, Backman and Crompton 1985, National Wildlife Federation 2001). This is a crucial result that indicates further study needs to be done on the subject.

6.1.3 Improvement in Science Learning

Increased science understanding & comprehension improved science application
Students who learn science concepts, observe and understand what they see, and do it in an outside environment benefit the most from this approach. They exhibit superior skills when applying science. According to statistical analysis, students significantly improved in knowledge, analysis, application, and synthesis levels within the cognitive domain variable. Analysis and application levels saw the most gains. They showed a greater comprehension of intricate scientific concepts than they had previously. Although nature was thought to be a great way to teach science, nature study enthusiasts also considered the outdoors a novel way to educate a variety of notions, from critical enquiry to spiritual, literary, and aesthetic understanding.

Participation, enthusiasm, and interest in learning science
This study proves that students are more enthusiastic about learning science outside of the classroom than inside. The children typically respond with

enthusiasm and a desire to share with the teacher and other children what they have learned. Even students previously thought uninterested in science classes engaged in their outdoor class with greater zeal and commitment. Due to their heightened engagement and contact with outside events, children at play are probably more highly motivated to learn. As a result, they have more control over some parts of their playtime learning and experiences, such as the location of the activities and the degree of complexity. One of the teachers claimed that "teaching and learning have become more fascinating due to the changes to our schoolyard. Both students' and faculty's attendance are higher when classes are held outside!

Outdoor Environment: A laboratory for learning Science

Outdoor classes are established as a laboratory for science learning through qualitative assessments of children's outdoor learning and surveys of the affective domain. 100% of the children wish to continue taking science sessions outside, and 87% regarded the outdoor setting as excellent for learning science. The outdoor group is undoubtedly the most realistic because the children experience the ideas in their natural surroundings. Also, it has been demonstrated that first-hand encounters with real-world situations are crucial for learning. Hence any instruction involving natural things should be conducted outdoors. When teaching science and environmental education, children and teachers have unique chances to explore the natural world. The results of this study are consistent with those of other studies, which demonstrate that school grounds can serve as significant locations for field-based investigations, which can foster cognitive learning and other desirable outcomes. Since all the components of a science textbook are all around them and are simple to access, the students and the teachers in this study believe that the outdoor environment is its laboratory. "*In the past, we believed that science education occurred just in a classroom rather than in the real world. Going outside to learn is enlightening for us.*"- said one of the children.

6.2 Limitations of outdoor class

A school garden classroom can provide many benefits for students, such as hands-on learning experiences and a deeper understanding of nature and the environment. However, there are also limitations to this type of learning environment.

Weather limitations

Outdoor classrooms can be subject to weather changes, which can make it difficult for teachers to conduct classes. In extreme weather conditions, classes may have to be canceled or moved indoors.

Seasonal Limitations

School gardens are usually only productive during certain seasons, which means that students may not have access to fresh produce or flowers throughout the year. This can limit the variety of plants that students can study and may require additional resources to maintain the garden during off-seasons.

Space Limitations

School gardens require space to grow, which can be limited in urban areas or schools with smaller campuses. This can limit the number of students who can participate in the garden, as well as the variety and quantity of plants that can be grown.

Time Limitations

Maintaining a garden requires a significant amount of time and effort, which can be a challenge for teachers and students who have other academic and extracurricular commitments. This can limit the frequency and duration of garden activities and may require additional resources to maintain the garden when school is not in session.

Resource Limitations

School gardens require resources such as soil, seeds, tools, and water, which can be expensive and difficult to obtain. Schools with limited budgets may struggle to provide the necessary resources to establish and maintain a garden.

Accessibility Limitations

Some students may have physical limitations or allergies that make it difficult or impossible for them to participate in garden activities. This can limit the inclusiveness of the learning environment and may require accommodations to be made to ensure all students can participate.

6.3 Outdoor Class: Not a Replacement rather an Extension of the Classroom

Not all or even most traditional education needs to be transferred outdoors, even though the outdoors is an effective teaching and learning place. Many concepts and goals are best learned indoors with readily available tools and facilities. Harvey investigated the cognitive aspect of environmental education (Harvey, 1989-1990) He proposed that using an outdoor learning space should be a continuation of the inside class rather than a method of teaching that relies on learning being discovered on the spot. He thinks instruction in the classroom and outside activities should be combined. Backman and Crompton also stated that "it is conceivable that environmental concepts may be taught effectively if students are oriented in the classroom with appropriate concepts so that they have some feeling of organisation before going into the outdoor activities." The outdoors should be considered a supplement to indoor study, enhancing it rather than taking its place.

6.4 Vision for New School Landscape

Children's science education is improved by outdoor learning spaces, which also improves the whole school environment. Natural components provide opportunities for exploration, experimentation, and appreciation of nature. Additionally, they enhance the school's diverse and rich sensory environment (Heusser, Adelson, & Ross, 1986)

This study has revealed the value of outdoor learning, which will help shape Bangladesh's primary schools' future construction. It is challenging to imagine a new educational environment. It disproves the designers' preconceived notions about what a school environment is for and how it ought to look. It must be looked forward and think about how education will be delivered in the coming century. It requires debating whether school grounds are necessary and figuring out what purpose they should serve. The school's traditional function may be superseded by the information and technology revolution, forcing the designers to reimagine the institution altogether. For now, another look may be taken at a familiar setting they had been ignored and taken for granted and see its potential as a community and educational resource. The experiences and perceptions of children must be the beginning point. The architects need to understand how to design learning environments that both cherish and challenge, that support rather than prohibit learning and can contribute in some measure to schooldays being the happiest days of people's life.

6.5 Steps to remove the Gap between Research and Practice

The "gap" between research and practice is not a new problem. In order to execute research findings via influencing educational policy, prior defined strategies and study designs are necessary. Studies should choose controllable, independent variables to maximise the impact on the real world to achieve this goal (Kuo, 2002). Otherwise, it is challenging to execute the findings. The built environment is a controlled factor in the outdoor class. All primary school building in Bangladesh is the responsibility of LGED, and DPE, which reports to the Ministry of Primary and

Mass Education, has the capacity and power to regulate the built environment covered by this study for the benefit of subsequent generations. Children's lack of access to adequate facilities for quality education is a subject in everyday media that must be addressed adequately ((Hasanuzzaman, 2010; Islam M. Z., 2010; Ahmed M. , 2010; Hossain, 2011).

The garden intervention in a primary school, financed by CASR, BUET, was part of the study and served as a practical application of the findings. However, more parties need to be involved if these studies are to have broad-based practical implications. Following all these, our political leaders must have a strong political will.

6.6 Directions for Future Research

N=55 children made up the sample for this study. To more confidently study the connections between children's learning and the outside environment, a similar research approach with a larger sample would be beneficial. Also, a bigger sample size could include more independent variables, which could deepen our understanding of how children learn concerning the features of outdoor classroom design. The study's primary finding is that numerous learning-related factors can impact children.

With the discovery of a favourable association between the outdoor environment and learning, this study became interested in the distinctive qualities of outdoor environments. However, because it was an M. Arch thesis, it needed more than it could cover. Fifty-five students from a single school were used to test this model. However, the same model can produce different findings for a bigger sample size.

To study the relationship between various outdoor learning spaces' characteristics and children's learning, research including gardens with various design characteristics may be done in the future.

Also, this study focused on children's opinions rather than actual emotional domain achievement. A detailed investigation of individual items in both domain variables is required. A large sample size and a well-designed domain survey questionnaire can help children learn about the outdoors in depth.

The qualitative research revealed delicately built environment characteristics that were case-specific and hence not included as variables in statistical models. Nonetheless, it was shown that these environmental characteristics impacted children's learning. Future studies can examine the relationship between these characteristics and learn by using them as variables in quantitative analysis.
Multidisciplinary research is crucial, especially regarding high-quality education and learning. For better results, architects, educators, and policy officials must collaborate. As no standardised test is available to evaluate the learning of class V students in primary school, developing an achievement test took much work for this research.

The requirement for research in the setting of primary schools in underdeveloped countries has been noted as another significant future direction. It is challenging and questionable whether using "western" study literature findings can help the situation in developing nations.

6.7 Conclusion

The world around humans has always been important to them. We start learning about our surroundings through exploration the moment we are born. Teachers should keep promoting environmental discoveries to preserve this connection because there is still much for us to learn. The findings of this study confirm and support the notion that the outdoors can be a handy tool for educators and students. The findings imply that children are influenced by their learning environment. Since the presented principles can be found in nature, the outdoor environment impacts learning.

Because there are so many first-hand, real-world experiences that students can have outside, it is ideal for the natural environment on school grounds to transform into a second classroom just as significant as the one inside.

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0make%20a%20big%20difference%2C%20too.&text=From%20the%20front%20door%20and,they%20feel%20about%20their%20school.

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Appendices

Appendix 1 Class V Students

Roll No.	Name
1	Sanjida Tasneem
2	Faria Sultana
3	Fahia Hamim
4	Rifa Tashfia Rodela
5	Ikra Moni Rose
6	Israt Jahan Meghla
7	Isha Moni
8	Prapti Shaha
9	Sanjida Rashid Muskan
10	Mubasshira Rahman
11	Tashfia Khanam
12	Durre Maknun Nidhi
13	Afrin Islam
14	Afifa Jarin Parsha
15	Iffat Jarin upoma
16	Jannatul Ferdous Jar
17	Taosia Tahia
18	Jannatul Ferdous
19	Umme Maria Raida
20	Sanjida Afrin Jui
21	Zara Rashid Safia
22	Tasmia Afrin
23	Sumaiya Islam Shammi
24	Nafisa Al baki
25	Najmunnesa Tasnuva
26	Samira Jahan
27	Tashfia Tanzila
28	Sadia Akter Shaila
29	Ayesha Jannat
30	Fabia Karim Subha
31	Sarah Sultana Tanha
32	Arabi Khan Ishami
33	Ayesha Siddik Ahir
34	Zarin Akter
35	Samiha Islam
36	Farzana Akter Mim
37	Nafisa Akter Ava
38	Nur e Jannat Namia
39	Rayanul Jannat Rida
40	Fatema Tuj Johora
41	Nusrat Jahan
42	Tasnim Jahan Dia
43	Faiza Afrin
44	Raisa Anjus Lamisa
45	Syeda Tanisha Rahman
46	Fatema Alam Raisa
47	Radia Binte Razi
48	Tabassum Adiba
49	Ayesha Fariha
50	Shemontika Das
51	Taslima Akter
52	Taiyeba Ahmed
53	Samia Alam Nowrin
54	Samiksa Haider Namira
55	Najmun Nahar

Treatment Group Children n=24

Appendix 2 Official permission letter

২৬.১২.২০১৯ ইং

বরাবর

অধ্যক্ষ,
ইঞ্জিনিয়ারিং গার্লস স্কুল এবং কলেজ
পলাশি, ঢাকা-১০০০।

বিষয়ঃ স্কুল প্রাঙ্গণে একটি বাগান স্থাপন এবং পাঠদানের আবেদন

উপরোক্ত বিষয়ের প্রেক্ষিতে জানানো যাচ্ছে যে, আমি, ডাঃ মোঃ জাকিউল ইসলাম, অধ্যাপক, স্থাপত্য বিভাগ, বুয়েট। আমার স্নাতকোত্তর শিক্ষার্থী দেওয়ান সাবরিনা শারমীন, এর একাডেমিক প্রয়োজনে আপনার বিদ্যালয় প্রাঙ্গণে শিক্ষার্থীদের সহায়তায় একটি বাগান স্থাপন পূর্বক তার **'An Investigation Of The Role Of A School Garden On Learning Science At A Primary School Of Dhaka'** (provisional) শিরোনামের থিসিসের কর্মসম্পাদনের লক্ষ্যে স্থাপিত বাগানের পরিপার্শ্বে শিক্ষার্থীদের পাঠদানের সদয় অনুমতি কামনা করছি

05/01/2020
ডাঃ মোঃ জাকিউল ইসলাম
অধ্যাপক
স্থাপত্য বিভাগ,
বুয়েট, ঢাকা।

Professor,
Department of Architecture
Bangladesh University of Engineering
& Technology, Dhaka, Bangladesh.

Appendix 3 Consent Form

সম্মতি ফর্ম

দেওয়ান সাবরিনা শারমীন (আইডি ১০১৪০১২০২০, মাস্টার্স প্রোগ্রাম, বুয়েট) এর একাডেমিক প্রয়োজনে ইঞ্জিনিয়ারিং গার্লস স্কুল এবং কলেজ, পলাশি, ঢাকা-১০০০ বিদ্যালয় প্রাঙ্গণে শিক্ষার্থীদের সহায়তায় একটি বাগান স্থাপন পূর্বক 'An Investigation of The Role of a School Garden on Learning Science at A Primary School of Dhaka' (provisional) শিরোনামের থিসিসের কর্মসম্পাদনের লক্ষ্যে স্থাপিত বাগানের পরিপার্শ্বে শিক্ষার্থীদের পাঠদানের সম্মতি ফর্ম:

০১। ছাত্রের নাম :

০২। জন্ম তারিখ :

০৩। অভিভাবক :

০৪। ঠিকানা :

০৫। টেলিফোন :

০৬। মোবাইল :

০৭। ই-মেইল :

০৮। জরুরী যোগাযোগ (যদি উপরের থেকে আলাদা হয়) : নাম:
টেলিফোন নং:

সম্মতি দিচ্ছি যে:

আমি আমার কন্যাকে এই প্রোগ্রামের কার্যকলাপে অংশ নিতে দিতে সম্মত।

স্বাক্ষরিত

তারিখ:

Appendix 4 Sample Signed Consent form from parents

(01)

সম্মতি ফর্ম

নেওয়াজ সাবরিনা শারমীন (আইডি ১০১৪০১২০২০, মাস্টার্স প্রোগ্রাম, বুয়েট) এর একাডেমিক প্রয়োজনে ইঞ্জিনিয়ারিং গার্লস স্কুল এবং কলেজ, পলাশী, ঢাকা-১০০০ বিদ্যালয় প্রাঙ্গণে শিক্ষার্থীদের সহায়তায় একটি বাগান স্থাপন পূর্বক 'An Investigation Of The Role Of A School Garden On Learning Science At A Primary School Of Dhaka' (provisional) শিরোনামের থিসিসের কর্মসম্পাদনের লক্ষ্যে স্থাপিত বাগানের পরিপার্শ্বে শিক্ষার্থীদের পাঠদানের সম্মতি ফর্ম

০১। ছাত্রের নাম: সারজিনা তাসনীম
০২। জন্ম তারিখ: ১১/০৬/২০০৯ ইং
০৩। অভিভাবক: মোছা: সোহানা খানম
০৪। ঠিকানা: খাজে দেওয়ান ১ম লেন, লালবাগ, ঢাকা
০৫। টেলিফোনে।
০৬। মোবাইল:
০৭। ই-মেইল: ebank.com.bd
০৮। জরুরী যোগাযোগ: (যদি উপরের থেকে আলাদা হয়) নাম: মো: আবু সাঈদ
টেলিফোন নং: 0

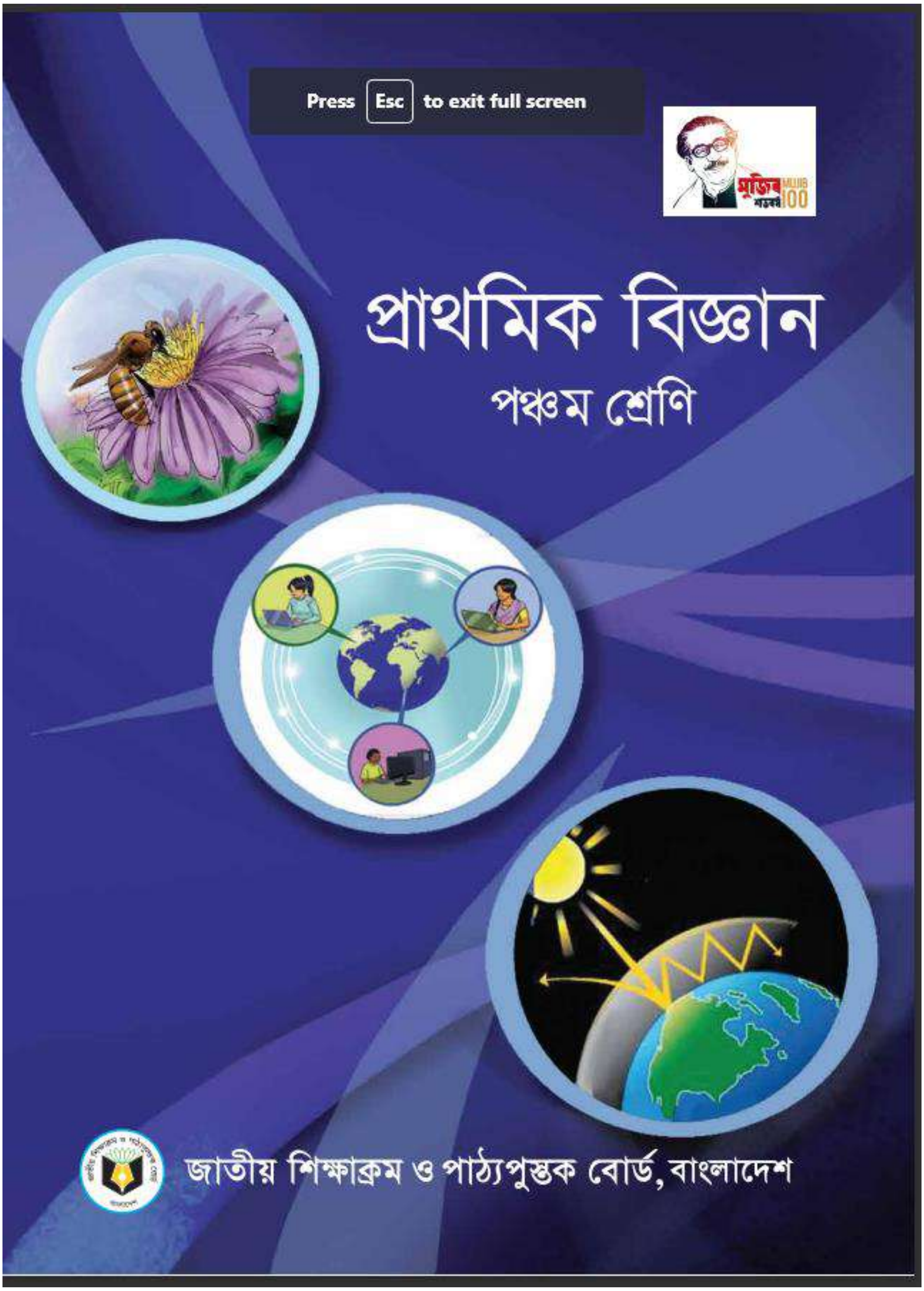
সম্মতি দিচ্ছি যে

আমি আমার কন্যাকে এই প্রোগ্রামের কার্যকলাপে অংশ নিতে দিতে সম্মত।

স্বাক্ষরিত Shohana
তারিখ: 14-01-2020

Appendix 5 Location Map.

Appendix 6 NCTB's class V science book



Appendix 7 NCTB's class V science book contents of chapter

প্রাথমিক বিজ্ঞান

বিষয়ভিত্তিক প্রান্তিক যোগ্যতা	শ্রেণিভিত্তিক অর্জন উপযোগী যোগ্যতা				
	১ম শ্রেণি	২য় শ্রেণি	৩য় শ্রেণি	৪র্থ শ্রেণি	৫ম শ্রেণি
১. পরিবেশ, পরিবেশের উপাদান, পরিবেশের পরিবর্তন ও পরিবেশ দূষণ সম্পর্কে জেনে পরিবেশ সংরক্ষণে সচেষ্ট হওয়া।	১. জগৎ ও পরিবেশের বস্তুসমুহ পর্যবেক্ষণের মাধ্যমে চিনতে পারবে। ২. দৈনন্দিন জীবনে ব্যবহৃত সামগ্রী কোথা থেকে আসে তা বুঝতে পারবে।	১. নিকট পরিবেশের বস্তুসমূহ কোনটি মানুষের তৈরি আর কোনটি প্রকৃতি থেকে পাওয়া যায় তা পর্যবেক্ষণের মাধ্যমে চিনতে পারবে। ২. মাটি, পানি, বায়ু ও জীবের প্রতি যত্ন নিতে পারবে।	১. পরিবেশ সম্পর্কে ধারণা লাভ করবে। ২. পরিবেশের উপাদানগুলো পর্যবেক্ষণের মাধ্যমে চিনতে পারবে। ৩. প্রাকৃতিক ও মানুষের সৃষ্ট পরিবেশ কী তা পর্যবেক্ষণের মাধ্যমে উপলব্ধি করবে।	১. নিজের প্রয়োজন মেটানোর জন্য জীব কীভাবে পরিবেশের উপর নির্ভরশীল তা জানবে। ২. প্রাকৃতিক ও মানুষের সৃষ্ট কারণে পরিবেশের পরিবর্তন ঘটছে তা বুঝতে পারবে	১. পরিবেশের বিভিন্ন উপাদানের মধ্যে পারস্পরিক সম্পর্ক ও নির্ভরশীলতা উপলব্ধি করবে। ২. পরিবেশ দূষণের কারণ ও প্রভাব সম্পর্কে জানবে। ৩. পরিবেশ সংরক্ষণের গুরুত্ব অনুধাবন করে পরিবেশ সংরক্ষণে সচেষ্ট হবে। ৪. উদ্ভিদ ও প্রাণীর সংরক্ষণের জন্য অনুকূল পরিবেশ সৃষ্টিতে সচেষ্ট হবে।
২. আমাদের পরিবেশে জড় ও জীব সম্পর্কে জানা	১. নিকট পরিবেশে কাদের জীবন আছে ও কাদের জীবন নেই তা চিনতে পারবে। ২। নিকট পরিবেশের জড়বস্তু ও জীবের যত্ন নিতে পারবে।	১. পর্যবেক্ষণের মাধ্যমে নিকট পরিবেশের জড় ও জীব বস্তু চিনতে পারবে। ২. বেঁচে থাকার জন্য উদ্ভিদের পানি ও আলো প্রয়োজন এবং প্রাণীর জন্য প্রয়োজন খাদ্য তা বুঝতে পারবে	১. জীব ও জড়ের পার্থক্য বুঝতে পারবে। ২. উদ্ভিদ ও প্রাণী চিনতে পারবে। ৩. বেঁচে থাকার জন্য প্রাণী কীভাবে উদ্ভিদ ও অন্যান্য প্রাণীর উপর নির্ভরশীল তা জানবে	১. বিভিন্ন জীব বিভিন্ন পরিবেশে বসবাস করে তা বুঝতে পারবে ২. উদ্ভিদ ও প্রাণীর মধ্যে পার্থক্য জানবে।	
৩. পরিবেশের উপাদান হিসেবে পানির গুরুত্ব সম্পর্কে জেনে পানির যথাযথ ব্যবহার ও সংরক্ষণ করা।	১. পানির ব্যবহার সম্পর্কে জানবে। ২. নিকট পরিবেশে পানির উৎস পর্যবেক্ষণের মাধ্যমে চিনতে পারবে।		১. পানির উৎস সমূহ জানবে। ২. নিরাপদ ও দূষিত পানি শনাক্ত করতে জানবে। ৩. মানুষের জন্য পানির গুরুত্ব সম্পর্কে জানবে। ৪. পানির অপচয় রোধে সচেষ্ট হবে।		১. উদ্ভিদ ও প্রাণীর জীবনে পানির প্রয়োজনীয়তা বর্ণনা করতে পারবে। ২. পানিচক্রের ধারণা অর্জন করবে। ৩. মানুষের জীবনে পানি দূষণের ফলাফল বা প্রভাব আলোচনা করতে পারবে। ৪. পানি দূষণের কারণ ও দূষণ রোধের উপায়গুলো জানবে। ৫. পানি শোধন করে নিরাপদ করার

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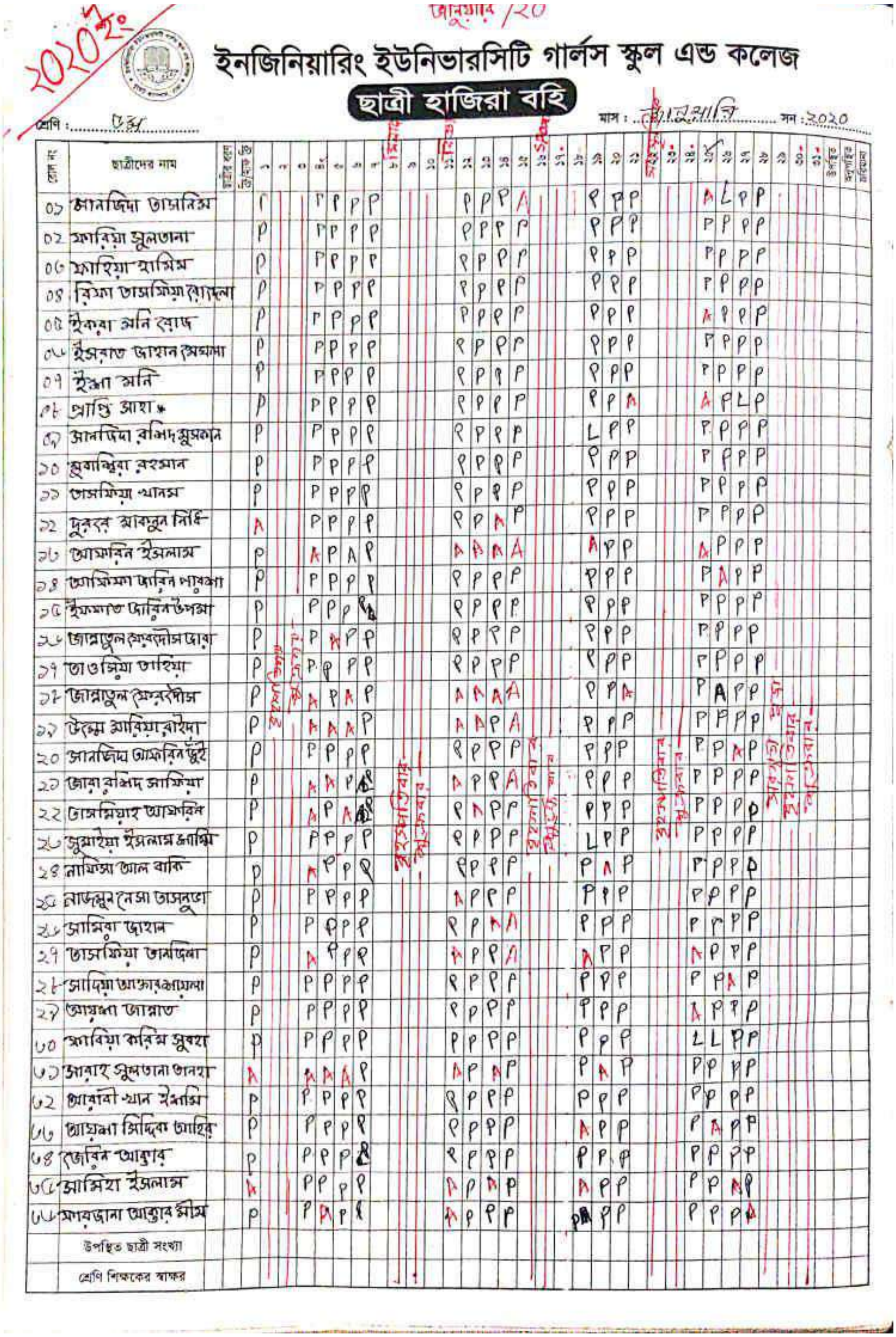
Appendix 8 Class Routine

CLASS ROUTINE

	8.30-9.10	9.10-9.50	9.50-10.30	10.30-11.10	11.10-11.30	11.30-12.10	12.10-12.50	12.50-1.30	1.40-1.41
Saturday	BD GS	**SCIENCE**	E1	B1	BREAK	E2	MATH	REL	B2
Sunday	E2	**SCIENCE**	BD GS	REL		E1	B1	MATH	B2
Monday	**SCIENCE**	B2	E1	MATH		B1	BGS	E1	REL
Tuesday	E2	MATH	MATH	BGS		E2	**SCIENCE**	REL	B1
Wednesday	E2	BD GS	E1	**SCIENCE**		REL	MATH	B2	B1

Science Class
Science outdoors
Alternate class during outdoor science class

Appendix 9 Attendance



Appendix 10 Achievement test

Achievement Test tool

১। পরিবেশ সংরক্ষণে গাছ কিভাবে সাহায্য করে? দুইটি উপায় লিখ। (Chap 02) ২

২। গাছ চেনার প্রাথমিক উপায় গুলো কি কি? (Chap 01) ২

৩। আমাদের স্কুলের আঙিনায় তুমি কি কি প্রাণী দেখতে পাও। (Chap 01) ২

৪। শিশির কি? (Chap 03) ২

৫। সূর্যের আলো উদ্ভিদের জন্য প্রয়োজনীয় কেন? (Chap 01) ২

৬। শীতকালীন কিছু সবজি ও ফুলের নাম লিখ। (Complimentary) ২

৭। তুমি কি কি সবজি খেতে পছন্দ করো? (Complimentary) ২

Appendix 11 Chi-Square Table

Degrees of Freedom *(df)*	**Probability (*p*)**										
	0.95	0.90	0.80	0.70	0.50	0.30	0.20	0.10	0.05	0.01	0.001
1	0.004	0.02	0.06	0.15	0.46	1.07	1.64	2.71	3.84	6.64	10.83
2	0.10	0.21	0.45	0.71	1.39	2.41	3.22	4.60	5.99	9.21	13.82
3	0.35	0.58	1.01	1.42	2.37	3.66	4.64	6.25	7.82	11.34	16.27
4	0.71	1.06	1.65	2.20	3.36	4.88	5.99	7.78	9.49	13.28	18.47
5	1.14	1.61	2.34	3.00	4.35	6.06	7.29	9.24	11.07	15.09	20.52
6	1.63	2.20	3.07	3.83	5.35	7.23	8.56	10.64	12.59	16.81	22.46
7	2.17	2.83	3.82	4.67	6.35	8.38	9.80	12.02	14.07	18.48	24.32
8	2.73	3.49	4.59	5.53	7.34	9.52	11.03	13.36	15.51	20.09	26.12
9	3.32	4.17	5.38	6.39	8.34	10.66	12.24	14.68	16.92	21.67	27.88
10	3.94	4.86	6.18	7.27	9.34	11.78	13.44	15.99	18.31	23.21	29.59
	Nonsignificant								Significant		

Appendix 12 T test Table

DF	A	0.80	0.90	0.95	0.98	0.99	0.995	0.998	0.999
	P	0.20	0.10	0.05	0.02	0.01	0.005	0.002	0.001
1		3.078	6.314	12.706	31.820	63.657	127.321	318.309	636.619
2		1.886	2.920	4.303	6.965	9.925	14.089	22.327	31.599
3		1.638	2.353	3.182	4.541	5.841	7.453	10.215	12.924
4		1.533	2.132	2.776	3.747	4.604	5.598	7.173	8.610
5		1.476	2.015	2.571	3.365	4.032	4.773	5.893	6.869
6		1.440	1.943	2.447	3.143	3.707	4.317	5.208	5.959
7		1.415	1.895	2.365	2.998	3.499	4.029	4.785	5.408
8		1.397	1.860	2.306	2.897	3.355	3.833	4.501	5.041
33		1.308	1.692	2.035	2.445	2.733	3.008	3.356	3.611
34		1.307	1.691	2.032	2.441	2.728	3.002	3.348	3.601
35		1.306	1.690	2.030	2.438	2.724	2.996	3.340	3.591
36		1.306	1.688	2.028	2.434	2.719	2.991	3.333	3.582
37		1.305	1.687	2.026	2.431	2.715	2.985	3.326	3.574
38		1.304	1.686	2.024	2.429	2.712	2.980	3.319	3.566
39		1.304	1.685	2.023	2.426	2.708	2.976	3.313	3.558
40		1.303	1.684	2.021	2.423	2.704	2.971	3.307	3.551
42		1.302	1.682	2.018	2.418	2.698	2.963	3.296	3.538
44		1.301	1.680	2.015	2.414	2.692	2.956	3.286	3.526
46		1.300	1.679	2.013	2.410	2.687	2.949	3.277	3.515
48		1.299	1.677	2.011	2.407	2.682	2.943	3.269	3.505
50		1.299	1.676	2.009	2.403	2.678	2.937	3.261	3.496

Appendix 13 Survey Questionnaire for control group

SURVEY QUESTIONNAIRE FOR CONTROL GROUP

1. তোমার ক্লাসরুমে আলোতে কেমন পড়া যায়?

1. খুব ভালো পড়া যায়
2. মোটামুটি পড়া যায়
3. পড়া যায় না
4. একদমই পড়া যায় না

2. ক্লাসরুমের ভেতর শব্দ কেমন?

1. পাশের ক্লাসের শব্দ উচ্চস্বরে শোনা যায়
2. পাশের ক্লাসের শব্দ শোনা যায় না
3. ক্লাসরুমের শব্দ ঠিক আছে
4. শিক্ষকের কথা খুব ভালোভাবে শোনা যায়

3. ক্লাসরুমে বসার জায়গা কেমন?

1. অনেক আরামদায়ক
2. কোন অসুবিধা হয় না
3. বসে পড়তে অসুবিধা হয়
4. অনেক বেশি অসুবিধা হয়

4. ক্লাসরুমের ভেতরে বিজ্ঞান ক্লাস পাঠদানের সময় তুমি কতটা সক্রিয়ভাবে অংশগ্রহণ করো?

1. প্রায় করি
2. মাঝে মাঝে করি
3. করি না
4. একদমই করি না

5. ক্লাসরুমের ভেতরে বিজ্ঞান পড়তে কেমন লাগে?

1. খুব ভালো
2. ভালো
3. ভালো লাগেনা
4. একদমই ভালো লাগেনা

6. তুমি কি ক্লাস রুমের ভেতরের বিজ্ঞান ক্লাস করতে চাও সব সময়?

1. হ্যাঁ
2. না

7. তুমি কি মনে কর বিজ্ঞান পরানোর ক্ষেত্রে স্থানের পরিবর্তন করা দরকার?

1. দরকার
2. দরকার নাই

8. যদি ৭ নং এর উত্তর হ্যাঁ হয়ে থাকে সেক্ষেত্রে কি?

1. বাইরে ক্লাস করানো যেতে পারে
2. ভেতরে ভিন্নভাবে ক্লাস করানো যেতে পারে

Appendix 14 Survey Questionnaire for treatment group

SURVEY QUESTIONNAIRE FOR TREATMENT GROUP

1. বাইরের আলোতে কেমন পড়া যায়?

1. খুব ভালো পড়া যায় — 2. মোটামুটি পড়া যায়
3. পড়া যায় না — 4. একদমই পড়া যায় না

2. বাইরে শব্দ কেমন?

1. পাশের ক্লাসের শব্দ উচ্চস্বরে শোনা যায় — 2. পাশের ক্লাসের শব্দ শোনা যায় না
3. ক্লাসরুমের শব্দ ঠিক আছে — 4. শিক্ষকের কথা খুব ভালোভাবে শোনা যায়

3. বাইরে জায়গা কেমন?

1. অনেক আরামদায়ক — 2. কোন অসুবিধা হয় না
3. বসে পড়তে অসুবিধা হয় — 4. অনেক বেশি অসুবিধা হয়

4. বাইরে বিজ্ঞান ক্লাস পাঠদানের সময় তুমি কতটা সক্রিয়ভাবে অংশগ্রহণ করো?

1. প্রায় করি — 2. মাঝে মাঝে করি
3. করি না — 4. একদমই করি না

5. বাইরে বিজ্ঞান পড়তে কেমন লাগে?

1. খুব ভালো — 2. ভালো
3. ভালো লাগেনা — 4. একদমই ভালো লাগেনা

6. তুমি কি বাইরে বিজ্ঞান ক্লাস করতে চাও সব সময়?

1. হ্যাঁ — 2. না

7. অন্যান্য স্কুলে বাইরের ক্লাস করা সম্পর্কে মতামত দাও

1. প্রত্যেক স্কুলে থাকা উচিত — 2. থাকা উচিত না

8. বিজ্ঞানের মত অন্যান্য ক্লাসও যদি বাইরে নেওয়া হয় তাহলে কেমন হয়?

1. খুব ভালো — 2. ভালো
3. ভালো না — 4. একদমই ভালো না

Appendix 15 Focus Group Discussion

FOCUS GROUP DISCUSSION

১। কিভাবে সবচেয়ে ভালো শেখা যায়?

২। বাইরে এবং ভেতরে ক্লাস করা সম্পর্কে তোমাদের মতামত কি?

৩। বাইরে বাগানে ক্লাস করার পরিবেশ সম্পর্কে বল?

৪। বাইরে পড়ার পরিবেশ/বসার পরিবেশ সম্পর্কে বল?

৫। বাইরের ক্লাসে কি কি পড়া যায়?

৬। বাইরে বিজ্ঞান ক্লাস সম্পর্কে তোমার মতামত কি?

৭। পাঠদানের সময় বিজ্ঞান ক্লাসে তুমি কতটা সক্রিয়ভাবে অংশগ্রহণ কর?

৮। তুমি কি বাইরে বিজ্ঞান ক্লাস করা চালিয়ে যেতে চাও?

৯। বাইরের ক্লাস পড়া ব্যতীত আর কি কাজে ব্যবহার কর?

১০। অন্য স্কুলে কি বাইরের ক্লাস থাকা উচিত?

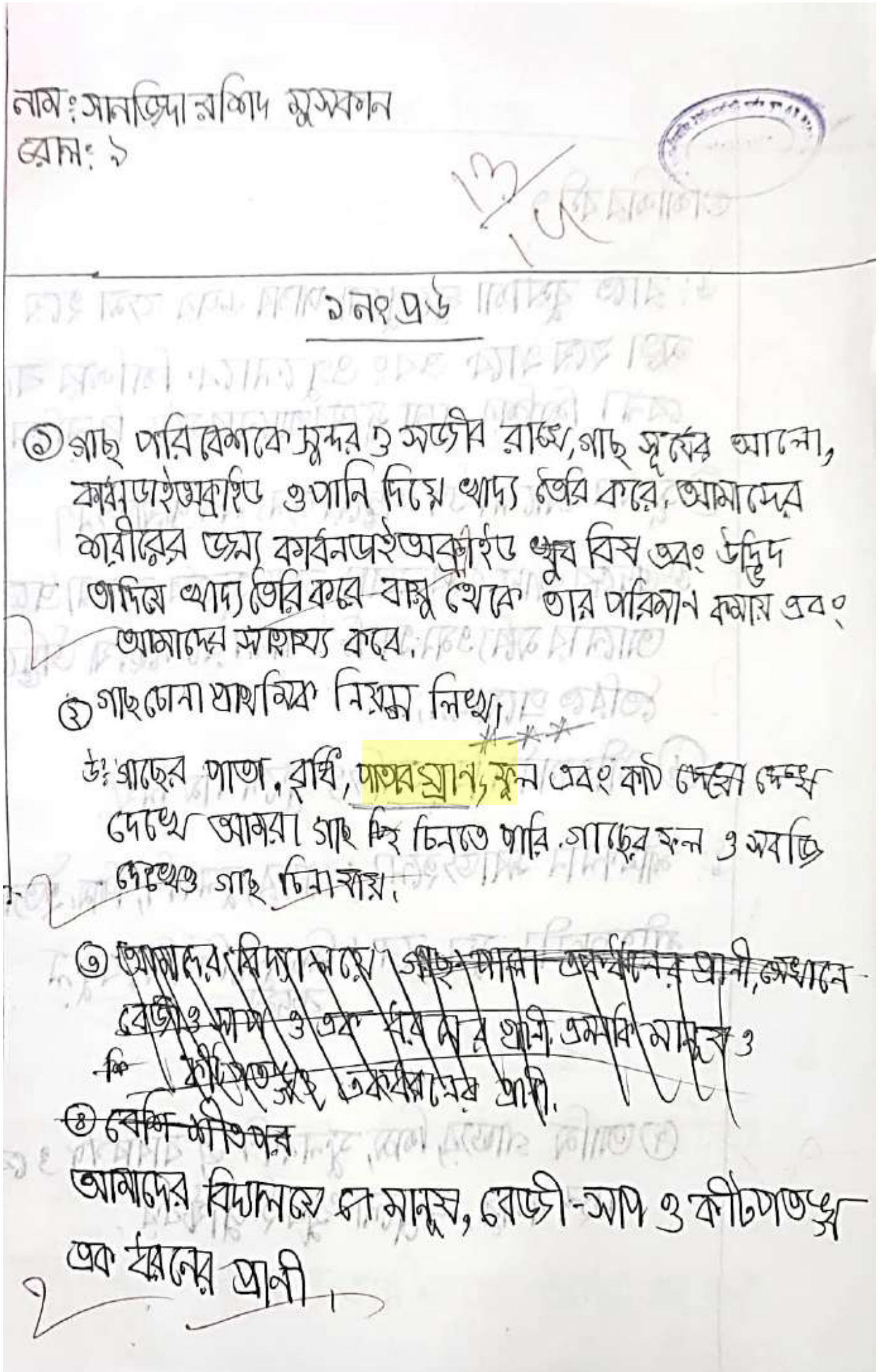
Appendix 16 Analysis of Attendance

List of **Class V students,** Engineering University Girls' School

Roll No.	Name	Jan-20			Feb-20		
		absent		present	absent		present
		overall class	in garden		overall class	in garden	
1	Sanjida Tasneem	2	1	14	0	0	19
2	Faria Sultana	0		16	0		19
3	Fahia Hamim	0		16	1		18
4	Rifa Tashfia Rodela	0		16	1		18
5	Ikra Moni Rose	1	1	15	0	0	19
6	Israt Jahan Meghla	0	0	16	0	0	19
7	Isha Moni	0		16	0		19
8	Prapti Shaha	2	2	14	4	1	15
9	Sanjida Rashid Muskan	0	0	16	2	0	17
10	Mubasshira Rahman	0	0	16	0	0	19
11	Tashfia Khanam	0	0	16	3	0	16
12	Durre Maknun Nidhi	2	0	14	2	0	17
13	Afrin Islam	8		8	3		16
14	Afifa Jarin Parsha	1	0	15	1	0	18
15	Iffat Jarin upoma	0	0	16	0	0	19
16	Jannatul Ferdous Jar	1		15	0		19
17	Taosia Tahia	0	0	16	0	0	19
18	Jannatul Ferdous	8		8	5		14
19	Umme Maria Raida	6		10	2		17
20	Sanjida Afrin Jui	1		15	0		19
21	Zara Rashid Safia	4		12	0		19
22	Tasmia Afrin	3		13	3		16
23	Sumaiya Islam Shammi	0	0	16	0	0	19
24	Nafisa Al baki	2	0	14	5	1	14
25	Najmunnesa Tasnuva	1		15	0		19
26	Samira Jahan	2		14	2		17
27	Tashfia Tanzila	5		11	2		17
28	Sadia Akter Shaila	1	1	15	4	0	15
29	Ayesha Jannat	1	1	15	5	0	14
30	Fabia Karim Subha	0		16	6		13
31	Sarah Sultana Tanha	7		9	2		17
32	Arabi Khan Ishami	0	0	16	0	0	19
33	Ayesha Siddik Ahir	2	0	14	2	0	17
34	Zarin Akter	0	0	16	0	0	19
35	Samiha Islam	5	1	11	1	0	18
36	Farzana Akter Mim	3	0	13	0	0	19
37	Nafisa Akter Ava	16		0	19		0
38	Nur e Jannat Namia	3		13	0		19
39	Rayanul Jannat Rida	0		16	1		18
40	Fatema Tuj Johora	5		11	3		16
41	Nusrat Jahan	0		16	0		19
42	Tasnim Jahan Dia	5		11	3		16
43	Faiza Afrin	9		7	10		9
44	Raisa Anjus Lamisa	13		3	10		9
45	Syeda Tanisha Rahman	5	1	11	5	1	14
46	Fatema Alam Raisa	4	1	12	0	0	19
47	Radia Binte Razi	9	1	7	6	1	13
48	Tabassum Adiba	6	1	10	3	2	16
49	Ayesha Fariha	5		11	2		17
50	Shemontika Das	2		14	0		19
51	Taslima Akter	0		16	3		16
52	Taiyeba Ahmed	5		11	4		15
53	Samia Alam Nowrin	10		6	8		11
54	Samiksa Haider Namira	4		12	3		16
55	Najmun Nahar	1		15	1		18

(light shading)	Treatment Group Children present in Achievement Test
(dark shading)	Treatment Group Children absent in Achievement Test

Appendix 17 Answer script roll 09


নাম: সানজিদা রশিদ মুসকান
রোল: ৯

১নং প্রশ্ন

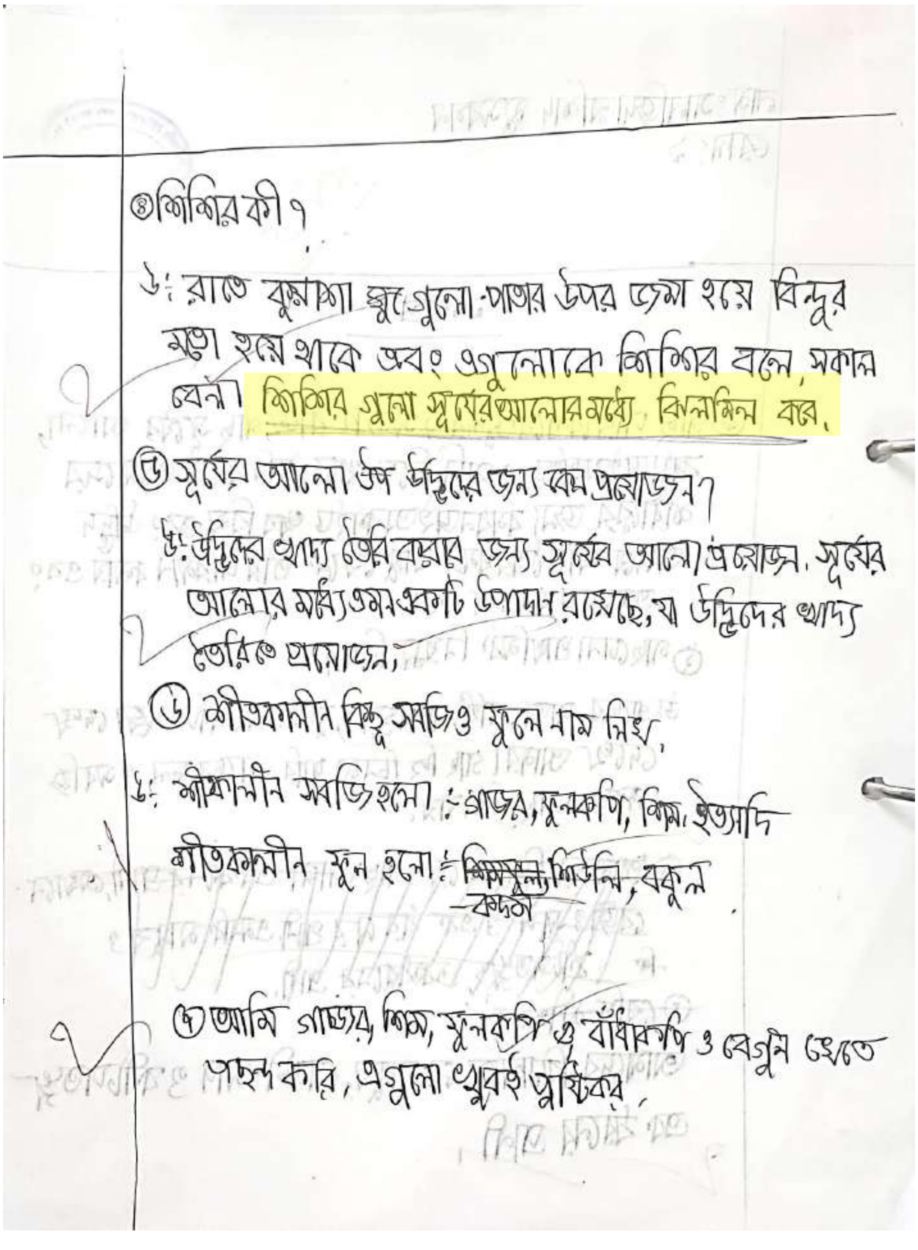
① গাছ পরিবেশকে সুন্দর ও সজীব রাখে, গাছ সূর্যের আলো, কার্বনডাইঅক্সাইড ও পানি দিয়ে খাদ্য তৈরি করে, আমাদের শরীরের জন্য কার্বনডাইঅক্সাইড খুব বিষ এবং উদ্ভিদ তা দিয়ে খাদ্য তৈরি করে বায়ু থেকে তার পরিমাণ কমায় এবং আমাদের সাহায্য করে।

② গাছ চেনা যায় কিভাবে নিয়ম লিখ।
উঃ গাছের পাতা, রং, পাতার ঘ্রাণ, ফুল এবং কাঠ দেখে দেখে দেখে আমরা গাছ চিনতে পারি। গাছের ফল ও সবজি দেখেও গাছ চেনা যায়।

③ ~~আমাদের বিদ্যালয়ে গাছপালা এক ধরনের প্রাণী, সেখানে কেঁচো ও সাপ ও এক ধরনের প্রাণী। এমনকি মানুষ ও কীটপতঙ্গ এক ধরনের প্রাণী।~~

④ ~~বেশি প্রতি~~
আমাদের বিদ্যালয়ে মানুষ, কেঁচো-সাপ ও কীটপতঙ্গ এক ধরনের প্রাণী।

Appendix 18 Answer script roll 09


৪ শিশির কী?

উ: রাতে কুয়াশা গুলো পাতার উপর জমা হয়ে বিন্দুর মতো হয়ে থাকে এবং এগুলোকে শিশির বলে, সকাল বেলা শিশির গুলো সূর্যের আলোর মধ্যে ঝিলমিল করে.

৫ সূর্যের আলো উদ্ভিদের জন্য কেন প্রয়োজন?

উ: উদ্ভিদের খাদ্য তৈরি করার জন্য সূর্যের আলো প্রয়োজন. সূর্যের আলোর মধ্যে এমন একটি উপাদান রয়েছে, যা উদ্ভিদের খাদ্য তৈরিতে প্রয়োজন,

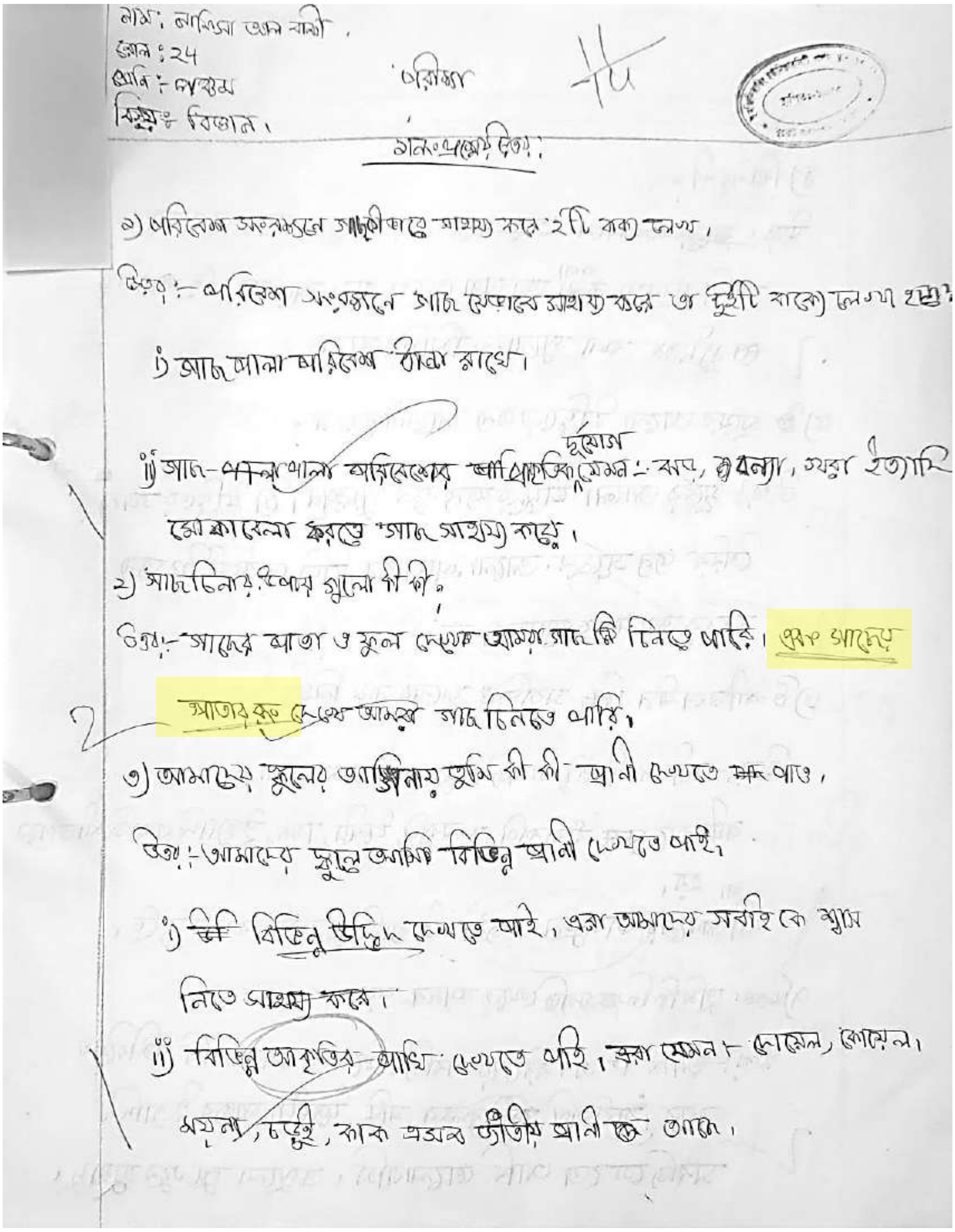
৬ শীতকালীন কিছু সবজি ও ফুলের নাম লিখ,

উ: শীতকালীন সবজি হলো :- গাজর, ফুলকপি, শিম, ইত্যাদি

শীতকালীন ফুল হলো :- ~~শিমুল~~, শিউলি, বকুল, কদম

৭ আমি গাজর, শিম, ফুলকপি ও বাঁধাকপি ও বেগুন খেতে পছন্দ করি, এগুলো খুবই পুষ্টিকর।

Appendix 19 Answer script roll 24



নাম: নাফিসা আল বারী।
রোল: 24
শ্রেণি: পঞ্চম
বিষয়: বিজ্ঞান।

পরীক্ষা

সংক্ষিপ্ত প্রশ্নের উত্তর:

১) পরিবেশ সংরক্ষণে গাছ কীভাবে সাহায্য করে ২টি বাক্য লেখ।

উত্তর: পরিবেশ সংরক্ষণে গাছ যেভাবে সাহায্য করে তা দুইটি বাক্যে লেখা হলো:

i) গাছ আলো পরিবেশ ঠান্ডা রাখে।

ii) গাছ-পালা পরিবেশের প্রাকৃতিক দুর্যোগ যেমন: ঝড়, বন্যা, খরা ইত্যাদি মোকাবেলা করতে গাছ সাহায্য করে।

২) গাছ চেনার উপায় গুলো কী কী।

উত্তর: গাছের পাতা ও ফুল দেখে আমরা গাছ চিনতে পারি। এছাড়া গাছের আকার দেখে আমরা গাছ চিনতে পারি।

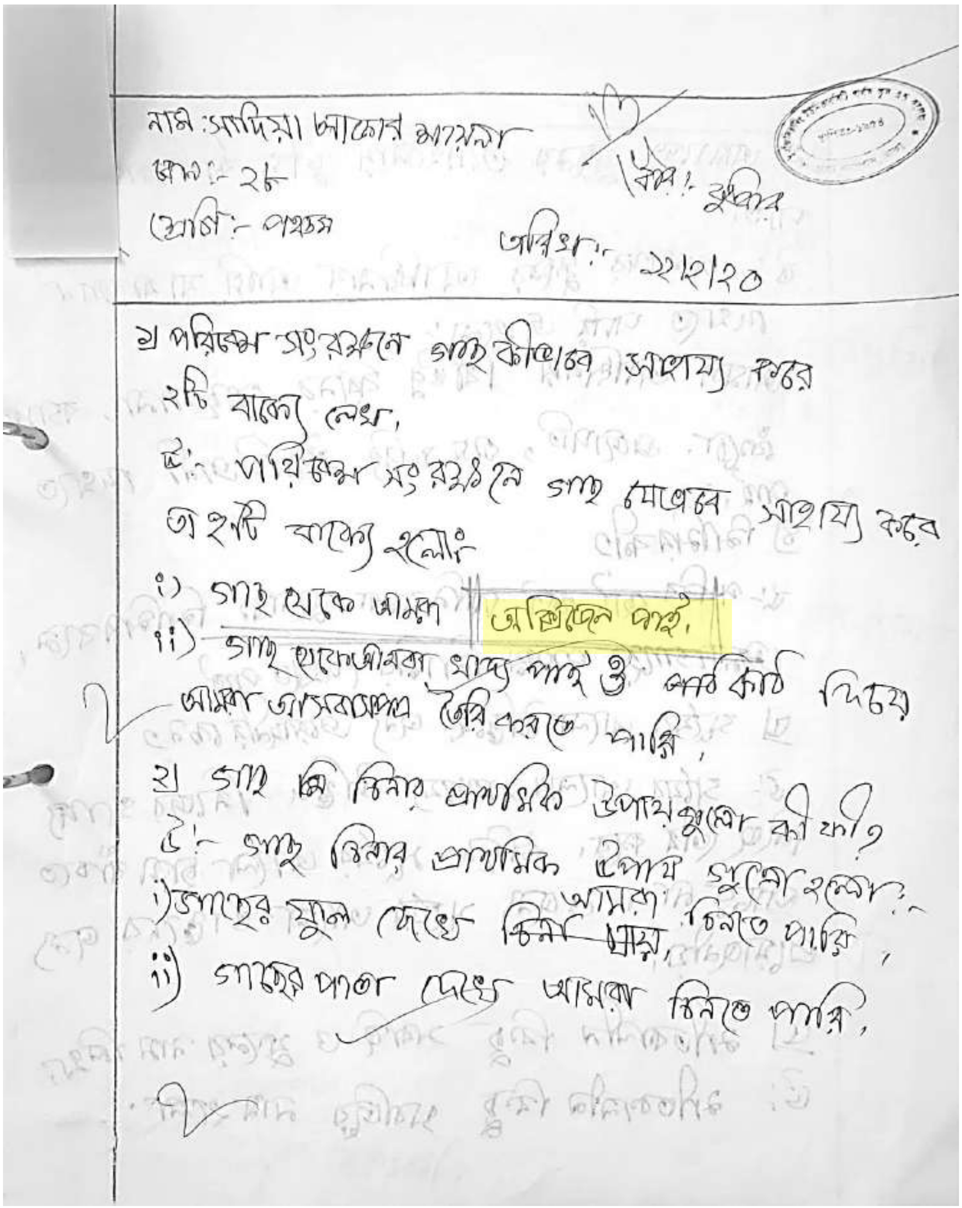
৩) আমাদের স্কুলের আঙিনায় তুমি কী কী প্রাণী দেখতে পাও।

উত্তর: আমাদের স্কুলে আমি বিভিন্ন প্রাণী দেখতে পাই।

i) বিভিন্ন উদ্ভিদ দেখতে পাই, এরা আমাদের সবাই কে শ্বাস নিতে সাহায্য করে।

ii) বিভিন্ন আকৃতির পাখি দেখতে পাই, যেমন: দোয়েল, কোয়েল, ময়না, চড়ুই, কাক এসব জাতীয় প্রাণী আছে।

Appendix 20 Answer script roll 28


নাম: সাদিয়া আক্তার আয়না
রোল:- ২৮
শ্রেণি:- পঞ্চম
বিষয়: কৃষি
তারিখ:- ২১/২/২০

১। পরিবেশ সংরক্ষণে গাছ কীভাবে সাহায্য করে ২টি বাক্যে লেখ।
উঃ পরিবেশ সংরক্ষণে গাছ যেভাবে সাহায্য করে তা ২টি বাক্যে হলো:
i) গাছ থেকে আমরা অক্সিজেন পাই।
ii) গাছ থেকে আমরা খাদ্য পাই ও কাঠ দিয়ে আমরা আসবাবপত্র তৈরি করতে পারি।

২। গাছ চিনার প্রাথমিক উপায়গুলো কী কী?
উঃ- গাছ চিনার প্রাথমিক উপায়গুলো হলো:
i) গাছের ফুল দেখে আমরা চিনতে পারি।
ii) গাছের পাতা দেখে আমরা চিনতে পারি।

Appendix 21 Detail marks attained in the Achievement Test _ Treatment Group

	sl	Rl	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Achvmnt test score
Treatment group	1	1	2	2	1	2	2	2	2	13
	2	5	2	2	2	2	2	2	2	14
	3	6	2	2	2	2	2	2	2	14
	4	8	2	2	2	2	2	2	2	14
	5	9	2	2	2	2	2	1	2	13
	6	10	2	2	1	2	2	2	2	13
	7	11	2	2	2	2	2	2	2	14
	8	12	2	2	2	2	2	2	2	14
	9	14	2	2	2	2	2	2	2	14
	10	15	2	2	2	2	2	2	2	14
	11	17	2	2	1	1	2	2	2	12
	12	23	2	2	2	0	2	2	2	12
	13	24	1	2	1	2	2	1	2	11
	14	28	2	2	2	2	2	1	2	13
	15	29	2	2	1	2	2	2	2	13
	16	32	1	2	2	2	2	2	2	13
	17	33	2	2	2	2	2	2	2	14
	18	34	2	2	2	2	2	2	2	14
	19	35	2	2	1	2	2	2	2	13
	20	36	2	2	2	0	2	2	2	12
	21	45	2	2	2	2	2	2	2	14
	22	46	2	2	2	2	2	2	2	14
	23	47								abs
	24	48								abs
	Q wise total		**42**	**44**	**38**	**39**	**44**	**41**	**44**	
	%		**95.45**	**100**	**86.36**	**88.64**	**100**	**93.18**	**100**	

Appendix 22 Detail marks attained in the Achievement Test _ Control Group

	sl	Rl	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Achvmnt test score
Control group	1	2	1	2	1	2	2	2	2	12
	2	3	1	2	1	2	2	2	2	12
	3	4	1	2	2	2	2	1	2	12
	4	7	2	2	1	2	2	2	2	13
	5	13	1	2	1	2	2	2	2	12
	6	16	2	2	2	2	2	1	2	13
	7	18								abs
	8	19	2	2	0	2	2	1	2	11
	9	20	2	2	2	2	2	1	2	13
	10	21	2	0	0	0	2	1	2	7
	11	22	2	2	1	2	2	2	2	13
	12	25	2	2	1	2	1	2	2	12
	13	26	1	2	2	2	2	2	2	13
	14	27	1	2	2	1	2	2	2	12
	15	30								abs
	16	31	2	2	2	2	2	2	2	14
	17	37								abs
	18	38	1	0	1	0	2	2	2	8
	19	39	2	2	1	2	2	2	2	13
	20	40								abs
	21	41								abs
	22	42	2	2	2	2	2	0	0	10
	23	43								abs
	24	44	2	2	2	2	2	1	2	13
	25	49	1	2	0	0	2	1	2	8
	26	50	2	2	1	2	2	2	2	13
	27	51	2	2	1	0	2	1	2	10
	28	52	2	1	2	2	2	2	2	13
	29	53								abs
	30	54	2							2
	31	55	1	1	2	2	2	2	2	12
	Q wise total		**38**	**39**	**30**	**37**	**45**	**36**	**44**	
	%		**79.17**	**81.25**	**62.5**	**77.08**	**93.75**	**75**	**91.67**	