UNIVERSITY OF CAPE COAST

INFLUENCE OF TEACHING PEDAGOGY ON STUDENTS' ATTITUDE TOWARDS PRIMARY SCIENCE IN LEFT BANK2B DISTRICT, LIBERIA

BURNIS KABAY WILLIAMS

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BY

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Thesis submitted to the Department of Basic Education of the Faculty of Educational Foundations, College of Education Studies, University of Cape Coast, in partial fulfillment of the requirements for award of Master of Philosophy in Basic Education

JANUARY, 2025

DECLARATION

Student's Declaration

I hereby declare that this dissertation is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature ………………………… Date ……………………

Name: ………………………………………

Supervisor's Declaration

I hereby declare that the preparation and presentation of the dissertation were supervised in accordance with the guidelines on supervision of dissertation laid down by the University of Cape Coast

Supervisor Signature ………………………. Date ………………………….

Name: ………………………………………………

ABSTRACT

With declining interest and engagement in science globally, examining the role of pedagogical quality in shaping primary students' attitudes and achievement is imperative. Science education lays the foundation for pursuing advanced study and careers, so negative early experiences deter long-term success. This study explored the influence of teaching practices' influence on science attitudes and performance among primary students in Liberia's Left Bank 2B District. An explanatory sequential approach, through a mixed method design, gathered quantitative survey data from 337 students and 20 teachers, followed by qualitative interviews with 20 head teachers. Surveys used Likert-type scales measuring pedagogy, attitudes, and influencing factors. Semi-structured interviews elicited perspectives on pedagogical effectiveness. The findings revealed that students highlighted innovative, varied teaching as the most positively impacting attitudes, while peer influences were complex. Supportive student-teacher relationships and hands-on activities also emerged as influential. Students reported minimal exposure to technology-enhanced, discussion-based, inquiry-focused science instruction. Interviews revealed prevalent direct transmission models rather than active learning and constructivist practices. Based on these findings, the study concluded that suboptimal, passive pedagogical practices appear to negatively shape primary students' attitudes and learning towards science in the Left Bank2B District. Also, students' attitudes and teacher pedagogy weakly impacted students' academic performance in science. Among the recommendations offered was the need for teachers to have professional development focused on hands-on, technology-integrated, and student-driven pedagogies.

KEY WORDS

Teaching Pedagogy

Attitudes

Student

Teachers

Science

Education

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DEDICATION

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CHAPTER ONE

INTRODUCTION

Science education is an essential subject for students since in educational literature it has been demonstrated that a society's economic progress is closely tied to science (Stuckey et al., 2013). On the contrary, there have always been issues with how people view science (Lazer et al., 2018). Teachers' instructional practices may be to blame for this unpleasant circumstance. Therefore, to comprehend student interest and the impact of teaching pedagogy on students' attitudes toward studying science, this study examines students' attitudes toward learning science. This study aimed to suggest improvements in teaching pedagogy, assess their impact on primary students' attitudes toward science, and evaluate their applicability within the educational system of the Left Bank2B District in Liberia. This chapter presents the background to the study, which contextualizes the entire research. The statement of the problem, purpose of the study, research objectives, questions, and hypotheses are also discussed in this chapter. The delimitations and significance of the research are presented as well.

Background to the Study

Instruction in science plays a significant role in the socioeconomic growth of any nation (Chowdhury, 2018). Due to its capability to describe several natural events and its prominent role in the world's contemporary scientific expansion, science has been and will continue to be significant (Turiman et al., 2012). In today's society, science is an unavoidable component of creativity and invention (Lederman et al., 2014). As a result, there is a rising demand for specialized and practicing scientists and a need for others to be taught in scientific disciplines. Notwithstanding, there have always been issues with how people view science (Lazer et al., 2018).

The ongoing ‘swing away from science’ in many nations is one of the significant reasons for worry (Akinsowon & Osisanwo, 2014). Therefore, the need for more science and technology workers may now be present worldwide (Weible et al., 2020), severely affecting national and international scientific advancements in various development fields. For example, some English and Welsh data on student subject choice published by Donnelly and Gamsu (2018) demonstrates the dramatic drop in the number of students electing to do the sciences. According to national leaders, policymakers, and educators, the number of students pursuing education in science and science-related fields is generally declining (Blank, 2013; Marginson et al., 2013; Xue & Larson, 2015).

Meanwhile, over the past forty years, numerous studies have been done on students' attitudes toward science (Adegbola, 2019; Fazzi & Lasagabaster, 2021; Nicol et al., 2022). For instance, more European students complete their formal education without a scientific degree (Toma & Greca, 2018). Kuo et al. (2018) studied the effects of high and low-achievers' motivation for science learning in Taiwan's eighth grades. Ifeoma and Oge (2014) have examined the impacts of guided inquiry teaching, demonstration, and traditional teaching strategies on students’ attitudes toward chemistry teaching and learning in Nigeria. For Liberia, Hackman et al. (2021) urge teachers to use several teaching techniques to assist pupils in having a better knowledge of the topic. However, many of these strategies cannot help the country’s trained teachers grasp scientific concepts (Hackman et al., 2021). Could the teaching strategies of instructors be the root of these problems? So, a key objective of science education globally should be to foster more favorable attitudes toward learning science (Bonney et al., 2016).

Students' learning styles, inadequate teaching and learning tools in primary schools, and teachers' lack of use of contemporary (blended) teaching approaches are some areas that demand study. As cited by Höttecke et al. (2012), science education has norms all over the globe. According to Anderson (2012), the relationship between students' attitudes about science and their success in studying science has long been of interest to scientists, educators, and researchers (Zeidan & Jayosi, 2015). Two goals of science education are to develop a favorable attitude toward science and increase young people's enthusiasm for pursuing scientific jobs (Tseng et al., 2013).

Henceforth, the value of the science education system hinges on the proficiency and quality of teaching skills the teacher has to offer that will make learning assessable and relevant to arouse the interest of the students (Modebelu & Nwakpadolu, 2013). As mentioned by Priestley et al. (2012), they are the most significant agents in the current effort to revolutionize scientific education and learning. According to Özgelen (2012), the goals of science education include knowledge of the science academic discipline, the acquisition of scientific method skills, having clear explanations for societal issues through an increasing interest in science literacy, and societal goals, as well as personal needs and career awareness. Tolan et al. (2020), reported that unusual or challenging situations in the classroom can easily upset and overwhelm new or inexperienced teachers. This stress can cause them to become confused and accidentally teach incorrect information to their students, which can harm the students' learning and academic performance. In contrast, experienced teachers are better equipped to handle these difficult situations. Over time, they have developed the skills and resilience needed to stay calm and clear, ensuring they teach the correct content even in challenging circumstances. Experimentation, observation, and finding are three of science's most distinguishing features. Through these means, students develop their skills in investigating and asking questions, making hypotheses, and drawing inferences about the results of experiments (Abd Rauf et al., 2013).

Some academic literature on education from the US, Australia, the UK, Canada, and New Zealand claim that teaching and pedagogy are sometimes used synonymously (Morrison et al., 2019). In this context, the term 'pedagogy' is used to refer to instructional methods, teaching practices, etc. (Özdem Yilmaz et al., 2017). Subsequently, pedagogy is involving all teaching strategies geared at assisting the teacher in making classroom instruction successful. Pedagogies are helpful instruments for facilitating subject matter transformation and interpretation while instructing. Additionally, pedagogy is about the broad sets of methods and strategies that the instructor requires to carry out the teaching task. As elucidated by Blake (2015), pedagogy necessitates knowledge of the developmental, social, and cognitive theories of learning and how these relate to students in the classroom. Pedagogy includes understanding lesson planning, teaching strategies, assessment techniques, classroom management, and instructors' adaptable knowledge in the classroom (Wolff et al., 2021). Gibbs and Jenkins (1992), as cited in Luntungan (2012), asserted that although society and the surroundings of the classroom have changed, the teaching strategies have not. Education technology integration is one of several recent studies seeking to address the problems that currently affect teaching strategies and student learning (Joo et al., 2018), teachers' roles (Farrington et al., 2012), the class environment (Davies et al., 2013), understanding the adult learner (Sogunro, 2015), length of the class session (Sklad et al., 2012), school class sizes (Duflo et al., 2015), students' attitudes (Abidin et al., 2012), and the modern world's increased interconnectivity (Wang et al., 2014). These factors have an impact on elementary education all across the world, particularly in underdeveloped nations like Liberia, the location of this study. This is particularly relevant when thinking about how students should be taught.

Science teachers use pedagogical skills to create effective, cogent, and successive teaching not just for understanding the scientific material but also for improving attitudes toward science. As a result, teaching skills pique students' interest in a subject, involve them in learning, help them develop skills, keep students on task, and are helpful in classroom engagement (Bundick et al.2014). The goal of implementing pedagogical strategies in scientific classrooms is to promote learning, inspire students to learn, and maintain student engagement throughout instruction and learning (Tanner, 2013). To accomplish this goal, pedagogical strategies such as set induction, stimulus variety, nonverbal communication, questioning, and feedback are employed in science classrooms. As Ayua (2017) stated, a set induction is a pre-planned action introduction used to pique the learner's interest and create a curious mood in the classroom. In other words, set induction works as an attention inducer, guides students through the learning process, and gets them ready for learning to take off on a psychological and mental level. It also refers to the process of using a thought-provoking statement, an interesting fact, or an audio-visual stimulus at the beginning of a lecture to gain the student's attention and give an overview of the lecture topic. Its main purpose is to gain attention, arouse motivation, assess understanding of prior learning, and provide an overview of content (Bradbury, 2016).

Stimulus variation is a concept that refers to the combination of various elements such as movement, speech, and writing styles. It may be applied in the classroom to improve how students comprehend the subject matter (Fathima & Saravanakumar, 2012). Students can judge the effectiveness of instructors by how they vary the stimuli used in their lessons (Dunlosky et al., 2013). This method will help keep them focused and make the learning more interesting and effective. Bakhsh (2016) observed that a short attention span can lead to students losing interest after a certain period. The use of one technique can quickly make the students lose interest and lead to them falling asleep or daydreaming. This is why it is important that the teacher uses various stimulus types to maintain and generate interest in the students. By Doing so, can help improve the students' mindset when it comes to learning about science.

Non-verbal communication, according to Benson et al. (2020), is a type of communication that involves the use of various thoughts and feelings. It can also be used to expose the students' confidence and frustration. The behaviors displayed by a teacher generate a psychological connection between students and teachers. This familiarity can help the teacher identify the students' delusions about scientific topics. It can also help the teacher understand the students' difficulties in comprehending the lessons. Meanwhile, through the students' opinions about the instructor's skills, the teacher can regulate the finest means to teach them. This demand can help make students feel more positive about science and prevent them from being negative about it. The importance of students' perception is acknowledged in the planning and teaching of educational programs. This is why science teachers must have the necessary knowledge about how students see the world. Through their knowledge of the students' thoughts about the various teaching techniques, science teachers can improve their skills in guiding them (Etuk et al., 2013).

The various methods utilized to acquire and educate on science topics have greatly benefited these processes (Smetana & Bell, 2012). Most teaching methods used in science education are either contemporary or conventional. Examples of these include the use of storytelling, lectures, group discussions, and role plays. Blended learning, computer simulations, and animations are examples of how science education can be taught using various approaches. These include the use of graphics, videos, and characters. However, Barry et al. (2016) claimed that there is a lack of use of blended learning methods in primary science. Most studies (Abidin, et al., 2012; Kintu et al., 2017; Mojavezi & Tamiz, 2012) found out that intrinsic motivation in boosting student achievement, suggesting that policies and practices promoting this motivation can improve educational outcomes.

Attitude, according to Mokoro et al. (2014), is a hypothetical construct that indicates an individual like or dislike for an item. Attitude means the way an individual thinks or acts towards a given subject or issue (Ezeudu et al., 2016). These definitions suggest that attitude may be defined as a person's response to a behavior that is examined. It's a mental pattern that describes how individuals interpret the environment and how this motivates their actions and behaviors. In school science, attitude is crucial since a person who wants to excel in science needs to have a good attitude toward the subject. Thus, one's attitude toward science is a sentiment, conviction, and system of values concerning science (Yllana-Prieto et al., 2021). The feelings, beliefs, and values one has about an object will either support or contradict it.

In favor of the aforementioned assertion, Benson et al. (2020) post that students who have a favorable attitude toward science are more likely to study it, whereas those who have a negative attitude are less likely to do so. Therefore, it is possible that teachers may be failing to meet students' objectives or goals, careers, incentives, and chances for them to embrace science, which is why students have a negative attitude toward science. Peirce et al. (2017) stated Man is an autonomous species by nature, capable of making choices depending on his or her views. As individuals gain experience and are exposed to new situations, these ideas continue to mold their perspective on the world. One of the main objectives of science teachers could therefore be to ensure that students have a good attitude toward science. This is an inevitable aim or phase in the science education process.

As specified by McCombs (2013), because attitudes are learned, they can be stable and shaped by experience, but they can also be unlearned and altered. This clarifies the adage that attitude is an acquired quality rather than a natural trait. Once more, this suggests that students' attitudes toward science, whether favorable or unfavorable, are greatly influenced by the experiences that teachers of science expose or offer during instruction. They will adopt a good attitude if they see their experiences as positive and a negative attitude if they perceive their experiences as bad. Moreover, one might discern a shift in individuals' mindset based on their reactions. Students have varying perspectives depending on how they interpret the circumstances that cause their reactions—positive or negative. On this note, this stimulus can be anything that anyone can distinguish or consider (Corr et al., 2013). This emphasizes how students' experiences during scientific instruction might influence their attitude toward science, either positively or negatively. Furthermore, a person's attitude toward science has a significant role in determining his or her motivation to study it. Therefore, one of the main reasons why students stop studying science courses is a negative attitude. A positive attitude toward science can increase the desire of individuals to study it. This can also result in more students enrolling in science courses.

There have been numerous studies that looked into the factors that influenced students' attitudes towards science. Jebson and Hena (2015) conducted a study in Nigeria's Adamawa State to investigate students' attitudes toward science subjects. They were interested in whether the students' age affected their attitude toward such subjects. The findings demonstrated that age had little impact on the favorable attitudes that senior secondary school students in Adamawa State had toward science classes. In another study, Mokoro, Wambiya, and Aloka (2014) examined how several social factors affected the attitudes of students in Nyamaiya division, Nyamira, Kenya, toward chemistry. The results showed a statistically significant relationship between the teachers' characteristics and perspectives of the students regarding chemistry. Benson et al. (2020) conducted studies to find out how students' attitudes about learning physics at senior secondary schools in Ekiti State, Nigeria, were affected by outdoor activities. The study's findings demonstrated that, compared to the control group, the experimental group had a more favorable attitude towards learning physics.

Adekunle and Femi-Adeoye (2016) examined the relationships between students' attitudes and interests and their academic performance in biology throughout their senior years of high school. The findings showed a significant relationship between students' performance in biology and their views toward the subject. Hussaini et al. (2015) conducted a study in the Nigerian city of Birnin Kebbi on secondary school students’ attitudes toward biology. Finding out how secondary school students felt about biology was the focus of study. According to the results, most students in Kebbi had a favorable attitude toward biology, and they credited their positive attitude to engaging in practical work and having access to sufficient instructional resources.

In Liberia, students’ attitudes about primary science are determined by the instructional skills of the teachers (Hackman et al., 2021). Students’ interest in pursuing science as a lifelong career significantly depends on the teaching method of the teacher (Duran et al., 2014). One of science education's most essential objectives is teaching pupils how to participate in the investigation. The teacher’s pedagogical and subject-matter expertise are crucial to achieving the purpose (Lee et al., 2018). In other words, educators should exhibit the abilities that will aid students in fusing their knowledge and interest to better comprehend scientific ideas. Teachers must concentrate on teaching science concepts, theories, and facts to inspire pupils to engage in scientific inquiry. As a result, the teacher's pedagogical expertise will allow them to create many ways that students might change, understand, and interpret the subject matter (Lucero et al., 2017). In school, students' attitude is critical to concept assimilation since everyone wanting to advance in any subject must have a positive attitude and passion toward it. On this premise, the diminishing interest of pupil at the primary level towards the learning of science subject can be assessed, with the pedagogy used by their teacher. Against this background, this research was conducted to explore the influence of teaching pedagogy on primary students' attitudes towards science in Left Bank 2B District, Liberia.

Statement of the Problem

The concern regarding students' attitudes towards science is paramount for teachers, as students' enthusiasm for any subject is closely tied to their attitudes (Potvin & Hasni, 2014). Nurturing a positive attitude towards learning science falls not only on teachers but also aligns with the overarching goal of science education (Aschbacher & Roth, 2010). It is worth noting that the effectiveness of science teachers does not solely hinge on the volume of content taught; instead, the pedagogical approach employed by teachers significantly impacts how students see science courses (Chai et al., 2013).

Numerous inquiries have delved into the multifaceted factors that influence students' attitudes towards science, recognizing their substantial impact on teaching and learning science and students' academic performance (Osborne et al., 2003; Wang& Degol, 2013; Potvin & Hasni, 2014; Zeidan & Jayosi, 2015). These factors encompass age, social conditions, pedagogical teaching, and the caliber of teachers' guidance (Jebson & Hena, 2015; Mokoro et al., 2014; Potvin & Hasni, 2014). For example, Jebson and Hena (2015) study revealed the influence of gender and age on secondary-level students' attitudes towards science subjects in Adamawa State. Similarly, the research of Tseng et al. (2013) demonstrated that project-based learning activities in Taiwan significantly transformed the attitudes of freshmen students towards engineering. Besides, another study by Connell et al. (2016) suggested that incorporating student-centered pedagogies and course content could enhance student learning and foster positive attitudes towards biology in science education.

Despite these explorations, not much research has delved into the impact of teaching methodologies on students' attitudes towards science in primary schools in Liberia, highlighting an existing knowledge gap. This study aims to bridge this gap by investigating how teaching pedagogy influences students' attitudes towards science in primary schools in Liberia. Notably, from the above mentioned, the majority of researches on teaching pedagogy has traditionally centered on senior high schools' education in Liberia. For example, the study by Hackman et al. (2021) involved 194 in-service teachers and 10 interviews with secondary school science teachers in Liberia, highlighting the importance of professional support and training in shaping attitudes towards STEM education and influencing educational policy. The method they used was a combination of questionnaire surveys and interviews. Also, another study carried out by Nicol et al. (2022) in Liberia showed that inquiry-based chemistry experimentation, including guided inquiry and demonstration methods, positively impacted students' attitudes toward chemistry. Their study used a cluster random sampling technique to select a sample of 328 grade-eleven students. Similarly, Nicolet et al. (2022) conducted a study on how students perceived science inquiry process skills about school type and gender. Their research used cluster random sampling to sample 360 grade 11 students from six high schools in Liberia. They compared the science inquiry process skills of Grade 11 students in government and private schools in Liberia. The study revealed that government school students have superior science inquiry process skills, while private school students struggled with experimental design, data representation, communication, and presentation.

Furthermore, the significance of students' attitudes towards learning science is underscored by their direct impact on academic performance (Narmadha & Chamundeswari, 2013). Liberia has faced challenges, as evidenced by poor student performance in the West African Senior Secondary Certificate Examination (WASSCE), particularly in chemistry (WAEC, 2017). This issue gained prominence when the Liberian Ministry of Education declared that all 25,000 candidates who sat for the University of Liberia's entrance examination in August 2013 failed (Chan et al., 2015; Gberie & Mosley, 2016). The decline in students' performance might have originated from their primary learning level. However, the root causes of this decline remain unexplored, with a conspicuous absence of research on primary school students' attitudes towards science teaching and learning and their potential impact on academic success. Despite its crucial role, there is a noticeable gap in empirical research examining the influence of teaching pedagogy on students' attitudes toward science in Liberia, especially the Left Bank2B District. This study was intended to address this knowledge gap.

In geographical terms, research endeavors involving Liberia have been insufficiently represented. Thus, this study is uniquely positioned to examine factors influencing teaching pedagogy on students' attitudes toward primary science in Liberia, particularly in the Left Bank2B District.

Purpose of the Study

This study examined the influence of teaching pedagogy on students' attitudes toward primary science in Left Bank2B District, Liberia. In addition, the study examined the effects of teacher pedagogy and students' attitudes on students' academic performance in primary science in the Left Bank2B District, Liberia.

Specifically, the study was intended to:

1. examine the factors that influenced students' attitudes toward primary science in basic schools in the Left Bank2B District, Liberia.
2. find out students' perceptions of the pedagogy used by teachers in teaching science in the basic schools in the Left Bank2B District, Liberia.
3. assess the relationship between teaching pedagogy and students' attitudes towards science in the basic schools in Left Bank2B District, Liberia.
4. examine the effects of teaching pedagogy and students' attitudes on students' academic performance in basic schools in Left Bank2B District, Liberia.

Research Questions

In order to address the problem at hand, the following research questions were formulated to guide this research:

1. What are the factors that influence students' attitudes towards primary science at the basic schools in the Left bank2B District, Liberia?
2. How do students perceive the pedagogy used by their teachers in teaching primary science at the basic schools in the Left bank2B District, Liberia?

Research Hypotheses

The following hypotheses were formulated to guide the study:

H_{o1}: There is no statistically significant relationship between the teachers' pedagogy used by teachers in teaching primary science in basic schools and students' attitudes toward primary science in the basic schools in the Left Bank2B District, Liberia.

H_{A1}: There is a statistically significant relationship between teachers' pedagogy used by teachers in teaching primary science in the basic schools and students' attitudes toward primary science in the basic schools in Left Bank2B District, Liberia.

H_{O2}: There is no statistically significant influence of pedagogy used by teachers and students' attitudes on students' academic performance at the basic schools in the Left Bank2 district, Liberia.

H_{A2}: There is a statistically significant influence of pedagogy used by teachers and student's attitudes on student's academic performance at the basic schools in the Left Bank2B District, Liberia

Significance of the Study

This study examined the influence of teaching pedagogy on students' attitudes toward primary science. Hence, the findings from the study will benefit critical stakeholders such as students, teachers, teacher educators, and the Ministry of Education. It will also add to the expanding corpus of research, benefit future scholars who might wish to study a related subject, and help provide appropriate and applicable information to the learning environment.

Besides, the findings of the study will benefit the students by helping them acquire essential knowledge and skills in various subjects and develop their critical thinking skills, creativity, and problem-solving abilities. Moreover, the findings will help to improve the students' educational experiences, leading them to become more independent and improve their academic performance. As such, it will increase their interest and help them build a positive attitude toward learning, especially science.

The research is also significant to science teachers because the findings will help them to develop their teaching skills and enhance classroom teaching and learning to be more effective and enjoyable. To improve instruction quality and make it more engaging, helping them develop effective strategies and methods. Hence, to help them identify areas where students are lacking and develop effective interventions to address them. More than that, it helps teachers become more independent and confident.

Findings from this research study will help the Ministry of Education to develop policies that will facilitate the full implementation of teaching strategies that would eventually enhance quality education in basic schools. The study findings will also help identify areas lacking in the curriculum and develop strategies to address them. Finally, the strategies presented in the report will benefit other researchers by allowing them to develop their ideas and improve their knowledge.

Delimitation of the Study

This research was restricted based on two criteria: population and subject matter. First, the research was delimited to public school students in the Left Bank 2B District, Liberia. The Left Bank2B District was selected due to limited recent research on science education practices and outcomes in that region. As Liberia continues rebuilding its educational system after a prolonged civil conflict, understanding issues within particular districts provides localized insight to guide context-specific improvements and resource allocation. Present students and teachers in the district were included, while non-teaching staff and the influence of peer pressure, including parents' involvement, were excluded.

Second, the study was delimited to exploring pedagogy, attitudes, and performance specifically within primary science education in the Left Bank2B District. This narrow focus was intentional for several reasons. First, science was chosen due to its importance as a foundational subject for enhancing one's ability to think critically, explore, and solve problems from an early age (Carrier, 2009). Primary school represents a pivotal window for igniting children's innate curiosity and motivating sustained engagement with science fields. Additionally, research indicates early science attitudes shape choices regarding advanced science coursework and careers (Christidou, 2011). Therefore, intervening at the primary level is crucial. The delimited focus enables deeper exploration of this critical early exposure.

Limitation

This study has certain limitations that should be noted:

First, a key constraint was the dependence on self-reporting via surveys and interviews, which gives rise to the potential for response bias. Respondents can give socially acceptable responses, which might overestimate the effectiveness of educational strategies or favorable attitudes. Furthermore, the temporal span of the study—which was limited to November 2023—might not have adequately captured possible variations in attitudes and academic performance throughout the course of the academic year.

Second, the results' limited generalizability might be attributed to their concentration on Liberia's Left Bank2B area. It's possible that the district's particular contextual factors—such as its socioeconomic and cultural components—are not reflective of other educational environments.

Third, even though every effort was taken to guarantee a 100% response rate, the study's external validity may be compromised by the comparatively small sample size of 20 teachers and 20 head teachers. When evaluating the findings and carefully inferring them to larger educational contexts, it is important to consider these constraints.

Fourth, the time of data collection was not favorable for the researcher, since most schools were almost on vacation. As a result, the researcher was unable to conduct a focus group discussion with the students that would have provided sufficient information with regards to the relationship between their attitudes and science teachers’ pedagogy, including their perception about the pedagogical skills of their teachers.

Definition of Terms

The study defines the following concepts to help the reader grasp their meaning and context.

These are:

Pedagogy: The process and manner of instruction, especially concerning the Left Bank2B District's primary science education.

Academic achievement: Is the quantifiable result of a student's scientific class performance.

District Educational Officer (DEO): A local administrative role managing educational initiatives within a particular area.

Attitudes: Are psychological constructs that indicate an individual's perceptions, feelings, and predispositions towards specific objects, people, ideas, or situations, encompassing thoughts, emotions, and behaviors.

Organization of the Study

There are five chapters in this study. The study was introduced in Chapter One, which also covers the study's background, problem statement, goal, objectives, and research questions. It also discusses the study's significance, delimitations, limits, and organizational structure. The pertinent literatures on the topic under consideration, as well as the empirical research conducted in the field, were reviewed in Chapter 2. The research design, demographic, sample, sampling technique, instrument, validity and reliability of the instrument, data collecting process, data analysis, and ethical considerations were all covered in Chapter Three. The results and findings were examined in the fourth chapter, and the summary, conclusions, and suggestions were also examined in the fifth and final chapter.

Summary of Chapter One

Chapter One provided important background and context for examining how pedagogical quality impacted primary science attitudes and performance in the Left Bank2B District of Liberia, the study was guided by specific research questions and hypotheses. The delimitations and significance of the research are presented as well. Finally, the researcher provided the organization of the entire research. The next chapter discusses the literature review.

CHAPTER TWO

LITERATURE REVIEW

The preceding chapter raised issues of students' attitudes toward primary science in different parts of the world. Thus, this chapter offers an in-depth understanding of the variables (teaching pedagogy and student attitudes). It examines the body of research on studies done by other researchers that were thought to be important to the study. The literature review makes it possible to compare the results of this study with those of other comparable studies, which may be used to both contextualize the present study and validate or refute previous findings and conclusions. The chapter is divided into a theoretical framework, a conceptual framework, and an empirical review. The literature review makes it possible to compare the results of this study with those of other comparable studies, which may be used to both contextualize the present study and validate or disprove previous findings and conclusions.

Theoretical Framework

The Constructivist Theory of Teaching Pedagogies

As reported by Bada and Olusegun (2015), the constructivist theory states that students are not passive recipients of learning but are actively involved in the process. Blake (2015) stated that this theory is based on the work of Piaget, who believed that people can construct knowledge by interacting with their surroundings. According to Keengwe et al. (2014), constructivist pedagogy encourages students to actively engage in the learning process by providing them with opportunities to do so through various forms of learning. These include problem-based, project-based, and inquiry-based methods. These allow them to develop their own critical and creative thinking skills. Chung et al, (2019) asserted that constructivism theory emphasizes the significance of the student's active participation in the educational process, allowing them to construct their knowledge through meaningful experiences.

Bada and Olusegun (2015) asserted that the constructivist theory of teaching pedagogy is founded on several main principles. First, it emphasizes learning is a dynamic process that includes the learners' engagement with their environment (Kay & Kibble, 2016). Second, it proposes that learners construct their understanding of the world by connecting latest information to their current understanding. Third, it suggests that learning is more effective when it is relevant to the learner's experiences and interests. Finally, it asserts that learners benefit from opportunities to collaborate and share their perspectives with others (Bada & Olusegun, 2015). One of the main components of constructivist pedagogy involves social interaction. In a constructivist classroom, teachers encourage students to collaborate and solve problems.

In contrast to traditional classrooms, assessments in constructivist settings emphasize as the process of helping students build their critical thinking abilities of learning. They are also used to evaluate the learners' ability to solve problems and analyze information. The concept of constructivism is that teaching involves the use of social interaction and authentic assessment. It aims to provide a framework for the development of learners by encouraging them to develop their own knowledge of the world around them. The philosophy of constructivism focuses on the idea that learning happens when students apply new knowledge to their existing understanding. It also states that learning can be influenced by the context in which it is taught and the attitudes and beliefs of students. According to Bada and Olusegun (2015), people construct meaning and knowledge from their experiences. The concept of constructivism refers to many approaches of teaching that may be applied in the classroom (Moore, 2014). In most cases, it means that students should use active techniques such as problem-solving and experiments to develop more knowledge. The teacher should also ensure that they are getting the necessary help to understand their own conceptions.

Although it is crucial for educators to grasp constructivism, it is also important to consider how this philosophy can affect professional development. According to constructivism, human learning is built on the foundation of previous knowledge (Bada & Olusegun, 2015). Constructivist teaching pedagogies can be applied in various educational settings, including traditional classroom environments, online learning, and experiential learning. In a classroom setting, teachers can use techniques such as problem-based learning, inquiry-based learning, and project-based learning to facilitate student engagement and knowledge construction (Kokotsaki et al., 2016). In online learning, instructors can create interactive and collaborative learning experiences that allow learners to construct knowledge through discussion and reflection (Akcayir & Akcayir, 2018). In experiential learning, learners engage in hands-on experiences that promote active learning and knowledge construction (Konak et al., 2014).

The Constructivist Theory of Teaching Pedagogies offers a compelling approach to education that emphasizes the learner's active involvement in the learning process. This approach has been supported by research and has been widely implemented in various educational settings (Ouyang & Stanley, 2014). As educators continue to explore new ways of promoting student engagement and knowledge construction, the Constructivist Theory of Teaching Pedagogies will undoubtedly continue to play a significant role in shaping educational practices. Like any educational theory, the Constructivist Theory of Teaching Pedagogies is not without its critics. Critics argue that constructivism places too much emphasis on student-centered learning and not enough on acquiring foundational knowledge. They argue that learners need to have a solid knowledge foundation before engaging in meaningful knowledge construction (Kirschner et al., 2018). They further argued that constructivism places too much responsibility on the learner to construct their knowledge, which can lead to confusion and misunderstanding.

Kirschner et al. (2018) propounded that learners need guidance and direction from teachers to ensure that they are constructing accurate and meaningful knowledge. Gilakjani et al. (2013) also argued that constructivism can be difficult to put into practice, particularly in large classroom settings; it can be difficult to provide individualized instruction and support to learners in a constructivist classroom. Despite these criticisms, constructivism continues to be a widely accepted and influential educational theory due to its compatibility with effective instructional strategies (Adler, 2013). It supports the student-centered learning approach, which can enhance students' motivation to learn science, as demonstrated by the study. Building on this concept, educators are continually seeking innovative ways to apply constructivist principles in the classroom. Constructivism is a learning theory that suggests learners actively build their own understanding and knowledge through experiences and reflection, rather than passively absorbing information. They use prior knowledge to interpret and make sense of new information.

Cognitive Apprenticeship Theory

Cognitive Apprenticeship is an educational approach that emphasizes the importance of learning through apprenticeship-style activities. In this approach, learners work alongside experts in a particular field, and through observation, reflection, and guided practice, they gradually develop the skills and knowledge necessary to become experts. Collins et al. (1989), describe Cognitive Apprenticeship as a method for learning in complex domains by breaking down tasks into smaller parts and teaching them explicitly while providing guidance and scaffolding. They suggest that the approach can be used in various settings, including traditional classroom environments, online learning environments, and workplaces.

Cheng (2014) proposed a conceptual framework for Cognitive Apprenticeship that emphasizes the importance of situated learning and social interaction. They suggest that learners should be immersed in authentic contexts and given opportunities to engage in collaborative problem-solving with peers and experts. They also emphasize the significance of reflection and metacognition in the learning process. Bereiter and Scardamalia (2014) argue that a Cognitive Apprenticeship is a practical approach to teaching and learning because it emphasizes the importance of developing higher-order thinking skills. They suggest that learners should be given opportunities to engage in complex problem-solving activities that require them to use critical thinking, creativity, and collaboration. Figure 1 illustrates the theory.

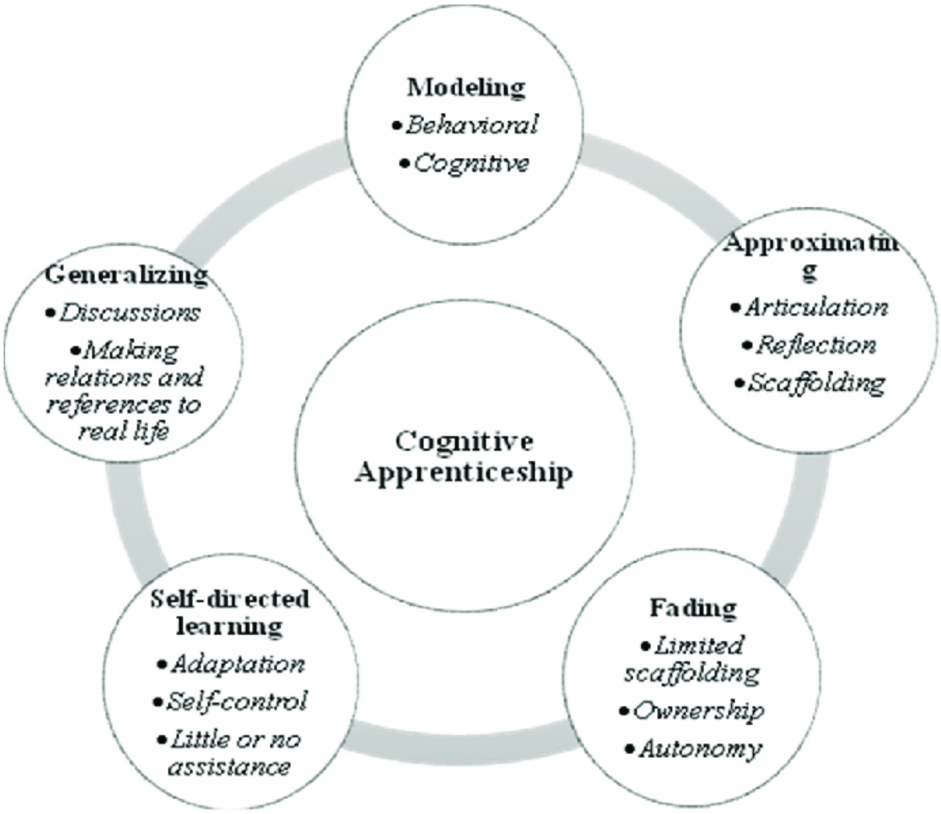

Figure 1: Cognitive Apprenticeship Framework (Source: Bautista et al., 2016)

Peters-Burton et al. (2015) suggest that Cognitive Apprenticeship can teach various skills and knowledge, including scientific inquiry, mathematical problem-solving, and programming. They argue that the approach can be adapted to multiple learning environments, including online and blended learning environments. Finally, García-Cabrero et al. (2018) emphasize using Cognitive Apprenticeship in teacher education programs. They argue that the approach can help prepare teachers to be effective in complex and diverse classrooms by allowing them to practice teaching skills in authentic contexts and receive feedback from expert mentors.

One criticism of Cognitive Apprenticeship is that it may only be effective for some learners. Some learners may struggle with the approach's social interaction and collaborative problem-solving aspects, or may not learn as well in authentic, situated contexts. Additionally, the approach may be less effective for learners who are not motivated or engaged in the learning process (Collins, et al, 2018). Another criticism is that Cognitive Apprenticeship may only be practical or feasible in some educational settings. For example, it may be difficult to implement the approach in large, lecture-based classes or online learning environments. Additionally, some educators may need more training or resources to effectively implement cognitive apprenticeship (Halverson, 2004). Finally, some critics like Downey et al. (2015) argue that cognitive apprenticeship may need to address issues of power and inequality adequately in the learning process. They argue that the approach may reinforce existing hierarchies and marginalize learners who do not fit into dominant cultural or social norms (Flores & Beardsmore, 2015).

Despite criticisms, Cognitive Apprenticeship is widely valued by educators and researchers for its effectiveness in helping students' master complex concepts and skills by making expert thinking processes visible. It has been shown to improve learning outcomes across various fields, particularly in real-world problem-solving. Its adaptability across different educational settings further enhances its versatility in meeting diverse learning needs. However, to maximize its potential, further research is needed to assess its effectiveness for different learners and to address issues of equity and social justice, ensuring it serves all students equitably.

Situated Cognition Theory

Situated Cognition theory asserts that knowledge is situated in the context in which it is learned and used (Bell et al., 2013; Cheng & Tsai, 2013). Therefore, learning is not just about acquiring information but also about participating in authentic activities within a community of practice. The learning process is seen as a form of legitimate peripheral participation, where learners start by observing and assisting more experienced community members, gradually taking on more complex tasks and roles over time. This process of participation and observation enables learners to acquire not only specific knowledge and skills but also the general ways of thinking and problem-solving that valued within the community.

The Situated Cognition approach is practical in various contexts, including STEM education Kelley and Knowles, (2016) and online social networks (Höttecke& Allchin, 2020). Situated Cognition has been used to support learning in vocational and technical education, where students learn practical skills in authentic work contexts (Kelley & Knowles, 2016). Research has also shown that Situated Cognition can improve student engagement, motivation, and the depth of understanding of scientific concepts (Sinatra et al., 2015). This is because Situated Cognition emphasizes the value of learning through participation in meaningful activities in a community of practice.

Despite its benefits, some critics have raised concerns about the transferability of knowledge acquired through this approach. They argue that learners may have difficulty applying knowledge gained in one context to other contexts. In addition, there is concern about the potential for Situated Cognition to reinforce existing power structures and cultural norms within communities of practice (Lemke, 2021). The Situated Cognition approach emphasizes learning in real-world contexts, allowing learners to apply their skills directly to real-life challenges. This approach fosters deeper understanding and retention of knowledge by connecting learning to social and cultural contexts. It also helps students develop social and collaborative abilities, making the learning process more relevant and engaging. Overall, the Situated Cognition approach is advantageous for preparing learners for real-world applications.

Social Constructivism Theory

Social constructivism strongly emphasized the value of social interactions and the creation of knowledge via communication and teamwork. According to the social constructivist theory, 'knowledge is created via active interaction with the learner and the environment rather than being passively transferred from instructor to student (Bada & Olusegun, 2015). According to this theory, learning occurs through the negotiation of meaning within a social context, as learners work together to construct new knowledge based on their individual experiences and perspectives. Social Constructivism highlights the significance of social interaction and collaboration in the construction of knowledge and suggests that learning is best facilitated in authentic contexts that reflect the practices of the domain being learned (Bonk & Cunningham, 2012). Figure 2, illustrates this theoretical framework.

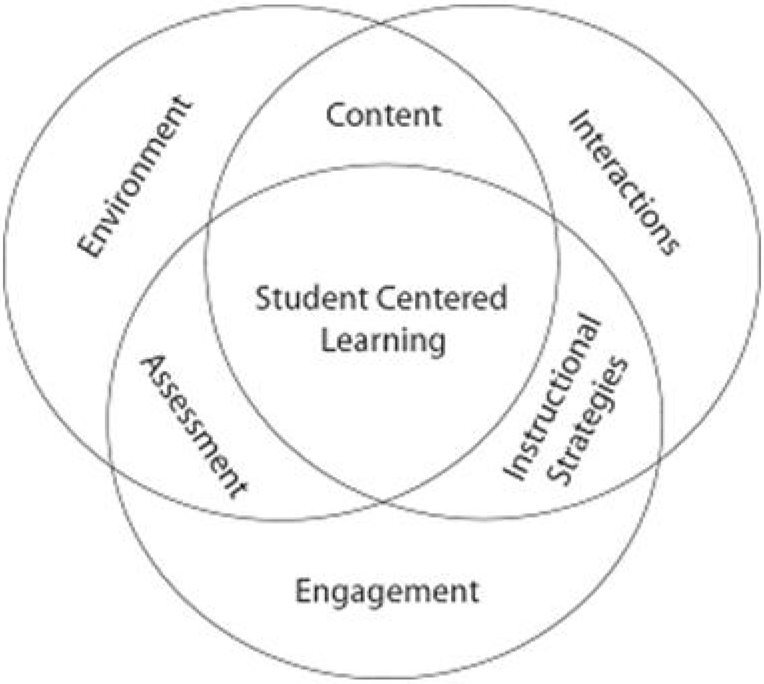

Figure 2: Social Constructivist Theory (Source: Amineh & Asl, 2015)

From Figure 2, the way that students interact with each other, the teacher, and the material is essential to student-centered learning. Also, the way that teachers teach and the materials that they use should be designed to engage students and help them to learn in a meaningful way. Students ought to participate actively in the learning process. Social Constructivism posits that learning is a collaborative process that occurs through social interactions and the negotiation of meaning within a given community of practice (Bonk & Cunningham, 2012). Studies have revealed that Social Constructivism can lead to improved student outcomes, such as higher levels of academic achievement and greater engagement in learning (Yang & Chang, 2013). Additionally, this approach effectively promotes cross-cultural understanding and reduces prejudice among learners from different cultural backgrounds (Gergen et al., 2015).

Critics of Social Constructivism have argued that it places too much emphasis on social interactions and not enough on individual learning (Bredo, 1994). There is also concern that this approach may lead to a need for more explicit objectives and assessment criteria, making it difficult to measure student progress (Kirschner et al., 2006). Social Constructivism, a social learning framework, has faced criticism for prioritizing social interactions over individual learning and for its practical implications in setting clear objectives and assessment criteria. Despite these concerns, it remains a significant perspective in education, advocating for real-world learning environments and collaborative learning.

Conceptual Review

Teacher Pedagogies and student motivation

Teacher pedagogies play a critical role in student motivation. Educators employ various instructional methods in order to encourage and maintain student involvement, and achievement in academic settings. This literature review examines the relationship between teacher pedagogy and student motivation. According to Valerio (2012), teacher pedagogies can influence student motivation by creating a supportive learning environment. The author notes that teachers who establish positive relationships with their students, provide clear expectations, and offer frequent feedback, can increase student motivation. Additionally, educators who use teaching strategies such as cooperative learning, problem-based learning, and active learning can enhance student engagement and foster intrinsic motivation.

Ryan and Deci (2020) argue that teacher pedagogies can either support or hinder student motivation based on their alignment with the basic psychological needs of autonomy, competence, and relatedness. The authors suggest that teacher autonomy-supportive practices, such as providing choices and acknowledging student perspectives, can promote intrinsic motivation, whereas controlling practices, such as rewards and punishments, can undermine student motivation. Moreover, Dole et al. (2016) contend that teacher pedagogies can affect student motivation by tapping into their interests and curiosities. The authors propose that teachers who use techniques such as activating prior knowledge, providing novelty and challenge, and encouraging personal relevance can increase student engagement and motivation.

Teacher-student Interactions and student learning

Teacher-student interactions are essential components of the learning process. These interactions can have a significant impact on students' learning outcomes. This literature review examines the relationship between teacher-student interactions and student learning. According to Pianta et al. (2012), positive teacher-student interactions can enhance student motivation, engagement, and achievement. The authors suggest that teachers who establish supportive relationships, provide timely feedback, and create opportunities for student autonomy, can increase learning outcomes. Additionally, teachers who use strategies such as questioning, active listening, and scaffolding can promote deeper learning and critical thinking.

Similarly, Jaggars and Xu (2016) argue that effective teacher-student interactions involve specific, timely, and actionable feedback. The authors contend that teachers who provide feedback on student performance can improve learning outcomes by helping students understand their strengths and areas for improvement. Moreover, feedback focused on the task rather than the student's abilities can promote a growth in mindset and increase student motivation. Furthermore, Sun and Wu (2016) propose that teacher-student interactions can facilitate peer learning and collaboration. The authors suggest that teachers who encourage students to work together, promote positive interdependence, and provide opportunities for group decision-making can increase learning outcomes. Additionally, collaborative learning can promote social skills, improve communication, and increase cognitive development.

Teacher-student interactions play a crucial role in student learning outcomes. The literature suggests that positive interactions that establish supportive relationships, provide timely and specific feedback, promote autonomy, and facilitate collaboration can enhance student motivation, engagement, and achievement.

Teacher professional development and student learning outcomes

Teacher professional development (PD) is critical to improving student learning outcomes. Professional development programs can enhance teacher knowledge and skills, leading to improved instructional practices and student outcomes. This literature review examines the relationship between teacher professional development and student learning outcomes. According to DeMonte (2013), effective teacher PD programs should focus on developing teachers' knowledge and skills, providing ongoing support, and aligning with school goals and standards. The authors suggest that PD programs that are job-embedded, collaborative, and sustained over time can lead to improved teaching practices and student outcomes. Professional development programs focusing on subject-specific content and pedagogical practices can also improve student achievement.

Smylie (2014) argues that effective teacher PD should be aligned with school improvement goals, be relevant to teachers' current needs, and include opportunities for practice and feedback. The author suggests that PD programs implemented with fidelity, providing ongoing support, and involving follow-up evaluation can improve teacher practice and student learning outcomes. Professional development programs incorporating teacher collaboration and inquiry-based learning can also enhance teacher learning and promote student achievement.

Furthermore, Guskey and Yoon (2009), as cited in Erdas Kartal et al. (2018), propose that teacher PD programs should focus on improving instructional practices, involve ongoing support, and be informed by research and evaluation. The authors suggest that PD programs incorporating teacher feedback, involving collaborative learning, and using multiple measures to assess teacher effectiveness can improve instructional practices and student outcomes. Professional development programs that provide teachers with opportunities to learn about new technology and incorporate it into instruction can also increase student engagement and achievement.

Teacher professional development is a critical component of improving student learning outcomes. The literature suggests that effective PD programs should develop teachers' knowledge and skills, be aligned with school goals and standards, provide ongoing support, and incorporate collaborative and inquiry-based learning.

Student-centered Learning and primary science education

Student-centered learning is an approach to teaching that places the learner at the center of the educational process. It is a pedagogical approach that emphasizes the development of critical thinking, problem-solving, and decision-making skills. This literature examined the connection between student-centered learning and primary science education. As Allchin (2013) asserted, student-centered learning in science education involves engaging students in scientific inquiry and discovery, promoting student autonomy and decision-making, and providing opportunities for collaborative learning. The authors suggest that student-centered learning can encourage deeper learning, increase interest and engagement, and improves scientific literacy. Moreover, student-centered learning can enhance the development of critical thinking, problem-solving, and decision-making skills, which are essential for success in science education and beyond.

Similarly, Hmelo-Silver, Duncan, and Chinn (2007), as cited in Hannafin et al. (2014), argue that student-centered learning can improve the quality of science education by engaging students in authentic scientific practices, promoting inquiry-based learning, and providing opportunities for collaboration and feedback. The authors suggest that student-centered learning can foster a deeper understanding of scientific concepts and principles and promote the development of scientific thinking and reasoning skills. Furthermore, English and Kitsantas (2013) propose that student-centered learning can enhance teacher practice and improve student outcomes by promoting inquiry-based learning, incorporating formative assessment, and providing opportunities for professional development. The authors suggest that student-centered learning can improve teacher knowledge and skills and promote student scientific literacy and interest development.

Researchers such as Adegbola (2019, p. 657) found that "teacher pedagogy significantly influences students' attitudes towards primary science". According to the study, teachers who employ student-centered teaching techniques like inquiry-based learning and practical activities positively influence their students' attitudes towards science (Duran & Dökme, 2016). The attitudes of students towards science are also favorably impacted by teachers who use technology in their classes and provide them with chances to cooperate and communicate with their classmates (Ahmadi & Reza, 2018). Study showed that teacher pedagogy has a significant role in determining how well primary science students learn and feel about science (Darby, L. 2005).

Conceptual Framework

The conceptual framework diagram includes more detailed inputs, processes, and outputs related to teachers' pedagogies and students' attitudes towards primary sciences. The inputs section includes various elements that can influence the effectiveness of teachers' pedagogies, including teaching strategies, content knowledge, pedagogical content knowledge, classroom management techniques, and assessment techniques. It also includes students' characteristics, such as prior knowledge and attitudes towards science, learning styles and preferences, and cultural and socioeconomic backgrounds.

The process section outlines the teaching and learning process, which includes classroom interactions and communication, inquiry-based learning and problem-solving skills, active and collaborative learning, the use of technology in teaching and learning, and differentiated instruction. The outputs section focuses on students' attitudes towards primary sciences, including their interest and inspiration for science, perception of science learning and knowledge, confidence in science skills and abilities, and attitudes towards science and science-related careers. Figure 3, shows that teaching pedagogy serves as the central factor in the conceptual framework.

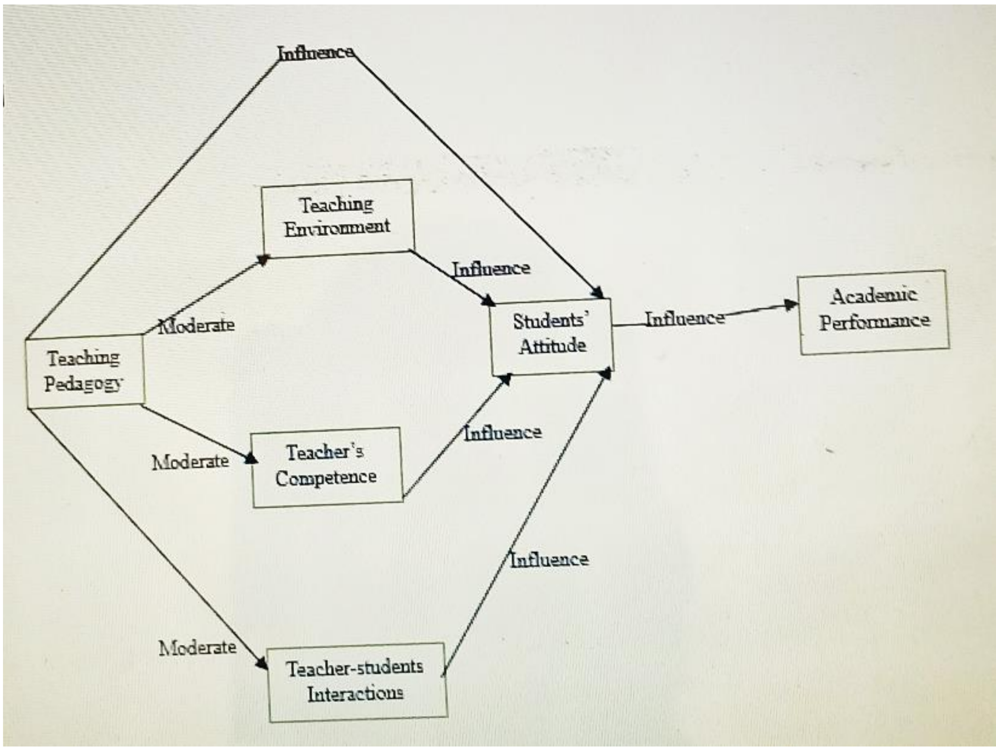

Figure 3: Conceptual Framework (Source: Williams, 2023)

Students' attitudes towards primary science are the outcome variables of interest. Teaching pedagogy directly influences students' attitudes, indicating the primary focus of the study. A conducive teaching environment can enhance the impact of pedagogy on students' attitudes towards primary science. A skilled and competent teacher can better implement effective pedagogical methods, leading to a positive attitude among students. Positive and supportive Collaboration between educators and learners can enhance the effectiveness of pedagogy in shaping students' attitudes towards primary science. All in all, a positive attitude towards primary science is expected to positively influence students' academic success.

Empirical Review

Factors Influencing Students Attitude towards Primary Science

Student attitudes towards the primary science have been a topic of interest among researchers for decades. It is widely believed that attitudes play a crucial role in shaping academic performance, motivation, and engagement. In this literature review, existing studies on student attitudes towards primary sciences will be explored focusing on the factors that influence these attitudes and how these attitudes affect academic performance. Bal-Taştan et al. (2018), explained that the teaching method used in primary science education can greatly impact students' attitudes towards the subject. In their study, Bal-Tastan et al., found that students who were taught using hands-on activities and experiments had a more positive attitude towards science than those who were taught using traditional lecture-based methods.

It has been noted that the curriculum can also contribute significantly in shaping students' attitudes towards the primary sciences. This argument has been supported by Cunningham & Lachapelle (2014), who stated that a relevant and engaging curriculum can spark interest and motivation in students, leading to a more positive attitude towards the subject. The influence of parental involvement on students' attitudes towards the primary sciences has also been noted in several studies. For example, in a study by Smith and Hausafus (1998), it was shown that parents who expressed interest in their children's education and provided opportunities for science-related activities outside of school had a positive impact on their children's attitude towards science.

Gender stereotypes and biases can also impact students' attitudes towards the primary sciences (Buabeng, 2020). In a study by Tyler-Wood et al. (2012), it was found that girls who believed science was a male-dominated field were more reluctant to show fascination in science. Teacher expectations and beliefs about students' abilities can also contribute significantly in shaping their attitudes towards the primary sciences. According to a study, Potvin and Hasni (2014), found that teachers who believed in their students' abilities and provided positive feedback had a positive impact on their students' attitudes towards science.

The learning environment, including access to resources and a well-equipped laboratory, can also influence students' attitudes towards the primary sciences. As noted by Al-Seghayer (2014), a lack of resources and inadequate laboratory facilities can negatively impact students' attitudes towards science. Finally, peer influence has also been noted as a factor that impacted students' attitudes towards the primary sciences. According to research by Kiemer et al. (2015), positive interactions with peers who were interested in science had a positive impact on students' attitudes towards the subject.

Role models such as science teachers and professionals can also influence students' behaviors towards science. Research has shown that positive role models can inspire students to pursue science-related careers and participate more actively in science-related activities (Conner & Danielson, 2016). The curriculum and teaching materials used in primary science education can also impact student behavior. Research has revealed that hands-on, inquiry-based learning can increase student engagement and motivation in primary science education (Bartholomew & Osborne, 2004; as cited in Gillies

& Baffour, 2017). Additionally, the use of multimedia resources, like videos and interactive software, can help make science education more accessible and engaging for students (Zheng et al., 2014).

Innovative Teaching Pedagogies and Student Attitudes

Innovative teaching pedagogies refer to instructional methods that deviate from traditional teaching techniques and engage students in active and collaborative learning. These methods are designed to promote a deeper understanding of the subject matter and enhance students' critical thinking and problem-solving skills. Numerous researches have looked into the influence of innovative teaching pedagogies on students' attitudes towards primary sciences (Bakeer, 2023; Peterson et al., 2018; Law, 2014).

A study conducted by Ferreira and Trudel (2012), explored the effect of problem-based learning (PBL) on primary school students' attitudes towards science. The study found that PBL significantly improved students' attitudes towards science, particularly their interest in and enjoyment of science. Another research by Tseng et al. (2013), investigated the efficiency of project-based learning (P; BL) in enhancing primary school students' attitudes towards science. In accordance with the study, P; BL improved students' attitudes towards science, particularly their perception of science as relevant and useful. Furthermore, a study by Jeong et al. (2016), examined the impact of flipped classroom teaching on primary school students' attitudes towards science. The study found that flipped classroom teaching significantly enhanced students' attitudes towards science, particularly their interest and motivation to learn science.

A study by Killian and Bastas (2015), found that students in classes that used active learning pedagogies performed significantly better on examinations and had more positive attitudes towards learning compared to students in traditional lecture-based classes. Research has shown that when teachers incorporate these pedagogies into their science instruction, students tend to have more positive attitudes towards science. For example, students are more likely to express a greater interest in science topics and report that science is fun and engaging. Innovative teaching pedagogies can include a range of approaches, such as inquiry-based learning, problem-based learning, project-based learning, and collaborative learning. These approaches can help students develop critical thinking and problem-solving skills, as well as foster curiosity and creativity. Kokotsaki et al. (2016) argued that project-based learning pedagogies improved students' attitudes towards learning and increased their motivation to learn.

According to Herodotou et al. (2019) some critics argue that innovative teaching pedagogies can be challenging to be implemented in primary science education due to time and resource constraints. Similar objections were raised by Buabeng-Andoh (2012), who raised concerns about the lack of teacher training and support for implementing innovative teaching pedagogies in primary science education. Based on these perspectives, this research sought to explore the use of innovative teaching pedagogies by primary science teachers and their effect on students’ attitudes toward the primary sciences.

Students' Perceptions of Teachers' Pedagogy

Several studies have found that students tend to view inquiry-based learning approaches, which emphasize student-centered learning and hands-on experimentation, as more engaging and effective in promoting an understanding of science concepts than traditional lecture-based teaching methods. In a study, Loizou and Lee (2020) founded that student in primary science classes perceived inquiry-based learning activities as more interesting and enjoyable than traditional lecture-based teaching methods.

Teachers who used multimedia resources such as videos, animations, and interactive simulations were generally viewed more positively by students than teachers who relied solely on traditional teaching methods. So et al. (2019), posited that learners in primary science classes perceived multimedia resources as more effective in promoting understanding of science concepts than traditional teaching methods. Primary school students seem to value interactions and communication with their science teachers, which can foster a positive and supportive classroom environment. In validation of this claim, in a study, Hardman et al. (2008) found that primary school students in Nigeria perceived their science teachers more positively when they provided clear explanations, engaged in open communication, and encouraged student participation in their lessons.

It has been suggested that primary school students are more engaged and motivated when their science teachers demonstrate enthusiasm and passion for the subject matter they are teaching. This suggestion has been supported by Okebukola et al. (2013), they stated that primary school students in Nigeria were more motivated to learn when their science teachers demonstrated enthusiasm for the subject matter. A study by Aiman and Hasyda (2020), found that primary school students in a science class were more motivated to learn science when their science teachers demonstrated enthusiasm for the subject matter. Students' perceptions of science teachers' pedagogy are influenced by various factors such as inquiry-based learning, teacher support and guidance, authentic and relevant activities, teacher enthusiasm and passion, and the use of technology. Teachers who use effective pedagogical practices that align with these factors are more likely to foster positive student perceptions of science learning. These findings can inform teaching practices and help science teachers provide more stimulating and productive learning environments for their students.

However, there has been criticism of the perception of students toward primary science teaching pedagogies. One study by Spronken-Smith et al. (2012) examined student perceptions of inquiry-based science instruction versus traditional lecture-based instruction. While students in the group that relied on inquiry perceived the instruction to be more engaging and enjoyable, the study discovered that there was no discernible change in the learning outcomes between the two groups. This suggested that student perceptions may not always align with the most effective pedagogical approach.

Another study by Overman et al. (2014) examined student perceptions of different pedagogical approaches in a high school chemistry class. The study found that while students generally preferred hands-on and interactive activities, they did not always perceive these approaches to be more effective than lecture-based instruction. Additionally, the study discovered that past knowledge and experiences with various teaching methods had an impact on students' views. These findings suggest that student perceptions of science teaching pedagogies should be considered alongside other factors when evaluating the effectiveness of different approaches. As Licorish et al. (2018) noted, it matters to gather data on student learning outcomes in addition to student perceptions to get a more complete picture of what works best for teaching science.

Relationship between Teachers' Pedagogy and Students' Attitude toward Primary Science

Several studies have examined the connection between teachers' pedagogy and students' attitudes toward primary science. A study by Emaliana (2017), found that the use of student-centered pedagogy positively influenced students' attitudes towards learning. The authors concluded that when teachers employed student-centered pedagogy, students felt more motivated and engaged in the learning process, resulting in a positive attitude towards learning.

Similarly, a study by Chan (2013), found that the use of interactive instructional strategies that included problem-solving exercises and group discussions positively influenced students' attitude towards learning. The author argued that interactive teaching methods allowed for active student participation and engagement, which fostered a positive attitude towards learning. In contrast, a study by Abdel and Collins (2017), found that the use of traditional teaching methods, such as lecturing, negatively influenced students' attitude towards learning. The authors argued that traditional teaching methods could be boring and monotonous, leading to a negative attitude towards learning.

In another study, Keller et al. (2017) discovered that educators' pedagogical content knowledge positively influenced students' attitudes towards learning. The authors argued that teachers, who possessed a strong understanding of the subject matter and could effectively communicate it to students, were more probable to develop a positive attitude about learning. Furthermore, a study by Altun (2017), found that teachers' enthusiasm and passion for teaching positively influenced students' attitude towards learning. Altun argued that teachers who were enthusiastic and passionate about teaching could inspire and motivate students, leading to a positive attitude towards learning.

Chapter Summary

The chapter reviewed theoretical frameworks. The theories reviewed were constructivism, cognitive apprenticeship, and situated cognition. These theories emphasized active, social, and contextualized learning. The conceptual framework proposed relationships between teaching pedagogy, student characteristics, classroom processes, and science attitudes. Empirical studies revealed that teaching methods, curriculum, parental involvement, gender biases, resources, and role models influenced science attitudes. Innovative pedagogies like PBL improve attitudes but faced implementation challenges. Studies revealed that students preferred inquiry-based, multimedia, and enthusiastic teaching. However, perceptions did not equate to learning.

CHAPTER THREE

RESEARCH METHODS

The chapter introduces a comprehensive overview of the various procedures and instruments utilized to better comprehend the teaching pedagogy and students' attitudes toward primary science in the Left Bank 2B District of Liberia. It also covers the topics of research design, sampling technique, the study's population, the kinds of data gathered, and the various steps involved in analyzing the data.

This study examined factors that influenced students' attitudes toward primary science and perceptions of teachers' pedagogy used in teaching science at the primary level. The study also examined the effects of pedagogy and students' attitude on students' academic performance and evaluated the relationship between teacher's pedagogy and students' attitudes towards primary science in the Left Bank 2B District, Liberia.

Research Design

The study was situated in the philosophy of pragmatism (James, 2020), which adopts the sequential explanatory design of mixed-methods research. The model of follow-up explanations was especially utilized. The design involved two stages in which mixed methods were used to collect data. The framework for the design is shown in Figure 4 below.

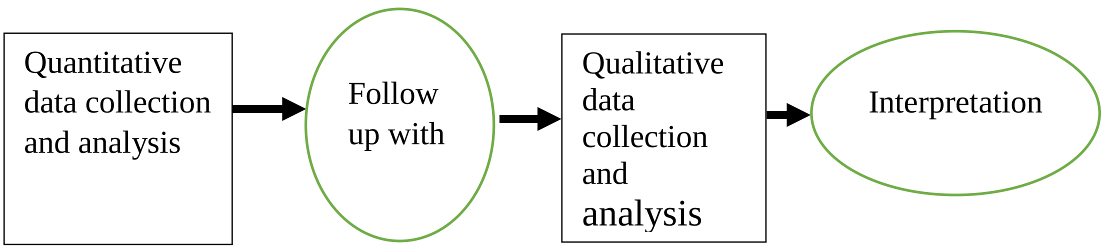

Figure 4: Explanatory Sequential Design (Source: Williams, 2023)

Research Design

Specifically, a sequential explanatory design was employed for this study. Using an explanatory mixed-methods research design was appropriate for this study (Subedi, 2016). The sequential explanation design is a type of research that involves collecting and analyzing data in two phases in which mixed methods are used to collect data (Fetters et al., 2013). It allows quantitative data to be collected and analyzed in the first phase, and qualitative data to be collected to explain the quantitative results in the second phase, which is planned and carried out based on the quantitative results (Tobi & Kampen, 2018). This design integrates substantial quantitative and rich qualitative evidence from respondents in specific research to seek explanation, expansion, portrayal, and clarification from one approach with the data from the other method. (Tobi & Kampen, 2018).

According to Plano and Clark (2011), an explanatory sequential design, as cited in Subedi (2016), states that the objective of the method is to provide a quantitative analysis of the problem and then explain the results. This strategy is usually carried out to give an overall picture and extend the scope of the study. However, more analysis is needed to refine the results. Plano and Clark (2011), as cited in Subedi (2016), argued that it is always good for the researcher to collect and analyze quantitative data first, followed by qualitative data, with the aim of explaining or enriching the initial quantitative findings. Tariq and Woodman (2013) describe a research approach where quantitative data is used to test hypotheses or address research questions, while qualitative data is employed to interpret the results or delve into unexpected outcomes.

This design can be useful for exploring the complexity of a research question and gaining a more in-depth understanding of the research participants' perspectives. In the first stage, the researcher started by collecting quantitative data from science instructors and grade six students in selected primary schools within the Left Bank2B District, Liberia. This data was collected through a survey that measured students' attitudes towards primary science and their perception of different teaching pedagogies of the science teachers. The researcher then used descriptive and inferential statistics to analyze the data and identify any significant associations between teaching pedagogies and student attitudes towards primary science.

In the second stage, the researcher conducted interviews with head teachers who had influence on science teachers and probably had a better understanding of the issue in the Left Bank2B District, Liberia. The head teachers' interviews were intended to gather direct information about the strategy teachers employed while instructing elementary science, as well as the attitudes of students on scientific learning in the Left Bank2B District.

Rationale for the Design

The strengths and weaknesses of different quantitative and qualitative methods are often complementary. The former allows for detailed analysis of the data, while the latter provides generalizable information. By combining the strengths and weaknesses of these two methods, a more complete picture of the research can be obtained (Choy, 2014). The development of theories and hypotheses can also be carried out in the qualitative phase. These can then be tested in the quantitative phase to increase the validity of the results (Fetters et al., 2013). Meanwhile, this design can increase the credibility of the results.

Data triangulation can also help improve the reliability and validity of results, as they are similar to those obtained through several techniques. The objective behind sequential design is to offer a comprehensive analysis of a research question by utilizing both quantitative and qualitative methods. This method can help generate effective hypotheses and enhance credibility (Subedi, 2016).

Strengths and Weaknesses of the Design

As stated by Rutberg and Bouikidis (2018), the explanatory design provides a comprehensive comprehension of the research question by integrating both quantitative and qualitative data while permitting a deeper investigation of the participants' experiences and perceptions. As mentioned by Subedi (2016), the investigator used the explanatory design method in order to search out the opportunity for a greater variety of divergent views. Thus, explanatory study is a great way to examine a phenomenon or explain a certain event. It can also help predict the future (Subedi, 2016).

Though explanatory research is typically helpful in developing hypotheses and theories, its results are not always conclusive (Tsang, 2014). In addition, through sequential design, the researcher triangulated the data by utilizing both qualitative and quantitative techniques. This improved the validity of the findings and counteracted the weaknesses of one approach.

On the contrary, the explanatory design has limitations such as time-consuming collection and analysis of quantitative data, potential delays in reaching conclusions, limited impact of the qualitative phase on the study's findings, and the risk of introducing researcher bias due to overemphasis on qualitative data (Creswell & Plano Clark, 2017).

Study Area

This research was conducted in the Left Bank2B District in Johnsonville, a suburban town on the outskirts of Monrovia, Liberia. The Left Bank2B District is situated in Montserrado County and it contains 200 public and private institutions. Johnsonville was chosen as it represents a major suburban population center in the capital city. Focusing on this specific district enables a localized examination of pedagogy, attitudes, and performance within the primary science education context. Moreover, the Left Bank2B District includes a diverse mix of public and private schools, allowing for potential comparisons based on school type.

Study Area Map

Figure 5: Map of Johnsonville

The post-war redevelopment of the Liberian education system means research focused on particular districts provides value in identifying strengths, challenges, and needs within different communities. While the Left Bank 2B District is located just outside the capital, it has received less research attention compared to schools in central Monrovia. Yet insight from this significant suburban area can guide resource allocation and educational improvements. With approximately 200 schools serving an extensive student population, the Left Bank 2B District represents a microcosm of the broader Liberian education system. Lessons learned in this district can likely translate to other districts of the nation. The study's localized nature also allows for in-depth qualitative interviews with school leaders to gain their first-hand perspectives on influencing factors.

Study Population

All grade six students in the Left Bank2B District had formed the target population. The study population comprised all grade six school-going children between the ages of twelve and fourteen who have enrolled in the 2022–2023 academic year, including all primary science teachers and headteachers (N = 20,000) of the Left Bank2b District, Liberia. Regarding the purpose of the study, the researcher chose these sixth graders because they formed a better population for the study. The researcher believes that these sixth graders have been exposed to various teaching pedagogies throughout their kindergarten and elementary studies, which places this study in a suitable position to examine their perceptions of the science teachers' pedagogies and factors influencing their attitudes towards the primary sciences. Other classes in primary schools were not included in the study because they still had more to cover when it came to experiencing their science teachers' teaching strategies and pedagogical skills.

The population comprised a disproportionate number of males and females within different age groups. Hence, these characteristics in the population may probably impact the perception of students toward their science teachers' teaching pedagogical skills, which might also influence their attitudes toward primary science. Meanwhile, this study's participating science teachers and head teachers had varying educational backgrounds. Head and science teachers had degrees from various universities in the Republic of Liberia. They participated in the study through interviews and the answering of questionnaires. All of them had at least five years of working experience and teaching experience in primary science. Their ages ranged from 20 to 40 years old.

Sample and Sampling Procedure

The sample for the study was drawn from 20 schools in the district, from which students were selected. The purposive sampling technique was used to sample the 20 schools (Campbell et al., 2020). Reasons for selecting these schools included easy accessibility and the willingness of school leaders and staff to engage in the research.

The sample size for the study consisted of 377participants (students, teachers and head teachers). The population of 20,000 participants gave a sample size of 377 based on the guidelines for determining sample size developed by Krejcie and Morgan (1970), as cited in Treputtharat and Tayiam (2014). Thus, the proportionate sampling technique was used to select 337 students (respondents from the respective schools in the Left Bank2B District).

However, the science teachers and head teachers were selected using the purposeful sampling technique based on the population of the selected schools. A total of 20 science teachers were given questionnaires to fill out. At the same time, a semi-structured interview was conducted with 20 head teachers from the selected schools to express their opinions about factors influencing students' attitudes towards primary science and the perceptions of students about science teachers' pedagogical skills used in the classroom.

Data Collection Instruments

The data collection instrument for the study were questionnaires for both students (Grade Six Students Questionnaire [GSSQ]), and teachers (Science Teachers Questionnaire [STQ]), students science test scores (STS), as well interview protocols (IP).

Survey Questionnaire

Questionnaires were used to gather data on the factors that influenced students' attitudes towards primary science and students' perceptions of teachers' pedagogy used in teaching primary science in the Left Bank2B District. The questionnaires were structured into three sections, covering the following aspects: demographic Information, factors influencing students' attitudes towards primary science and students' perceptions of teachers' pedagogy in teaching primary science. Both the GSSQ (Appendix D) and STQ (Appendix C) were adapted from Osborne et al. (2003). The selected items were modified to suit the study's context and purpose.

Each questionnaire comprised of twenty closed-ended questions, and was structured on a 5-point Likert-type scale ranging from "strongly disagree" to "strongly agree." This approach was chosen because closed-ended questions facilitate the collection of structured and quantifiable data efficiently and consistently (Li et al., 2015; Starr, 2014). The controlled response options ensured relevance and provided respondents with the necessary information to make informed choices, reducing the risk of non-response bias. Questionnaires enabled participants to conveniently share their opinions and offer timely feedback (Omar, Embi, & Yunus, 2012). Through questionnaires, participants were to provide their opinions on various subjects, and they could respond conveniently (Robinson, 2018). Questionnaires were cost-effective, time-efficient, anonymous, and standardized, eliminating bias (Brittain et al., 2022). On the other hand, Safdar et al. (2016) asserted that questionnaires were useful tools for research but could have some biases, limited response options, and a low response rate, leading to an imbalanced sample and reduced generalizability. The instruments were designed with a strong focus on reliability and validity. The structured questionnaires, featuring twenty closed-ended questions on a 5-point Likert scale, enhanced reliability through internal consistency, ensuring respondents answered within a standardized framework. Efforts to ensure content validity involved selecting relevant and informative questions, while the cost-effective, time-efficient, and standardized nature of the questionnaires contributed to face validity. These measures reflected a deliberate approach to creating a reliable and valid tool for data collection.

Interview Protocol

A semi-structured interview protocol (Appendix E) was designed and administered to head teachers since it was believed that most of them were aware of their teachers' teaching methods and strategies in the classroom. Secondly, head teachers were most often available on campus during school hours, so to conduct an interview with them was much easier. Semi-structured interviews were particularly suited for this study, as they allowed for the collection of rich, in-depth data, and encouraged participants to express their thoughts and experiences comprehensively (Kallio et al., 2016). Through semi-structured interviews, participants' voices and perspectives were given precedence, enabling them to share insights and opinions that may not be readily obtainable through standard surveys (McIntosh & Morse, 2015).

The flexibility inherent in semi-structured interviews permitted the adaptation or revision of questions based on participants' responses during the interview process, ensuring the continued relevance of the inquiry to their unique experiences (Kallio et al., 2016). These interviews provided a deeper and more nuanced understanding of the subject matter, allowing participants to furnish detailed information often missed in closed-ended and structured interviews (McIntosh & Morse, 2015). The interview guide was tailored to focus on the primary research questions guiding the study. To enhance validity, questions in the interview guide were directly related to the research objectives, following the guidance of Kallio et al. (2016). Participants were encouraged to contemplate their responses to focus questions before the interview began, aligning with the suggestion by Arsel (2017). Additionally, efforts were made to ensure that the selected items in the interview protocol were clear and unbiased, as advised by Roopa and Rani (2012).

Students test scores

The students' first- and second-semester examination scores in science for the 2022/2023 academic year were collected and used for the study. The average for the two semester-scores was calculated, and average values were then used as proxy for academic performance of students.

The researcher utilized the test scores of students to gain a deeper understanding of the effects of teacher pedagogy and students’ attitudes on academic performance in science. This approach was chosen for its ability to assess the effectiveness of educational interventions, teaching methods, or curriculum changes. Additionally, it aided in policy evaluation, identifying achievement gaps, and predicting future academic outcomes (Elias et al., 2014). By analyzing these test scores, the researcher aimed to uncover patterns and insights that could inform improvements in teaching practices and educational strategies.

Validity and Reliability of Instruments

The researcher reviewed the instruments under the supervisor's guidance to ensure validity and reliability. Thus, face and content validity of the instruments were established with the assistance and direction of my supervisor and other experts in tool validation. The initial items were revised based on their feedback, followed by a comprehensive review by my supervisor to confirm that the initial items and their wording were suitable for the participants, and that the data gathered would support sound decision-making. A pretest was also conducted to determine the internal consistency, stability, and accuracy of the questionnaires. The pre-test served four purposes: to ascertain whether respondents understood the items on the questionnaires, to prevent confusion between questions and the corresponding response options, to estimate the time needed to complete the questionnaire, and to use the results to improve the questionnaires.

The researcher and four assistants administered and collected the questionnaires in five randomly selected schools in the Left Bank2B District of Montserrado County, Liberia. Meanwhile, these schools did not form a part of the main data collection since they had similar characteristics and were found within the exact location of the study. The questionnaires were completed by 130 students and 5 science teachers. The items on the questionnaires were coded and imputed to the SPSS software. The items were grouped under three sections, A, B, and C. Section A contained students' demographic information, Section B included factors influencing students' attitudes toward primary science, and Section C had items relating to students' perceptions of teachers' pedagogical skills. The degree to which each item in the scales measured the same underlying characteristic was ascertained using Cronbach's Alpha coefficient as an index of internal consistency (Tavakol & Dennick, 2011).

For the students' questionnaire, GSSQ, the two scales – factors influencing students' attitudes toward primary science, and students' perceptions of teachers' pedagogical skills had reliability coefficient of 0.735 and 0.764 respectively. Similarly, the STQ recorded reliability coefficients of 0.890 and 0.796 for the same scales.

Taber (2018) stated that any scale with a reliability coefficient of at least 0.70 is considered reliable. Likewise, Kalkbrenner, (2023) confirms that the internal consistency of a scale is determined by the alpha value of a scale ranging from 0 to 1, with optimal values ranging between 0.7 and 0.9. Based on these statements and the coefficient values recorded from the pre-test, the GSSQ and STQ were considered reliable for collection of data for the research.

Ethical Consideration

The study was carried out according to the ethical guidelines established by Cape Coast University. In order to carry out the study, the researcher first obtained an introduction letter from the Department of Basic Education to seek permission from the relevant authorities. The researcher got ethical clearance (Appendix A) from the University of Cape Coast's Institutional Review Board (IRB). The researcher and four other assistants administered the questionnaires, clarifying issues for the respondents when necessary to increase the return rate. Ethically, respondents had to consent to participate in the study without coercion or prejudice. Hence, a consent form was provided to the respondents so that they understood that their information would be collected.

The respondents were provided with a guarantee of anonymity and confidentiality to avoid violating the study's confidentiality rules. Such issues were crucial ethical matters, as their violation could have compromised the research. They were told that the survey was exclusively intended for academic use and that if it became necessary to share the results with a third party, they would be asked for permission. Additionally, they were free to leave at any moment. The study's ethical aspects were considered when collecting and analyzing the data. Without changing the respondents' answers, the gathered data was sorted and examined.

Data Collection Procedures

The data collection for this study occurred in two distinct stages. Firstly, questionnaires were administered to science teachers and grade six students, facilitating the acquisition of valuable insights into their perspectives. Subsequently, semi-structured interviews were conducted with head teachers, providing a deeper understanding of the phenomena. Additionally, students' test scores were meticulously gathered to authenticate the impact of pedagogy and attitudes on academic performance in science.

After obtaining ethical clearance from the university's review board and an introductory letter from the Department of Basic Education, the researcher proceeded with the data collection process. The data collection precisely began on November 7, 2023, when the researcher submitted a copy of an introductory letter to the District Educational Officer (DEO) of the Left Bank2B district for approval to conduct the research in the district. When the request was granted, the researcher visited the selected schools and informed the teachers and students through a consent letter (Appendix B). They were assured that the exercise was not meant to victimize anyone but to gradually understand their perception about their science teacher's pedagogical knowledge and how it influenced their attitudes toward science. Their phone and registration numbers were recorded to locate them. Subsequently, the survey questionnaires were distributed to the participants with the help of four qualified research assistants.

Semi-structured interviews were conducted with head teachers. Qualitative data was recorded, and the interviews were transcribed and analyzed. Based on the research questions, themes related to the research questions were designed to answer the research questions.

Questionnaire and Interview Response Rate

The researcher indicated during the data collection procedure that she ensured the completeness of the questionnaire instrument. Ultimately, this promoted the questionnaire and interview response rate. That is, all teachers and headteachers who totaled forty (40) provided their responses to the questionnaires and the semi-structured written interviews, respectively, reflecting the efficiency of the collection process. All students (337) also responded to the questionnaire tool, which had no missing values. This added to the comprehensiveness of the research generally. In all, there was a 100% response rate for both questionnaires and interview guide.

Recruitment and Training Plan for Research Assistants

For this research project, the selection and preparation of research assistants were critical to ensure the success and quality of the data collected. Four individuals were carefully chosen as research assistants based on specific criteria, emphasizing their expertise in the local educational context. The selection criteria were prioritized based on the following attributes:

Research assistants must deeply understand the local educational environment, including its tones, challenges, and details. Practical communication skills, both in verbal and written forms, were essential for interacting with participants and ensuring precise data collection. Research assistants should be available and committed during the data collection phase to maintain the project's timeline and integrity.

A comprehensive training workshop was conducted to equip the selected research assistants for their roles. This workshop covered the following key areas:

Research assistants received a detailed explanation of data collection procedures, emphasizing the importance of accuracy, consistency, and attention to detail. Sampling techniques were thoroughly explained to ensure that research assistants understood the underlying principles so that they could effectively implement them during the data collection process. Research assistants were adequately trained to administer questionnaires, ensuring they clearly understood the questions, response options, and the overall survey process. The training included a discussion of ethical considerations related to the research, particularly the significance of obtaining informed consent from participants and respecting their rights throughout the data collection process. Clear roles and responsibilities were outlined for each research assistant, specifying their tasks and areas of focus to prevent any ambiguity or overlap. A strategy for addressing potential challenges during data collection was provided to the research assistants, enabling them to respond effectively to unforeseen circumstances. Research assistants were informed about the expected duration of their involvement, including the specific days or weeks required for the data collection. The payment structure was transparently outlined to ensure fairness and clarity in compensation. The importance of maintaining strict confidentiality and upholding ethical standards while respecting participants' rights were consistently reinforced throughout the data collection process. An ongoing supervision and support system were established, including regular check-ins with the research assistants. A designated point of contact was available to address any questions or issues that arose during the data collection period.

Data Analysis

The data collection instruments generated both quantitative and qualitative data, hence quantitative and qualitative approaches to data analyses were employed.

Research Question One explored the factors influencing students' attitudes towards primary science and research question two sought to explore how students perceived their teachers' pedagogy used in teaching primary science at the basic schools in the Left Bank2B District, Liberia. Descriptive statistics; mean, and standard deviation, were used to establish the total disagreement scores, neutral, and total agreement scores in the data. Figures, tables, and charts were used to present the results where necessary.

In testing hypothesis one, the researcher utilized the Pearson moment correlation coefficient to explore the relationship between teachers' pedagogy and students' attitudes. To examine the relationship between the two variables, the researcher deemed it prudent to apply the Pearson correlation. This test aided in assessing whether the observed relationship between the two variables was statistically significant (Zessin et al., 2015).

Similarly, for hypothesis two, the researcher also employed regression analysis to evaluate the influence of teacher pedagogy and students' attitudes (independent variables) on students' academic performance (dependent variable). As stated by Yang (2017), regression analysis is a versatile statistical tool that aids in hypothesis testing by systematically modelling, quantifying, and testing relationships and/or effects between variables. It allows researchers to evaluate the significance of these relationships, control for confounding factors, and make predictions based on the observed data (Boulesteix & Strimmer, 2007). Once again, the analysis applied the p-value to establish whether the influence was statistically significant. As reported by Lu & Ishwaran (2018), p-value found to be less than p = 0.05, indicates considerable statistically significant at the 95 % confidence interval, indicating a significant association between the independent and dependent variables whereas p-value found to be greater than p = 0.05, indicates no considerable statistically significant at the 95 % confidence interval, indicating no significant association between the independent and dependent variables.

The researcher used thematic analysis to analyze the qualitative data. Head teachers' data were transformed into themes based on the objectives of the research study. The process involved a careful data preparation, systematic coding and theme development, rigorous interpretation, and thoughtful reporting of findings to answer research questions effectively.

Summary of Chapter Three

This chapter presented the methodologies and procedures adopted for the research. The researcher situated the research in a mixed-method design. The primary philosophical approach was the pragmatist perspective. The study population, sampling, sampling procedures, and area of the research were discussed. The data collection and analysis procedures were discussed as well.

CHAPTER FOUR

RESULTS AND DISCUSSION

This chapter presents the data analysis, results and discussion of the findings of the study. The chapter is divided broadly into five sections: (a) introduction; (b) factors influencing students' attitudes towards primary science; (c) students' perceptions of teachers' pedagogy used in teaching primary science; (d) hypotheses testing and (e) summary of results and discussion. Concerning sections (b) and (c), the study presents both the quantitative and qualitative results. The quantitative analyses are illustrated in tables, figures, frequencies, means, standard deviations, and percentages. Extracts from the interview are attached to the qualitative analysis for discussion. Previous empirical studies reviewed in Chapter Two were used to foreground the discussion for comprehensive analysis.

Demographic Characteristics of Respondents

The study involved students, teachers, and head teachers. The information on students is presented first. Results of the descriptive analysis from the SPSS software were presented in percentages and frequencies.

Gender distribution of students

The statistical analysis revealed that 52.50% of the respondents, representing 177 participants, were females, while 160 males representing 47.50%, of the participants. The analysis indicates that both male and female students participated in the study, though with a marginal difference of female students higher than the male students. Table 1 presents the results for the gender distribution.

Table 1: Gender Distribution of Students

Gender Variable	Frequency	Percentage %
Male	160	47.50
Female	177	52.50
Total	**337**	**100.00**

Source: Fieldwork, Williams (2023)

Deducing from Table 1, the gender distribution in the public schools is relatively balanced, with females slightly outnumbering males. This suggests that efforts have been made to promote equal opportunities for both boys and girls in primary education in Liberia (Akpakwu & Bua, 2014; Gbollie & Keamu, 2017). The fact that females make up 52.50% of the student population is encouraging. It indicates that there may be initiatives in place to promote girls' education and create an inclusive learning environment.

Age distribution of students

This subsection examined the age distribution of students who were involved in the study. The results of the age distribution are presented in Table 2. The age distribution helps inform our understanding of the composition of the student body and the implications for pedagogies, support systems, and resource allocation.

Table 2: Age Distribution of Students

Age	Frequency	Percentage %
10	52	15.40
11	51	15.10
12	79	24.50
13	155	46.00
Total	**337**	**100.00**

Source: Fieldwork, Williams (2023)

As seen in Table 2, 46.00% of the students were aged 13 years. While there is a concentration of students aged 13, the age distribution appears relatively balanced across 10 representing 15.40%, 11 representing 15.10%, and 12-year-olds representing 23.50%. This balance may facilitate more effective teaching and classroom management as students within a similar age range often have comparable developmental milestones (Klug, Bruder, & Schmitz, 2016). With a distribution of four different ages among the students, teachers should adopt differentiated instruction techniques. This involves customizing teaching methods, content, and assessment to accommodate the varying learning styles, abilities, and developmental levels of students.

Cross-tabulation distribution of demographic information of teachers

Further analysis on the demographic features of teachers is presented in a cross-tabulation form relating to gender, which provides insightful findings. Concerning the gender distribution of teachers, 12 representing 60.0% were males, while 8 representing 40.0% were females. The fact that only 40.0% of teachers were female could influence the perceptions and aspirations of students regarding gender-specific careers, including the field of education. The results are presented in Table 3.

Table 3: Cross-tabulation analysis of demographic features of teachers

Gender Variables	**Age Group**					**Frequency**	**Percentage %**
		26-30	31-35	36-40	40+		
Male	3	4	3	2	0	12	60.**00**
Female	1	1	3	1	2	8	40.**00**
Total	4	5	6	3	2	**20**	**100.00**

	Educational Status			**Frequency**	**Percentage %**
	Diploma	BSC/ BA/ BED	Masters		
Male	2	9	1	12	60.**00**
Female	2	5	1	8	40.00
Total	4	14	2	20	100.00

	Work Experience					**Frequency**	**Percentage %**
	<5 years	5-10 years	11-15 years	16-20 years	20+ years		
Male	1	6	1	4	0	12	60.00
Female	2	2	1	2	1	8	40.00
Total	3	8	2	6	1	20	**100.00**

Source: Fieldwork, Williams (2023)

From Table 3, the cross-tabulation on gender variables and the age group of the respondents reveals that female teachers were less represented in the older age groups (36–40 and 40+). This underrepresentation may result in a lack of female role models for students in the later stages of their education, potentially impacting female students' perceptions and aspirations in science subjects. However, interestingly, the older teachers in the schools were females (2). This implies that the basic schools in the Left Bank 2B District, Liberia, had enough youthful educators and experienced personnel who were involved in teaching and managerial activities in the schools. The variation in the age groups of teachers could lead to diverse teaching experiences and pedagogical approaches. Younger teachers (20–25 and 26–30) may bring fresh perspectives and familiarity with modern teaching methodologies, while older teachers (36–40 and 40+) may have more experience and subject expertise. This finding concurs with the finding by Awonong (2018) in the Sagnarigu District of Northern Ghana and Bahati (2016) in Kenya, who found more youth teachers in the basic education system in the Sagnarigu District of Ghana and Kenya.

Moreover, on the educational qualifications of the teachers, some fascinating findings were also identified. The data shows that the majority of male teachers had higher educational qualifications, with 9 out of 12 (75.00%) holding bachelor's (BSC/BA/BED) degrees. On the other hand, female teachers had a more even distribution across different educational qualifications. Male teachers with higher educational qualifications (bachelors and masters) might have strong subject expertise, which could be beneficial for teaching science subjects. These teachers might be better equipped to delve into complex scientific concepts and offered more in-depth explanations to students (McNeill & Krajcik, 2008; Posnanski, 2002). Female teachers, with a more balanced distribution across educational qualifications, might have diverse teaching experiences and approaches. Conclusively, all the teachers had received some form of tertiary qualification to teach science. Similar findings were reported by Little (2013) and Matthew (2013), where most of the teachers in their study had acquired tertiary education.

Finally, on median range, 55.00% of the teachers had teaching experience of 10 years or less, while 35% had 16 years or more teaching experience. Ten percent of the teachers had teaching experience ranging from 11 to 15 years. The data indicate balance in work experience among male teachers, with a fairly even distribution across different experience categories. However, there were fewer female teachers in the higher work experience categories, suggesting the need to focus on retaining experienced female educators and providing opportunities for their professional growth in primary science subject pedagogy.

Cross-tabulation distribution of demographic information of headteachers

This portion of the descriptive analysis focuses on the responses from the headteachers. Seventy percent of headteachers were male, while 30% are female. The data indicates an imbalance in gender representation among headteachers, with males being significantly more represented in leadership positions. The results of their responses are presented in Table 4.

Table 4: Cross-tabulation analysis of demographic features of headteachers

Gender Variables	**Age Group**					**Frequency**	**Percentage**
	20-25	26-30	31-35	36-40	40+		
Male	1	3	6	3	1	14	70
Female	0	0	3	2	1	6	30
Total	1	3	9	5	2	**20**	**100%**

	Educational Status			**Frequency**	**Percentage**
	Diploma	BSC/ BA/ BED	Masters		
Male	1	11	2	14	70
Female	0	5	1	6	30
Total	1	16	3	20	100%

	Work Experience					**Frequency**	**Percentage**
	<5 years	5-10 years	11-15 years	16-20 years	20+ year		
Male	3	4	4	2	1	14	70
Female	0	3	2	1	0	6	30
Total	3	7	6	3	1	20	**100%**

Source: Fieldwork, Williams (2023)

From Table 4, the data shows that majority of the headteachers were within the age groups of 31–35 and 36–40, representing 45.00% and 25.00%, respectively of the respondents. Headteachers within the 31–40 age range can benefit from targeted professional development programs that enhance their leadership skills, managerial abilities, and educational knowledge. Most of the male headteachers (78.60%) had a bachelor's (BSC/BA/BED) degree, while 83.3% of the female headteachers had a bachelor's (BSC/BA/BED) degree. The data shows that majority of headteachers (both male and female) possessed a bachelor's degree. Schools should encourage and support headteachers in pursuing higher education, such as master's degrees. Furthermore, most headteachers (70.00%) had over 5 years of work experience. This significant level of experience suggests that these headteachers were likely to bring valuable leadership expertise and educational insights to their positions in primary science education.

Analysis of Students and Teachers Questionnaire Responses

This section presents the quantitative analysis of the survey responses collected from students and teachers. The first part focuses on the responses from students, and the second part discusses the responses from teachers.

Factors Influencing Students' Attitudes towards Primary Science

Research question one sought to explore the factors that influenced students' attitudes towards primary science in basic schools in the Left Bank2B District, Liberia. The study aims to contribute to an understanding of the challenges and opportunities in promoting positive attitudes towards science learning in this specific district. Through a comprehensive analysis of the data, the researcher aims to identify potential barriers and facilitators that may impact students' engagement and interest in science subjects.

The section of the instrument answered this research question was scored on a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The data was analyzed using total agreement scores, neutral, total disagreement scores, mean and standard deviation. Based on the scoring, a cut-off points of 3.0 was used since the scale was a five-point Likert-type. This cut-off point was deemed appropriate according to Croasmun and Ostrom (2011). Mean scores above 3.0 were considered high while the scores less than 3.0 were considered as low (Note: This was applied throughout the analysis). A high mean score suggests that respondents frequently agreed, while a low mean score indicates that respondents rarely held the specific attitudes towards pedagogy. Table 5 illustrates students' perspectives on the factors that influenced students' attitudes towards primary science I n basic schools in the Left Bank2B District, Liberia.

Table 5: Students' Responses on Factors Influencing their Attitudes towards Primary Science (N=337)

	% Responses					
Statements	**TA**	**NR**	**TD**	**Mean**	**SD**	**Skewness**
The relationship between the science teacher and the students is cordial	76.60	0.00	23.40	3.71	1.316	-0.997
The teaching pedagogies of science teachers are more effective in improving students' attitudes toward primary science	83.70	0.00	16.30	4.03	1.230	-1.403
Peer pressure is one of the factors that influence students' attitudes toward learning science.	64.10	0.90	35.00	3.44	1.467	-0.506
Using instructional materials and science equipment promotes students' attitudes toward science.	86.00	0.00	14.00	4.10	1.136	-1.517
The science teacher supports and encourages students' participation in activities in the science class.	70.90	0.30	28.80	3.59	1.377	-0.753
The science classroom environment is decorated with teaching materials that attract learning	83.10	0.30	16.60	3.98	1.205	-1.341
Gender differences impact students' attitudes toward science	67.70	0.00	32.30	3.49	1.446	-0.624
Parents' involvement influences students' attitudes toward science.	79.80	0.60	19.60	3.94	1.288	-1.194
The teacher's knowledge of science subject is a key factor influencing students' attitudes toward science.	73.90	0.00	26.10	3.74	1.436	-0.905
The teacher uses various teaching methods to enhance learning in the science class	88.50	0.00	11.50	4.23	1.102	-1.758

Source: Fieldwork, Williams (2023)

TA is total agreement, NR is neutral response, TD is total disagreement, and SD is standard deviation.

From Table 5, the most agreed-upon factor was teachers using various teaching methods to enhance learning in science class, with 88.5% agreement (M = 4.23, SD = 1.102). This indicates students responded positively when teachers used effective and varied pedagogical techniques in science instruction. The low standard deviation (SD) of 1.102 suggests that the responses were closely clustered around the mean. The negative skewness (-1.758) suggests that the distribution of responses was moderately skewed to the left, with a majority of students expressing strong agreement.

The least agreed-with factor was peer pressure, with 64.1% agreement (M = 3.44, SD = 1.467). The standard deviation (SD) of 1.467 implies that the responses were somewhat spread around the mean and had a moderate level of agreement. This suggests that peer influences on science attitudes were complex, as students were likely to face social pressures that encouraged or discouraged them from science engagement.

Most factors had high levels of agreement and negatively skewed distributions, including the teacher-student relationship (76.60% agreement; M = 3.71, SD = 1.316, skewness = -0.997), use of instructional materials (86.00% agreement; M = 4.10, SD = 1.136, skewness = -1.517), and decorated science classrooms (83.10% agreement; M = 3.98, SD = 1.205, skewness = -1.341). The high percentage agreement and left skewed indicated that most students viewed these factors as important contributors to their positive attitudes toward science. The lack of symmetrical distributions shows there was a strong consensus on the favorable impact of these factors. Combined, these skewed results underscore the consistent importance of social, pedagogical, and environmental influences on the attitudes of students toward science across the literature.

Gender differences had the lowest mean score (M = 3.49, SD = 1.446) besides peer pressure, suggesting that the gender of students had a weak influence on their attitudes than teachers and classroom elements. While gender had the second lowest mean score in the survey after peer pressure, research on how gender influenced science attitudes has been mixed.

The researcher also collected responses from teachers. Table 6 presents the results from teachers concerning the factors that influenced students' attitudes towards primary science in basic schools in the Left Bank2B District, Liberia. The responses from teachers were sought so as to triangulate the data for a comprehensive understanding of the phenomenon.

Table 6: Responses on Factors Influencing Attitudes of teachers towards Primary Science (N=20)

	% Responses					
Statements	**TA**	**NR**	**TD**	**Mean**	**SD**	**Skewness**
Teachers' teaching methods can influence the attitudes of students toward science.	65.00	0.00	35.00	3.30	1.592	-0.549
Teachers' qualifications can influence students' attitudes toward science.	90.00	0.00	10.00	4.20	0.894	-1.412
The learning environment has an impact on students' attitudes toward science.	90.00	0.00	10.00	3.85	1.039	-2.167
Instructional materials affect students learning of science	100.00	0.00	0.00	4.55	0.510	- 0.218
The perception of the students affects their' attitudes toward science	55.00	0.00	45.00	3.00	1.622	0.164
Gender differences impact students' attitudes toward science.	95.00	0.00	5.00	3.95	0.759	-3.122
Peer influence affects students' attitudes toward science.	100.00	0.00	0.00	4.70	0.470	-0.945
Parental influence affects students' attitudes toward science.	80.00	0.00	20.00	4.25	1.332	-1.547
Lack of motivation from teachers influences students' attitudes toward science.	50.00	0.00	50.00	3.00	1.297	0.000
Teachers' attitudes toward the subject can influence the students' attitudes toward science	50.00	0.00	50.00	3.05	1.468	0.016

Source: Fieldwork, Williams (2023)

TA is total agreement, NR is neutral response, TD is total disagreement, and SD is standard deviation.

From Table 6, the results indicate that teachers believed their teaching methods, qualifications; the learning environment, instructional materials, gender differences, peer influence, parental influence, and their attitudes could influence students' attitudes towards science. Statements with the highest percentage of agreement were "Instructional materials affect students' learning of science" with 100.00% agreement (M=4.55, SD=0.5104, Skewness= -0.218), "Peer influence affects students' attitudes toward science" with 100.00% agreement (M=4.70, SD=0.4701, Skewness=-0.945), and "Gender differences impact students' attitude toward science" with 95.0% agreement (M=3.95, SD=0.7591, Skewness=-3.122). This suggests that teachers strongly believed that instructional materials, peer interactions, and gender differences impact students' attitudes toward science. Also, the statement with the highest mean score was "Peer influence affects students' attitudes toward science"(M=4.70, SD= 0.4701). A negatively skewed value of -0.945 suggests that the distribution of responses for this factor was slightly skewed to the left, indicating a strong agreement or consensus among respondents that peer influence impacted students' attitudes toward science. Other statements with high means were "Parental influence affects students' attitude toward science" (M=4.25, SD=1.332, skewness= -1.547), and "Teachers' qualifications can influence students' attitudes toward science" (M = 4.20, SD = 0.89, Skewness= -1.412). Teachers widely agreed that their qualifications, expertise, and peer interactions shaped students' attitudes. Students were more likely to have positive attitudes towards science if their teachers were qualified and knowledgeable.

Statements with moderate mean were, “Teachers’ teaching methods can influence the attitudes of students toward science” (M = 3.30) but a higher standard deviation (SD = 1.59), “Learning environments have an impact on students’ attitude toward science” had a moderate mean (M = 3.85) but a standard deviation of (SD =1.04), and “Parental influence” was also split, with the relevant statement having a mean of (M = 4.25) but a standard deviation of (SD =1.33).

The statements with the lowest percentages of agreement, “The perception of the students affects their attitudes toward Science”, with 55.00% agreement (SD =1.622) and "Lack of motivation from teachers influences students' attitudes toward science", with 50.0% agreement (SD =1.297), share the lowest mean score of (M = 3.00). This suggests a moderate level of influence for both factors. However, it is worth noting that while they shared the same mean score, “The perception of the students” exhibited a slightly positively skewed distribution of (0.164), indicating that more respondents tended to disagree than agree, whereas “Lack of motivation from teachers” had a nearly symmetrical distribution of responses with a skewed value of (0.000) which indicates that the distribution of responses for this factor was approximately symmetrical. In other words, the data for this factor was evenly distributed around the mean, with roughly equal numbers of respondents on both sides of the distribution.

The results reveal that teachers' perceptions illustrate a vital consent regarding the positive influence of instructional materials (M=4.55, SD=0.510), peer interactions (M=4.70, SD=0.470), and gender differences (M=3.95, SD=0.759), on students' attitudes toward science. Moreover, teachers believed their qualifications and expertise (M=4.20, SD=0.894), played a significant role. However, there was more variability in their opinions about the influence of teaching methods (M=3.30, SD=1.592), the learning environment (M=3.85, SD=1.039), students' perceptions (M=3.00, SD=1.622), and teacher motivation (M=3.00, SD=1.297). Taking these perceptions into account can inform strategies to improve students' attitudes toward science by focusing on the factors that teachers strongly agree with.

Student's Perceptions of Pedagogy Used by Teachers in Teaching Primary Science

Research question two sought to explore how students perceived the various teaching methods, strategies, and approaches their science teachers used during science lessons. That is, the researcher explored how students perceived the various teaching methods, strategies, and approaches used by their science teachers during science lessons. The implications of the research findings can guide educational policymakers, school administrators, and science teachers in the Left Bank2B District to make informed decisions about instructional strategies and professional development opportunities. The data collected were analyzed using total agreement percentages, neutral response percentages, total disagreement percentages, mean, and standard deviation. The results are presented in Table 7.

Table 7: Students' Responses on Perceptions of Teachers' Pedagogy Used in Teaching Primary Science (N=337)

	% Responses					
Statements	**TA**	**NR**	**TD**	**Mean**	**SD**	**Skewness**
The science teacher effectively explains scientific concepts and ideas.	32.00	0.00	68.00	2.46	1.466	0.641
The science teacher incorporates hands-on experiments or practical activities in the classroom.	11.50	0.00	88.50	1.82	1.095	1.708
Science teachers encourage student participation and active learning during science lessons.	22.80	0.60	76.60	2.28	1.268	1.001
Your science teacher values and respects your ideas and opinions in the classroom.	80.40	0.30	19.30	3.91	1.271	-1.202
Science teacher promotes a growth mindset and critical thinking in science learning.	22.30	0.00	77.70	2.09	1.327	1.082
The science teacher encourages creativity and innovation in science projects or assignments.	62.00	0.30	37.70	3.32	1.525	-0.421
The science teacher encourages class discussions and student questions during science lessons.	24.30	0.00	75.70	2.23	1.382	0.973
The science teacher uses technology or digital tools to enhance science instruction.	8.90	0.30	90.80	1.68	1.005	1.951
The science teacher supports your understanding of difficult or complex scientific topics.	32.00	0.00	68.00	2.57	1.425	0.640
The science teacher encourages student collaboration and teamwork in science activities or projects.	67.10	0.00	32.90	3.53	1.547	-0.621

Source: Fieldwork, Williams (2023)

TA is total agreement, NR is neutral response, TD is total disagreement, and SD is standard deviation.

As can be seen in Table 7, the low means, especially for hands-on activities (M =1.82), technology use (M =1.68), discussions (M =2.23), and critical thinking (M = 2.09), implied that these practices were rarely implemented. Students disagreed that they occurred frequently. Interestingly, high standard deviations for practices like creativity promotion (SD =1.525) and collaboration (SD = 1.547) suggest there was a wide variability in perceptions of these. Some students experienced these activities more than others. Moreover, highly positive skewness values for hands-on instruction (1.708), technology integration (1.951), and critical thinking (1.082) indicate the data was clustered on the lower end. The distribution was highly non-normal, affirming that these practices were infrequent. In contrast, respecting students' ideas (skewness = -1.202) and valuing creativity (skewness = -0.421) were less skewed, fitting with the higher means. Still, the negative skews show more students agreed than disagreed. Altogether, these distributional statistics confirm students had low exposure to active learning pedagogies, though social support practices were slightly more prominent. The non-normal data reflects consistency in student perceptions. Further explanations of the items are provided in the ensuing paragraphs. The highest-rated pedagogical practice was teachers valuing and respecting students' ideas and opinions, with 80.4% agreement (M = 3.91, SD = 1.271).

The lowest-rated practices were incorporating hands-on activities (11.5% agreement, M = 1.82, SD = 1.095) and using technology (8.9% agreement, M = 1.68, SD = 1.005). The highly positive skew indicates most students desired more active, technology-enhanced instructional approaches. Other student-centered practices, such as promoting discussions and questions, with 24.3% agreement (M=2.23, SD= 1.382) and critical thinking, with 22.3% agreement (M=2.09, SD=1.327), were also rated low. What appears to be surprising is the level of disagreement concerning the statement that "science teachers promote a growth mindset and critical thinking in science learning". Figure 6 illustrates the distribution of agreement and disagreement.

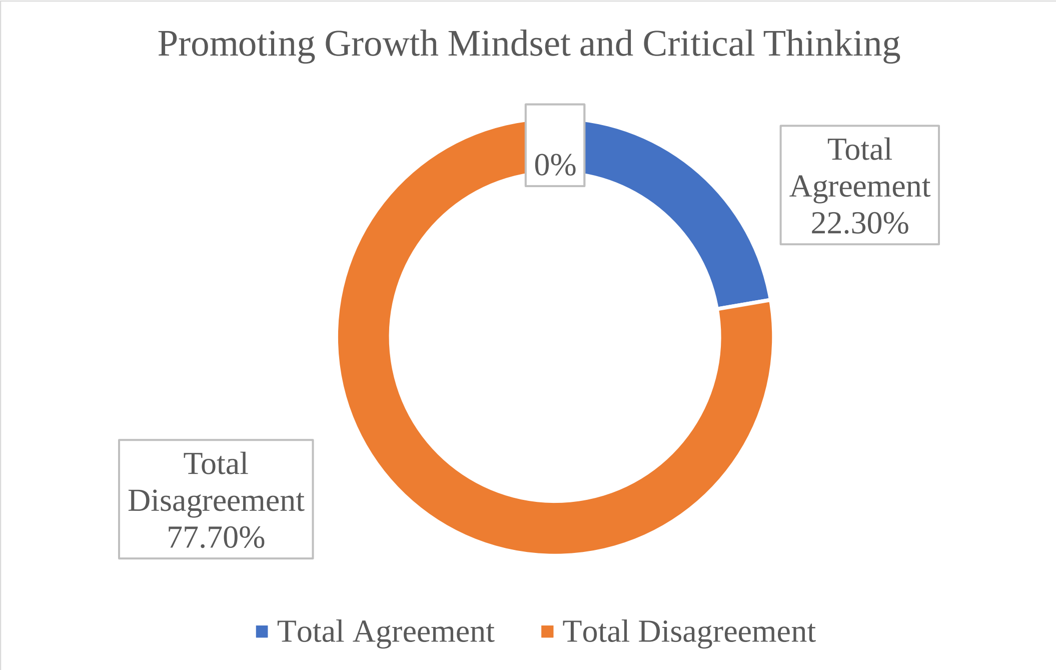

Figure 6: Promoting Growth Mindset and Critical Thinking (Source: Fieldwork, Williams, 2023)

As seen in Figure 6, majority of students (77.7%) disagreed or strongly disagreed with the statement. This highlights a significant need for improvement in how science teachers promoted a growth in mindset and critical thinking in their classrooms. To support this with the data on skewness, the positive skewness of 1.082 indicated that the distribution of responses was skewed to the right, with more students leaning towards disagreement.

In contrast, directly explaining concepts well (32.0% agreement) and supporting understanding of difficult topics (32.0% agreement) were rated higher. The relatively higher percentages for teacher explanations and support with complex concepts suggest students still depended significantly on direct instruction from the teacher rather than conducting hands-on inquiry themselves. Collaborative teamwork had moderate agreement (67.1%), and a low disagreement (32.9%).

The researcher also sought to explore the perceptions of teachers regarding students' attitudes towards the pedagogy used in teaching primary science in the basic schools of the Left Bank2B District, Liberia. This investigation aimed to explore how teachers perceived their instructional approaches and how they perceived students' responses to these approaches in the science classroom. The implications of the findings are multifaceted and hold significant value for science education in the Left Bank2B District. The results are presented in Table 8.

Table 8: Teachers' Responses on their Pedagogy Used in Teaching Primary Science

	% Responses					
Statements	**TA**	**NR**	**TD**	**Mean**	**SD**	**Skewness**
The lesson or activity used by the teacher helps pupils grasp a scientific concept	90.00	0.00	10.00	4.20	0.8944	-1.412
The teacher encourages collaboration and teamwork among students in science activities or projects.	45.00	0.00	55.00	3.05	1.571	.180
The teacher helps a student overcome their scientific illiteracy.	95.00	0.00	5.00	4.05	0.6048	-1.598
The teacher motivates the students to think creatively and critically in class.	45.00	0.00	55.00	2.85	1.755	.188
Science teachers encourage teamwork and collaboration among their students.	40.00	0.00	60.00	2.75	1.446	0.370
The teacher approach science teaching with varying needs and learning styles.	45.00	0.00	55.00	3.00	1.521	0.199
The teaching methods used by the science teacher make the subject interesting and engaging.	60.00	0.00	40.00	3.25	1.446	-0.370
The teacher changes his/her pedagogy to accommodate the curriculum or science lesson.	30.00	0.00	70.00	2.45	1.468	0.774
The teacher frequently incorporates hands-on experiments and practical activities into science lessons.	40.00	0.00	60.00	2.65	1.424	0.331
The teacher engages the pupils in scientific learning and fosters a sense of curiosity.	55.00	0.00	45.00	3.25	1.446	-0.138

Source: Fieldwork, Williams (2023)

TA is total agreement, NR is neutral response, TD is total disagreement, and SD is standard deviation.

As can be seen in Table 8, the statement with the highest level of agreement was "The lesson or activity used by the teacher helps pupils grasp a scientific concept" (90.0% agreement), which had the highest means (M = 4.20) and lowest standard deviations (SD = 0.89). This implies that most teachers were confident in their ability to choose activities and lessons that promoted conceptual understanding. However, this high level of confidence may actually reflect a narrow view among teachers about what constitutes effective science instruction.

In contrast, the results reveal some inconsistencies in teachers' use of pedagogical strategies shown to support student engagement and positive attitudes toward science. Statements about utilizing techniques focused on critical thinking, hands-on experimentation, and collaboration had relatively low means ranging from 2.75 to 3.05. Additionally, the standard deviations for these items were moderately high, spanning from 1.44 to 1.75. In a similar vein, the moderate means and higher standard deviations for making science interesting and fostering curiosity imply inconsistent beliefs among teachers about whether their current instructional approaches achieved these attitude-focused outcomes.

Furthermore, some surprising results were identified with statements 6 and 8, which concerned "the teacher approaches science teaching with varying needs and learning styles" and "the teacher changes his or her pedagogy to accommodate the curriculum or science lesson," respectively. The total agreement responses are summarized and illustrated in Figures 5 and 6, respectively.

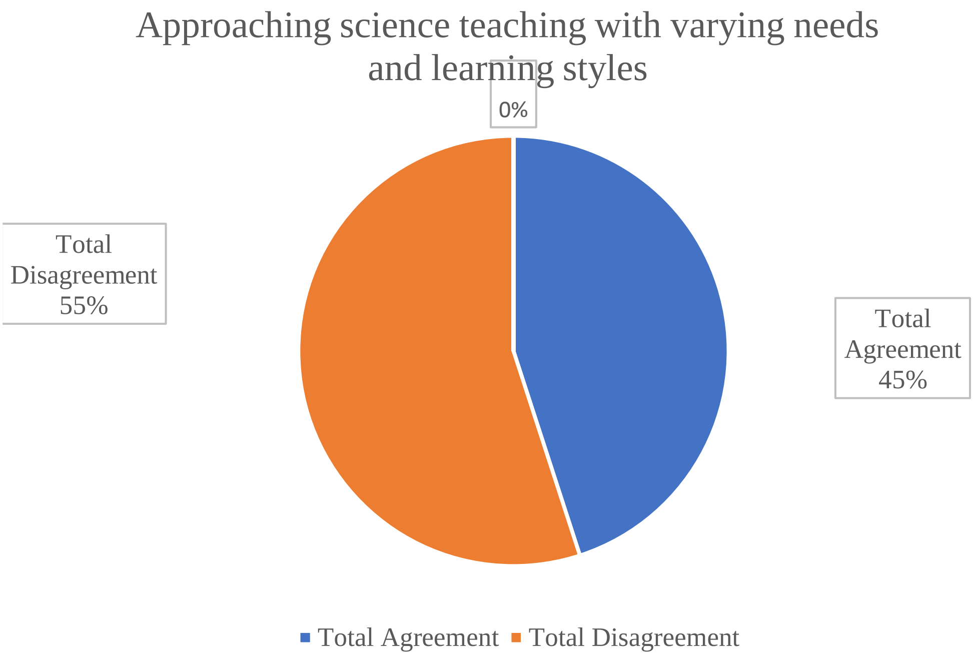

Figure 7: Approaching Science Teaching with Varying Needs and Learning Styles (Source: Fieldwork, Williams, 2023)

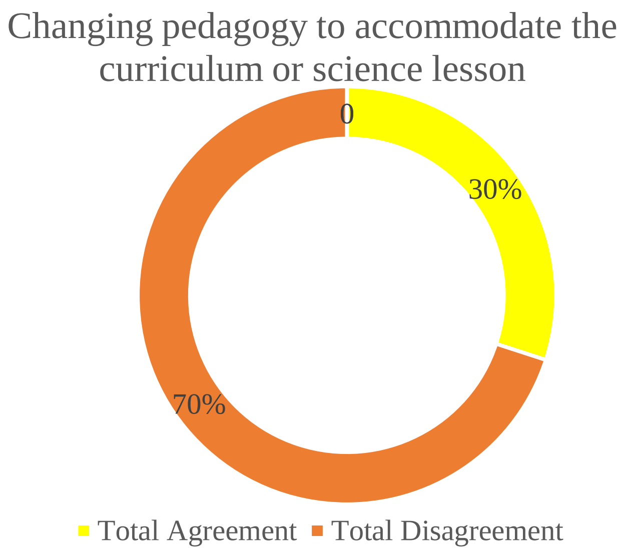

Figure 8: Changing Pedagogy to Accommodate the Curriculum or Science Lesson (Source: Fieldwork, Williams, 2023)

Deducing from Figures 5 and 6, the statements about accommodating varying needs and changing pedagogy to accommodate curriculum both had low levels of teacher agreement, with only 45.0% and 30.0% agreeing, respectively. The means for these statements were also on the lower end, at 3.00 and 2.45. Meanwhile, the standard deviations were moderately high at

1.521 and 1.468. The low means indicate teachers overall did not feel they engaged in these practices regularly. The higher standard deviations suggest there was wide variability in whether teachers modify their instructional approaches to address diverse learning styles or align with particular science content.

Comparatively, teachers mostly believed in the importance of instructional materials. With a unanimous agreement of 100.0%, they affirmed that instructional materials significantly affected students' science learning. The high mean score of 4.55 indicates a consensus that instructional materials were essential tools for effective pedagogy. Meanwhile, they firmly believed that their qualifications and expertise significantly influenced students' attitudes toward science. An overwhelming 90.0% agreed with this statement, resulting in a high mean score of 4.20. This indicates that teachers recognized the impact of their qualifications on shaping students' perceptions of the science subject. Teachers also acknowledged the importance of peer and parental influence on students' attitudes toward science. They recognized that both factors played a significant role, with high agreement percentages of 100.0% for peer influence and 80.0% for parental influence. However, when it came to teaching methods, there was more variability in their responses, 65.0% agreed, resulting in a moderate mean score of 3.30. This suggests that while teachers acknowledged the role of their teaching methods, opinions differed on the extent of its influence on students toward science.

Meanwhile, students firmly believed peer influence significantly affected their attitudes toward science. Like teachers, 100.0% of students agreed with this statement, yielding a high mean score of 4.70. This alignment underscores the powerful impact of peer interactions on students' attitudes. A noteworthy 95.0% of students agreed that gender differences impacted their attitudes toward science. This high level of agreement, coupled with a mean score of 3.95, indicates that students knew the influence of gender-related factors on their perceptions of the subject. However, students were divided regarding teacher motivation's impact on their attitudes toward science. An equal 50% agreed and disagree, yielding a moderate mean score of 3.00. The nearly symmetrical distribution of responses (skewness of 0.000) suggests a balanced view. Both groups emphasized the importance of instructional materials and peer influence, with unanimous agreements and high mean scores. Teachers placed significant emphasis on their qualifications, while students were more aware of the impact of gender differences. Additionally, teachers and students had varying views on the influence of teaching methods, the perception of students, and teacher motivation.

Hypotheses Testing

In the pursuit of enhancing the quality of education and promoting positive outcomes in primary science education, it becomes essential to explore the potential impact of teachers' pedagogy on students’ attitudes and teachers' pedagogy, students’ attitudes on academic performance in science. This section examines two critical hypotheses in the context of the Left Bank2B District, Liberia.

Relationship between teachers’ pedagogy and students’ attitude towards the teaching of primary science

The first null hypothesis (H_{01}) postulates that there is no significant relationship between the pedagogy used by teachers in teaching primary science and students' attitudes towards primary science in the basic schools of the Left Bank2B District, Liberia. Conversely, the alternative hypothesis (H_{A1}) proposes that a significant relationship exists between the pedagogy used by teachers and students' attitudes towards primary science. The first null hypothesis was tested with Pearson correlation. This is because it assesses the linear relationship between two continuous variables, which aligns with the measurement of both pedagogy and attitudes using multi-item Likert scales. In this regard, the Likert scale data for both variables can be treated as continuous measurements satisfying Pearson assumptions. Before this, the researcher tested for normality (using Q-Q plot) (see Figures 7 and 8) and linearity (scatter plot) (see Figure 9) of the data before the Pearson correlation test.

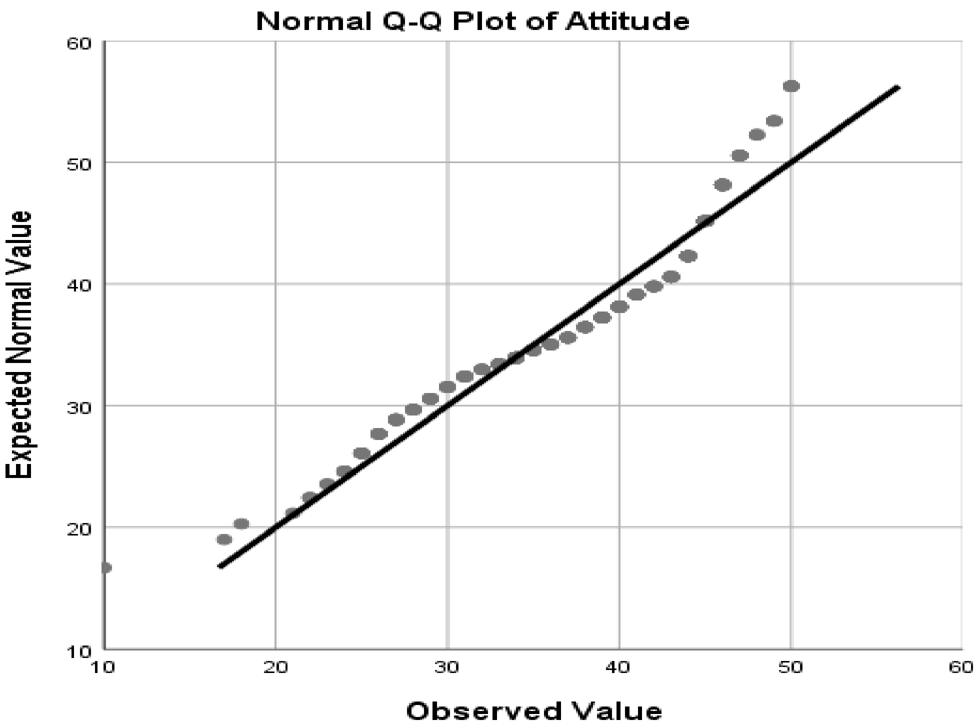

Figure 9: Q-Q Plot of Attitude (Source: Field data, Williams, 2023)

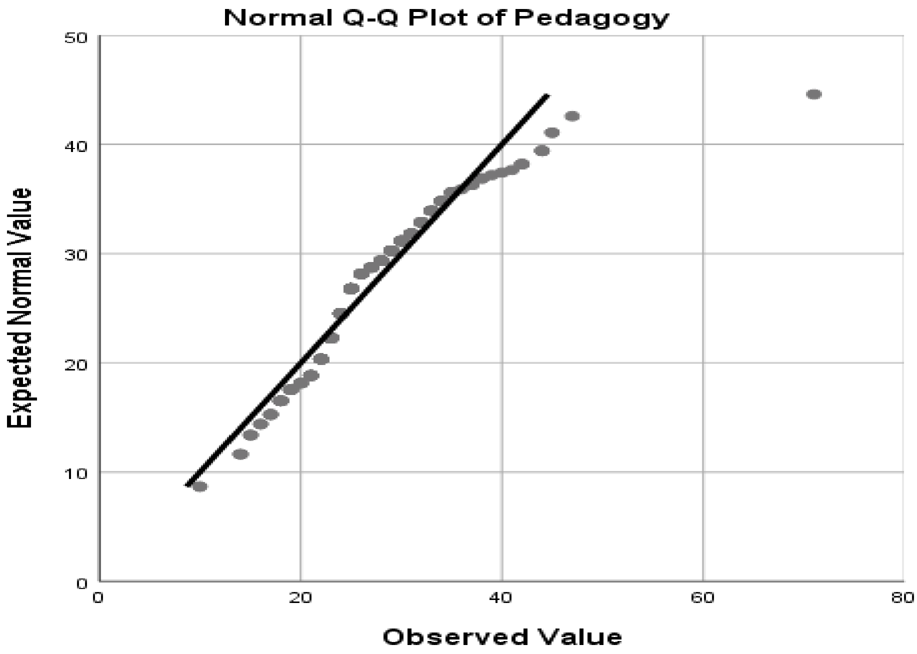

Figure 10: Q-Q Plot for Pedagogy (Source: Field data, Williams, 2023)

From Figure 9, the equation y = 35.29 + 0.11*X, represents a linear relationship between the variables y (Attitude) and X (Pedagogy). Following these normality tests, the researcher proceeded to conduct the correlation analysis between teachers' pedagogy and students' attitude.

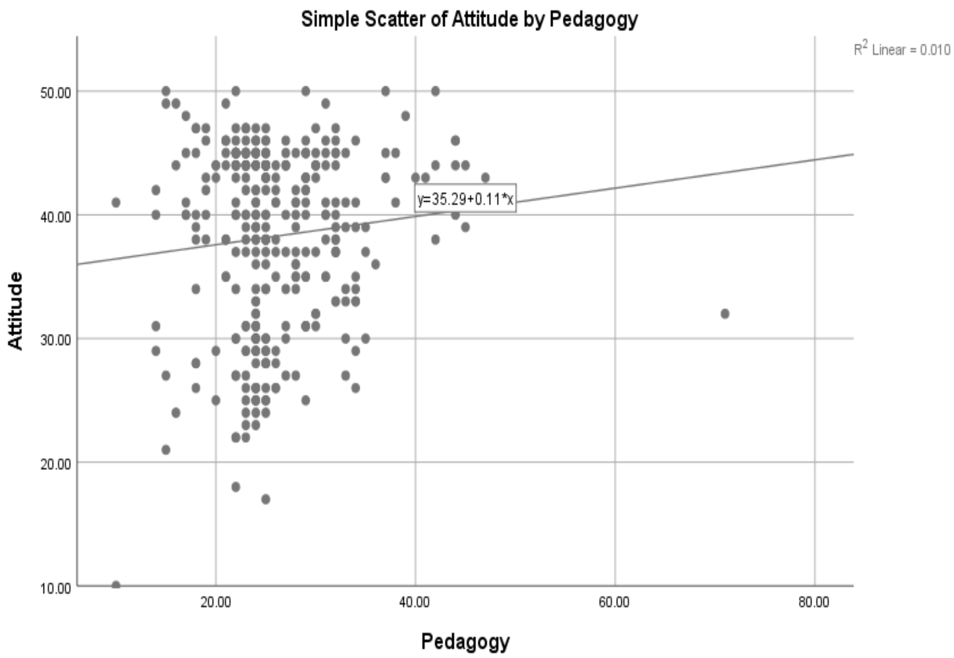

Figure 11: Scatter Plot for Attitude and Pedagogy (Source: Field data, Williams, 2023)

The main Pearson correlation results of the statistical relationship between the pedagogy used by teachers and students' attitudes is presented in Table 9. Based on the correlation results in Table 9, the researcher failed to reject the null hypothesis (H_{01}). The results show a weak positive correlation between students' attitudes and teachers' pedagogy [r (337) = 0.098, p = 0.071]. Notably, this correlation lacks statistical significance at the 0.05 significance level (p = 0.071). Consequently, these outcomes did not support rejecting the null hypothesis at the 0.05 significance threshold. The findings suggest a weak positive correlation between teachers' pedagogy and students' attitudes, which shows that the relationship was not statistically significant. Therefore, based on the analysis, it cannot be concluded that teachers' pedagogy has appreciable relationship with students' attitudes towards primary science. Other variables or factors may play a more substantial role in shaping students' attitudes in this context.

Table 9: Statistical Relationship between Teacher's Pedagogy and Students' Attitudes

		Students' Attitude	**Teachers' Pedagogy**
Students' attitude	Correlation Coefficient	1.00	0.098
	Sig. (2-tailed)		0.071
	N	337	337
Teachers' pedagogy	Correlation Coefficient	.098	1.00
	Sig. (2-tailed)	0.071	
	N	337.00	337.00

Source: Fieldwork, Williams (2023)

Influence of teachers' pedagogy and student attitudes on students' academic performance in science

Research hypothesis two was intended to determine the influence of teacher pedagogy and students' attitude on the student's academic performance. The hypothesis sought to find out how much of the variance in students' academic performance in science could be explained and accounted for by teachers' pedagogy and students' attitudes towards the subject. To achieve this purpose, a standard regression analysis was carried out. The model consisted of one dependent variable (students' academic performance) and two predictor variables (teacher pedagogy and students' attitudes). Before analyzing the data, assumptions of, normality, linearity, homoscedasticity and multicollinearity (Pallant,2016) were examined.

Firstly, a normality check was performed on the residuals through a histogram, revealing an approximately normal distribution, as shown in Figure 10.

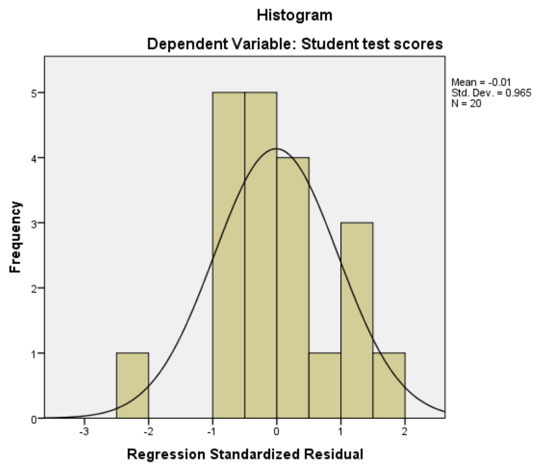

Figure 12: Histogram of Dependent Variable (Students test scores)

Observing the normality probability plots and residual scatter plot suggests no significant deviation from normality (see Figure 11 and Figure 12). In the normality probability plots, the points were approximately distributed along the straight diagonal line from bottom left to top right. In the scatterplot the residual were roughly rectangularly distributed (Pallant, 2016).

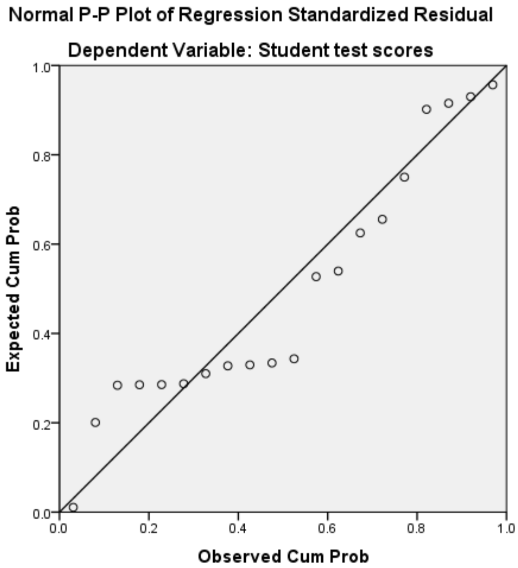

Figure 13: Normality Probability Plot

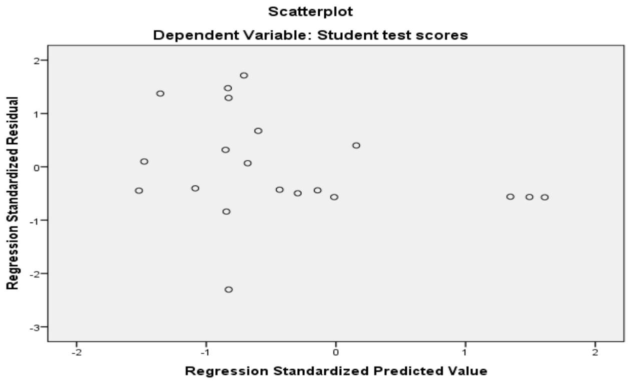

Figure 14: Residual Scatterplot

The R-value shows the correlation between the dependent and independent variables. If R > 0.4, the model is chosen for additional analysis due to the likelihood of collinearity in the dataset (Senthilnathan, 2019). In this instance of dependent variable: Students' test scores examined by predictors: Teaching pedagogy (R = 0.000) and Student attitudes (R = - 0.042) was very weak correlation as shown in Table 10, multicollinearity was not violated.

Table 10: Correlations Results for Multicollinearity Assumption

		Student test scores	Teacher Pedagogy	Student attitudes
Pearson Correlation	Student test scores	1.000	0.000	-0.042
	Teacher Pedagogy	0.000	1.000	0.071
	Student attitudes	-0.042	0.071	1.000
Sig. (1-tailed)	Student test scores	.	0.499	0.222
	Teacher Pedagogy	0.499	.	0.382
	Student attitudes	0.222	0.382	.
N	Student test scores	337	20	337
	Teacher Pedagogy	20	20	20
	Student attitudes	337	20	337

The model summary result of regression analysis is presented in Table 11. The R^2 value indicates how much of the variance in the dependent variable (Student test score) is explained by the model that is student attitudes and teacher pedagogy, the independent variables (predictors)

Table 11: Summary Results for Students Attitudes and Teacher Pedagogy on Students Test Scores

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.042[a]	0.002	-0.116	8.206

a. Predictors: (Constant), Student attitudes, Teacher Pedagogy
b. Dependent Variable: Student test scores

Using R^2 (Coefficient of determination), the total variation in the dependent variable by the independent variables (predictors) can be accounted for. The model is effective enough to identify the association when $R^2 > 0.5$ (Senthilnathan, 2019).

In this case the value of R^2 is 0.002. Expressed as a percentage, this means that students' attitude and teachers' pedagogy explain 0.2 % of the variance in student test scores. In order words, holding all other factors constant, students' attitude and teachers' pedagogy accounted for only 0.2 % of the differences in students' test scores. That is, about 99.8 % of the variation in students' test scores cannot be explained by teachers' pedagogy and students' attitudes. There might be other factors which need to be explored.

As illustrated in Table 12, upon closer examination of individual predictors, it became evident that only the constant term, representing the intercept, exhibited statistical significance (B = 73.28, $p < 0.000$). This suggests a significant impact even when Teachers' Pedagogy and Student Attitudes are held constant at zero. In contrast, both Teachers' Pedagogy (B = 0.019, p = 0.991) and Student Attitudes (B = -0.439, p = 0.865) were not statistically significant. These findings imply that, while the overall model is robust, the individual predictors did not independently contribute significantly to the variation in the dependent variable (student test scores). Caution is advised in generalizing these results, and further research is needed to explore additional factors influencing the outcome variable.

Table 12: Beta Results for Students Test Scores and Predictors: Teacher Pedagogy and Student Attitudes

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	73.283	10.913		6.715	0.000
	Teacher Pedagogy	0.019	1.707	0.003	0.011	0.991
	Student attitudes	-0.439	2.537	-0.042	-0.173	0.865

a. Dependent Variable: Student test scores

Analysis of Headteachers Interview Responses

This section presents the qualitative analysis of the semi-structured interview responses collected from headteachers in primary schools in the

Left2Bank District. The analysis and discussion are presented in relation to the research questions. Themes were developed to guide the discussion.

Science attitudes in early education play a pivotal role in developing motivated and engaged learners who pursue science interests over the long-term. To understand factors shaping primary students' affective responses to science, interviews were conducted with heads of schools in the Left Bank2B District of Liberia. These leaders offer valuable insights from their observational experiences in schools. Their insider position provides a unique vantage point on attitudinal drivers. This qualitative analysis aims to elucidate key themes in their perceptions of influences on student science attitudes. Specifically, the analysis helps illuminate the first research question of this study: What are the factors influencing students' attitudes towards primary science in basic schools in the Left Bank2B District, Liberia? This inductive process provides a rich, grounded understanding of elements cited as shaping students' motivation and engagement with science subjects. By coding and synthesizing the perspectives of these experienced school heads, common themes related to impactful factors emerged (a) teachers' relationship with students, (b) impact and measures to improve students' attitudes, (c) effective teaching pedagogies and adjustment (d) support and professional development for teachers, and (e) loss of interest and encouragement of students in science.

Teachers' relationship with students

Concerning this theme from the interview responses, there appeared to be some variation in how heads of schools characterized the student-teacher relationships in their schools. An instance is provided below.

The relationship between teachers and students in my school were characterized by a strong sense of community, respect, and mutual support. Our teachers genuinely care about the well-being and academic success of their students. (HT1)

HT1 described a very positive relationship marked by "a strong sense of community, respect, and mutual support." This suggests an environment where teachers and students connected on both academic and personal levels. This response highlights a positive and supportive relationship between teachers and students. The reference to teachers caring about student "well-being and academic success" implied a holistic concern for development. Teachers were invested in the well-being and academic success of their students, indicating a healthy and nurturing environment.

HT7 offered a more neutral assessment, describing the relationship simply as "smooth." This could mean an absence of major conflict, but did not necessarily suggest deep caring bonds.

The relationship between the teacher and students is smooth. (HT7)

This could indicate that in some cases, the relationships might not be completely positive or completely challenging but rather fell somewhere in between. Aside from HT7, responses from HT2 and HT12 indicated a more nuanced and mixed relationship between teachers and students.

The relationship between teachers and students in most cases are always bitter sweet. (HT2)

Mostly the relationship is not smooth. (HT12)

While one response described the relationship as "bitter sweet," the other implied that the relationship was often not smooth. These descriptions suggest that there might be both positive and challenging aspects to the interactions between teachers and students. These responses could potentially signify areas that need improvement in terms of communication, rapport, or understanding. Conclusively, there appears to be a range of relationship dynamics reported across the schools, with examples of very strong as well as difficult student-teacher relationships. This variation likely reflects differences in school climate, leadership, teacher skills, and student behaviors. But these insights reveal relationship-building as an area for ongoing attention and improvement.

Impact and measures to improve students' attitudes

The analysis of this theme based on the responses show that heads of schools perceived the teachers' pedagogical approach as having a significant influence on students' attitudes towards science. There were some practical measures that could be implemented to enhance students' engagement and positive perceptions of science education.

From my experience as a principal, one of the factors that impact students' attitudes is the teacher's way of teaching the subject. (HT20)

To enhance teachers teaching method and lesson presentation. (HT3)

The use of visuals and practical instructions. (HT11)

The teaching method of the teacher has a powerful impact on students' attitudes toward learning science. (HT7)

HT20 notes that "the teacher's way of teaching the subject" impacts student attitudes, indicating instructional methods play a key role. HT7 echoes this, stating the "teaching method of the teacher has a powerful impact". That is, HT7 and HT20 imply that an effective teaching method can contribute positively to students' attitudes. With regard to improving attitudes, heads recommended enhancing teaching techniques (HT3), using visual aids and hands-on activities (HT11), and improving lesson presentation (HT20). This implies that student-centered, engaging methods were viewed as better for nurturing positive affect.

However, some heads reported observing poor student attitudes and disinterest overall (HT7, HT13), suggesting current teaching strategies may not be optimized to motivate students. Concerning the perceptions of headteachers towards the overall attitudes of the students, some headteachers commented that:

From my own perception, students have poor attitudes towards science. (HT7)

Students seem not to have interest in learning the discipline. (HT13)

These responses provide insight into headteachers' perceptions of the overall attitudes of students, suggesting that some headteachers believed that students might have negative attitudes or lacked interest in science as a discipline. The perceptions of headteachers provide an external perspective on students' attitudes. The comments about poor attitudes and lack of interest raise questions about potential underlying reasons for these perceptions, which could include curriculum relevance, teaching effectiveness, or students' personal interests.

Effective teaching pedagogies and adjustment

In the realm of education, understanding the dynamics that influence students' attitudes towards learning science is of paramount importance. This theme provides insights from heads of schools on effective teaching strategies for improving student attitudes towards science, as well as ways teachers can adjust their pedagogy. Some responses are provided below.

I have observed over the years that cooperative methods are effective in improving students' attitudes towards learning science. (HT20)

I have noticed what I consider as "play work" method – where students are taught the concept of science and some activities through the form of play. This helps a lot to increase their interest in science. (HT10)

Teacher should explain the importance of science in our daily life. (HT2).

Teachers can do this by working on their skills and even their plan of action. Indeed, this can also be done by doing proper studies, putting in more time to research materials and following the rightful patterns of notes preparation. (HT4)

From the responses, HT20 noted that cooperative, collaborative methods had been effective based on his observations. Cooperative methods involve collaborative and interactive learning among students, fostering engagement, peer interaction, and a positive learning atmosphere. Group work and peer learning may help build engagement. HT10 introduced the concept of "play work" as an effective pedagogical method. Play-based learning involves using playful and interactive activities to teach scientific concepts. HT10 described a "play work" approach using activities to teach concepts. Such teaching with hand-on makes science fun, which increase student interest. Connecting science to real-world relevance is another recommendation (HT2). Linking concepts to everyday life could potentially make material more meaningful. Teachers could make science more meaningful and engaging for students by demonstrating how science concepts are interconnected with real-world applications. Finally, HT4 focused more on the teacher's preparation and skills. Suggestions include researching materials, thoughtful lesson planning, and honing note-taking abilities. The response by HT4 shows that improving teaching skills, planning, and pedagogical approaches through research, preparation, and learning can enhance the effectiveness of instruction and, consequently, students' attitudes towards learning.

Support and professional development for teachers

The heads of schools described providing professional development for science teachers primarily through workshops and training sessions. On the surface, this seems like a reasonable approach to enhance pedagogical skills. However, I have some concerns about overreliance on these types of traditional activities.

Workshop. (HT5)

We provide workshop and training. (HT7)

Our teachers are provided with the following; workshops and training sessions. This is where experienced science educators share their expertise in the area of science. (HT10)

We provide our teachers with separate teacher training only for science (primary) teacher workshop. (HT3)

All the responses point to workshops and training. Workshops and trainings are valuable for sharing information, but do they really provide sustained skills development? A one-off workshop may give an inspirational burst of new ideas, but teachers may not transfer this knowledge to the classroom. Interestingly, targeted teacher training (HT3) allows educators to focus on subject-specific pedagogies and content, ensuring that they are well-equipped to effectively teach science to their students. Also, having veteran teachers (HT10) share their expertise is great, but newer instructors may offer fresh perspectives too. Some heads mentioned "training" which implied more hands-on skill building. But again, isolated training events won't change ingrained practices without follow-up mentoring and feedback. I would recommend supplementing workshops with instructional coaching, teacher peer observations, and communities of practice to really transform pedagogy.

Loss of interest and encouragement of students in science

Some of the interview excerpts provided insights from heads of schools regarding factors that might contribute to students losing interest in science, as well as ways to encourage continued engagement. The responses pointed to inadequate teaching methods, resource limitations, and promoting importance of science. Excerpts are presented below.

The inadequacy of teaching and methods used in the classrooms could be one of the possible reasons for students losing interest in primary science. (HT6)

Limitation of resources such as access to science laboratories equipment can cause students to lose interest in primary science. (HT3)

Making students know the importance of science. (HT9)

You can encourage students to pursue science careers by developing their interest in the subject. (HT20)

One potential reason cited was inadequate teaching methods in the classroom (HT6). It raises a concern about the relevance and effectiveness of instructional strategies employed within classrooms. This points to the critical role pedagogy plays in influencing attitudes and implies current practices may not be optimized to inspire intrinsic motivation. As posited by Jones (2018), traditional transmission-focused techniques can fail to nurture the curiosity, creativity, and love of discovery that fuel sustained passion for science. Another factor mentioned was limited resources and laboratory access (HT3). Lack of hands-on learning opportunities could understandably dampen enthusiasm. This limitation underscores the structural challenges within educational institutions that may hinder students' enthusiasm for the subject. As Kapur (2008) discussed, active experimentation allows students to experience the wonder of scientific processes first-hand. In terms of encouragement, heads recommended underscoring the relevance of science (HT9) and developing inherent interest (HT20). This perspective aligns with the long-term impact of early engagement.

Teaching practices play an instrumental role in shaping students' educational experiences and attitudes toward learning. To understand primary students' perception of science pedagogy in the Left Bank2B District of Liberia, interviews were conducted with heads of schools who interact closely with pupils. Students are the primary stakeholders affected by pedagogical choices. Their lens may reveal areas where teaching practices succeed or need improvement. As proxies for direct student voices, heads' insights help characterize dominant views among pupils. This analysis was intended to uncover key themes related to how students viewed their teachers' instructional approaches during science lessons. To analyze the responses, the researcher grouped common perspectives that emerged regarding strengths, weaknesses, and general impressions of current science teaching strategies. The themes are (a) Methods adopted in assessment and learning (b) Teaching styles, Teaching and Learning Materials and pedagogical strategies (c)

Students' socio-demographic differences and perceptions of teachers' pedagogy (d) Students' perception of the strengths and weaknesses of teachers' pedagogy, and (e) Students' motivation, engagement and inclusive learning environment.

Methods adopted in assessment and learning

The methods employed to assess and facilitate learning play a pivotal role in shaping students' understanding and engagement with subjects, particularly in the context of science education. The heads described several methods science teachers currently use, including formal examinations, informal questioning, and inquiry-based activities. While these techniques have merits, overemphasis on testing may limit appropriate gauging of conceptual grasp and cognitive development.

Quizzes, assignments, exams, and class tests. (HT12)

Science teachers use verbal questioning and answering method to assess their students' perceptions about their teaching pedagogy. (HT17)

I believe teachers can use inquiry-based learning cooperative learning and participatory method to help students relate and understand science better. (HT18)

Method of evaluation on some great scientist who contributed toward science causes and they were successful in life. (HT19)

From the response, summative assessments like quizzes and examinations (HT12) had value for evaluating discrete knowledge and skills. However, research indicates frequent standardized testing can inhibit intrinsic motivation and creativity among students (Berliner, 2011). Incorporating informal discussions and questioning (HT17) allows teachers to gauge learning in real-time and tailor teaching accordingly. This aligns with formative assessment practices promoting differentiation and student-centered pedagogy. Project-based assessments via inquiry or cooperative methods (HT18) offer another means of eliciting three-dimensional understandings. As Kuhn (2005) found, evaluating argumentation and applied problem-solving abilities reveals deeper learning than factual recall alone. However, enacting authentic, performance-based assessments requires considerable pedagogical skill and resource allocation.

Teaching styles, Teaching and Learning Materials and pedagogical strategies

The convergence of teaching styles, instructional materials, and pedagogical strategies hold a crucial part in determining the educational landscape. Pedagogical approaches and tools wield tremendous influence in engaging and motivating young science learners. The heads described current reliance on teacher-centered delivery (HT9) and inadequate methods (HT20), signaling a need for enhanced student-focused instruction. While visual aids (HT13) and manipulative (HT8) support learning, mere transmission of content often failed to activate higher-order inquiry. The responses are presented below.

The teaching style of my teachers have been teacher-centered method. (HT9)

To some extent, the teaching styles of our science teachers are very poor in terms of methods and strategies. (HT20)

Based on these teaching styles, the headteachers provided insights into the tools and materials used in teaching. These help to improve their pedagogies. Some commented that:

Science teachers use diagrams, picture cards, concrete objects and equipment to support their pedagogy. (HT13)

Yes indeed. There are particular teaching tools or materials that can serve this purpose such as: pictural displacement of living and non-living things, primary science books of human's skeleton and laboratory materials displacement. (HT8)

The spectrum of teaching styles (HT9 and HT20) underscores the significance of adapting instructional approaches to suit students' needs and promote critical thinking. A critical perspective prompts educator to re-evaluate the alignment between teaching styles, TLMs, and pedagogical strategies to optimize learning outcomes and cater for diverse learning profiles. From these explanations, the headteachers also mentioned some effective pedagogical strategies of the teachers. The heads endorsed student-created visuals (HT8) and group work (HT15) as impactful techniques.

The most effective pedagogical strategies of the primary science teachers include, first, teaching the students materials that they themselves will be able to view like displaying it on the blackboard. Second, allowing them to bring pictures of living and non-living materials in class and keeping their mind set on your subject as a primary teacher of science. (HT8)

Effective used of visual aids, group work, notes inspection and correction. I encourage their use by enhancing their efforts giving help where necessary. (HT15)

As Laboy-Rush (2011) found that, learner-driven knowledge construction significantly improves attitudes and achievement of students. The advice of the heads aligns with constructivist approaches relying on learner inquiry over transmission. Transitioning to student-focused pedagogy entails risks and requires extensive scaffolding. But the potential rewards for igniting curious, analytical young minds are immense. As science leaders, heads are ideally positioned to guide this instructional shift.

Students' socio-demographic differences and perceptions of teachers' pedagogy

The influence of socio-demographic differences on students' perceptions of teachers' pedagogy is a complex and pertinent topic. Student demographics including socioeconomic status, learning styles, motivation levels, and peer groups can shape perceptions of teachers' pedagogy. The heads described how these factors create variances in attitudes and engagement. While recognizing this diversity is important, a sole focus on student deficits can absolve teachers of pedagogical responsibility. Excerpts from the responses and further discussions are provided in the ensuing paragraphs.

Yes. When students associate themselves with others that are willing to learn, they become the best and also in the society or community, when they participate in issues of transformation, they become the best. However, the moment they associate with the unwilling learners, their methods of transformation change completely. (HT4)

Yes. This usually comes about where the student lacks the basic needs of life which is supposed to help them cope well. (HT11)

Yes. Teachers' teaching is not inclusive of all the learning styles. Therefore, some students are left out. (HT2)

Yes. The differences are sometimes: 1. The individual student's style of learning and what they consider 2. The teachers' method of presentation 3. The available resources for learning. (HT10)

References to students lacking "basic needs" (HT11) and resources (HT10) have validity. Disadvantaged students face barriers to learning that teachers must consider. However, constructivist approaches emphasize building on learners' inherent strengths and curiosities regardless of background. Statements about peer influences (HT4) and learning styles (HT2) also acknowledge the range of student individualities. But as Coffey (2010) argued, truly inclusive pedagogies involve flexibility and scaffolding to resonate across styles, not just conforming to one standard. Heads were cognizant that students had varied assets and needs that influenced their educational experiences. But recognizing differences should catalyze teachers to hone their craft, not provide excuses for ineffective one-size-fits-all instruction. With dedication and creativity, teachers can discover each child's unique path to engagement. This student-driven mindset is essential for inclusive, inspiring science pedagogy. In sum, there is a broader societal context and structural factors that contribute to disparities in students' perceptions and learning experiences.

Students' perception of the strengths and weaknesses of teachers' pedagogy

Within the landscape of education, students' perceptions of teachers' pedagogy stand as a critical point of inquiry, providing insights into the effectiveness and impact of instructional approaches. The headteachers identified several factors that influenced these perceptions, with implications for improving instructional effectiveness.

The lack of visuals and technology. (HT11)

They perceive the teacher's experience in science and his/her good and practical presentation as a strength while they see a lazy and inexperienced teacher and the absence of a laboratory as a weakness. (HT10)

Students perceive teacher strengths when the teacher is able to relate to them in a way that they can understand and participate. (HT7)

The strength has to do with receiving the materials. They will be eager to get the material. The weakness will be reading the material and also putting it into their daily life activities. (HT5)

Students respond positively to teachers demonstrating strong content knowledge and engaging delivery (HT10). As Dhindsa and Chung (2003) found, teacher expertise and enthusiasm increase motivation and learning. However, students perceive weaknesses when lessons lack interactivity. The heads cited deficiencies in visuals, technology (HT11), and relatability (HT7). Addressing these deficiencies requires embracing student-centered methods focused on inquiry, discovery, and collaborative learning. The response by HT5 unveils the intersection between material relevance, eagerness, and application as perceived strengths and weaknesses. That is, linking concepts to practical contexts enhances meaning and interest. Planning purposeful, culturally responsive activities could strengthen perceptions. These activities align with the social constructivist theory adopted for the research. To conclude, the headteachers' insights point to needs for improved content mastery, student focus, and contextualization. The path to impactful science pedagogy lies in teachers inspiring curiosity within themselves and their students.

Students' motivation, engagement and inclusive learning environment

This theme related to suggestions or recommendations from the headteachers to motivate engage and promote inclusive learning environment. Cultivating motivated, engaged learners requires an inclusive classroom environment that responds to students' developmental needs and passions. The heads offer important recommendations for how teachers can foster this optimal affective climate. Some of the responses are presented below.

Science teachers need to involve the students in the learning process and make the lesson interesting and enjoyable. (HT13)

In order for students to stay motivated and interested in the subject over time, science teachers should always teach the basic concepts of primary science to the students, allowing them to view it as their life-time careers in detail by conducting detail explanation and helping them to understand it to the fullest. (HT8)

Our teachers are encouraged to used or adopt a more suitable classroom learning environment for teaching primary science. (HT1)

By letting them know that they need to create an environment where no student will be left out of the activities irrespective of their color, creed, religion, etc. which make students to know that they are supported and motivated. (HT15)

First, teachers emphasized designing active, enjoyable lessons that immersed students in the learning process (HT13). The researcher asserts that instruction driven by student inquiry and interests is essential for intrinsic motivation. Connecting science to potential careers and life purposes was another key strategy noted by the headteachers (HT8). Demonstrating relevance and real-world applications enhances meaning and sustains passion beyond the classroom. Furthermore, the heads advocate adapting the physical and social environment to engage all learners (HT1, HT15). The role of the learning environment is to appropriately promote effective teaching practices. In all, the researcher finds some correlations between the theories that underpinned the research and the findings.

Discussion of Results

This section of the research discusses the results from the analysis in relation to the research questions and the hypotheses formulated. The discussion is done under themes.

Students' Attitudes towards Primary Science

For students, the results showed that innovative and varied teaching methods, peer influence, making science personal, active, visual, and gender were all factors that influenced their attitudes towards primary science. The impact of these factors was mixed, with teaching methods and peer influence showing divergent effects on attitudes. Gender differences were inconclusive.

As Adeoye et al. (2019) noted, the use of innovative teaching methods can increase student engagement, enjoyment, and positive attitudes in science. Varying activities and instructional strategies help sustain students' attention and curiosity, preventing boredom that can diminish attitudes (Barmby et al., 2008). Novel, fun activities like experiments and demonstrations can spark student enthusiasm. Also, the results revealed peer influence on the attitude of students towards primary science. Research does indicate peers can shape attitudes, though parental and teacher influences tend to be stronger (George, 2000). Peer norms are complex; they may encourage or discourage science engagement. Some students may experience peer support for science, while others may face ridicule (Barmby et al., 2008). The peer support and ridicule may diminish the overall perceived impact. Students may interpret direct encouragement from parents and teachers as more relevant to their science attitudes than indirect peer norms.

Making science personal, active, concrete, and surrounded by visual stimulation appears impactful. More positive attitudes may also strengthen teacher-student relations, increase the use of instructional materials, and enhance classroom displays over time (Abudu & Gbadamosi, 2014; Gehlbach et al., 2016). This reinforces the importance of social, pedagogical, and environmental factors in fostering positive science attitudes (Barmby et al., 2008). On the fact that gender has a role to play in the factors influencing students' attitudes towards primary science, some studies have found that boys reported more positive science attitudes than girls, such as in areas like physics and chemistry (Barmby et al., 2008; George, 2000). However, other studies have shown no significant gender differences in science attitudes when controlling for other factors, like teaching methods (Caleon & Subramaniam, 2008). The researcher asserts that this inconclusive result could be attributed to the variation in age of the respondents. Some studies found the largest gender differences in attitudes emerge in late middle and high school as stereotypes strengthen (Andre et al., 1999). Primary school boys and girls may have more similar science attitudes.

However, the results for the teachers showed divergent beliefs about how impactful their teaching methods were in shaping attitudes of their students. Teachers were uncertain about the role of the classroom environment versus other factors. They felt parental influence was secondary to their own. However, teachers strongly agreed that gender shaped students' science attitudes through socialization and stereotypes.

As Posner et al. (1982) found, teachers had a range of beliefs about how impactful their pedagogical choices were in shaping attitudes. While some saw their methods as crucial, others felt student attitudes were predetermined or influenced more by other factors. The diversity of responses suggests teachers need more evidence on how particular instructional approaches promote positive science attitudes. As Fraser (1998) discussed, dimensions like classroom design, cooperative vs. competitive goal structures, and overall school climate can all potentially impact science attitudes. The variability in teacher responses reflects uncertainty about how significant these environmental factors shaped attitudes compared to other influences. This is another area warranting further empirical research to clarify the role of the learning environment.

As Simpkins et al. (2006) found, parents' own science attitudes and involvement in activities can positively shape children's attitudes. However, teachers may feel parental influence is secondary to their own instructional impact. The divergence here indicates teachers need more information on effectively partnering with parents to promote positive science attitudes. As posited by Jones et al. (2000), boys and girls may develop different attitudes about science from a young age due to socialization influences that engender stereotypical views of the subject as “male”. With such a strong consensus from teachers, it is clear they felt gender was a factor in shaping students’ science attitudes that needed to be addressed. Teachers likely need to employ instructional strategies that appeal to both males and females and counteract potential stereotypes students absorb about science being for boys or girls.

Student’s Perceptions of Teachers’ Pedagogy

The results showed that students valued teacher warmth, respect, and support. They saw limited use of hands-on inquiry, discussion, and critical thinking strategies, instead describing more passive teaching dominated by lectures and explanations. Students only moderately agreed teachers used group activities. This aligns with research finding that teacher warmth and support predicted positive student attitudes and engagement in science classrooms (Gehlbach et al., 2016). This aligns with situated cognition theory which states that students are more motivated and engaged when they feel teachers satisfy their basic psychological needs for autonomy, competence, and social relatedness (Ryan & Deci, 2020). Respecting students' perspectives makes them feel heard and valued, fostering a sense of belonging. This meets the need for relatedness (Gehlbach et al., 2016). Warm, supportive teacher-student relationships characterized by mutual respect build students’ trust in the teacher and their perceptions of the teacher as caring (Barmby et al., 2008). This further promotes students’ engagement in their inquiry-based and digital supports in science instruction (Tomas et al., 2019).

The student perspective aligned these results with research showing the importance of positive teacher-student relationships, situated learning theory, cognitive apprenticeship, and interactive methods for engagement. The cognitive apprenticeship argues that learning is facilitated when teachers model expert thinking and give students opportunities to practice applying knowledge and skills in an authentic context with scaffolded support (Collins et al., 1989). Hands-on science activities like experiments allow teachers to model the cognitive and physical processes involved in scientific inquiry. Students then practice these themselves. This aligns with the modeling and approximating tenets of cognitive apprenticeship (Collins et al., 1989). However, the survey results reveal that students perceive very little use of hands-on learning. This lack of authentic inquiry experiences limits the potential for cognitive apprenticeship. Students are not able to “think like scientists”.

The lack of hands-on and discussion strategies was seen as limiting engagement. This signals a need for teachers to shift from passive to more interactive, cognitively engaging pedagogies to positively impact attitudes (Caleon & Subramaniam, 2008). The limited use of discussion aligns with research by Tsai et al. (2019), who found science classes in many contexts still relied heavily on lecture rather than interactive strategies like peer discussion. This provides fewer chances to actively construct knowledge. Similarly, Suduc et al. (2015) found teachers using more passive transmission methods and fewer opportunities for dialogue and hands-on inquiry, missing chances to build critical thinking skills. Science teachers may need additional training on facilitating productive discussions centered on “big ideas”, rather than just shallow Question and Answer sessions, to enhance conceptual understanding (Tsai et al., 2019). Critical thinking and growth mindset are vital skills in science education as they encourage students to analyze information, ask questions, and evaluate evidence (AlJaafil & Sahin, 2019; Ma et al., 2023). Hence, the students' disagreement with the statement becomes crucial since they are lacking in that aspect.

Also, the findings of Adeoye et al.'s (2019) findings showed that science classrooms in many developing country contexts continued to be dominated by traditional lecturing approaches, with the teacher as the core source of information. While clear explanations are important, an overreliance on lectures limits opportunities for interactive learning and the application of concepts that drive motivation and deep understanding (Dorph et al., 2007). Students may rate explanation quality higher because it is the main pedagogy they are accustomed to. But this may reflect passive learning norms rather than truly effective practice. In this regard, the survey results likely reflect ingrained norms of didactic instruction in these schools, but the literature suggests supplementing direct teaching with more inquiry-based strategies could better develop scientific thinking capabilities and engagement.

Group activities can support engagement but require planning and management skills to implement effectively (Tomas et al., 2019). The modest but not overwhelming agreement for group work likely reflects the dual benefits and challenges of cooperative learning in science classrooms. On the positive side, collaborating provides opportunities to engage in discussion, debate, and investigation in a social context that can increase motivation (Dorph et al., 2007). However, as Tomas et al. (2019) note, implementing groupwork effectively requires thoughtful planning around team composition, clear task directions, and active facilitation and monitoring by the teacher during activities. Students may have experienced some poorly structured group activities lacking clear goals or accountability, diminishing the impact. This highlights the need for training on best practices in cooperative learning (Gillies, 2016). Group work also brings classroom management challenges, as noise and off-task behavior can emerge without strong norms and procedures. Teachers need guidance on promoting positive dynamics (Gillies, 2016). While group work holds promise for enhancing engagement, teachers likely need additional training and support to maximize the benefits while navigating the logistical and behavioral challenges inherent in coordinating successful student teams.

For teachers, the results showed they strongly valued clear conceptual lessons but had divided perspectives on using inquiry-based methods consistently. As Cuevas et al. (2005) found, elementary teachers often equated good science teaching with simplified activities that conveyed conceptual knowledge. Also, more hands-on, inquiry-based approaches may further enhance conceptual learning and attitudes. In another breath, the strong agreement on conceptual lessons may indicate many teachers did not fully appreciate how pedagogies focused on investigation and student-driven learning promoted improved attitudes and engagement. This aligns with research showing elementary teachers received limited training on implementing inquiry-based science instruction (Bergman & Morphew, 2015).

Teachers were uncertain whether their pedagogy enhanced student attitudes and interest. The teacher results implied limited differentiation or adaptation based on student needs. As Bergman and Morphew (2015) found in their survey of elementary teachers, many did not routinely implement inquiry-based science instruction focused on problem-solving, experimentation, and collaborative teamwork. The variability seen here aligns with those prior findings, suggesting divided perspectives among primary teachers about the frequency with which they employed these types of pedagogies. However, research clearly demonstrates that consistent use of inquiry-based activities with emphasis on critical analysis, hands-on investigations, and peer collaboration promote more positive attitudes and engagement with science among students (Minner et al., 2010). The divided responses indicate a need for professional development to provide teachers with training, resources, and strategies to integrate these high-impact pedagogical techniques more consistently, as they are unlikely to be used effectively without targeted support and practice.

The teachers' perspective focused more on their pedagogical choices, knowledge limitations, and uncertainty about impact. Their strong preference for conceptual lessons was critiqued as potentially simplistic. The divided views on inquiry methods highlighted a need for more training and practice. Uncertainty about impact indicated a need for classroom research. As Casey (2016) discussed, pedagogical choices directly impact student motivation and attitudes toward science. Yet teachers appeared uncertain about whether their own methods effectively enhanced interest and curiosity. This highlights the need for more classroom-based research to empirically identify teaching techniques that reliably nurture positive science attitudes and engagement among primary students. Taken together, the discussions imply that many teachers did not routinely differentiate instruction or adapted their pedagogical strategies based on student needs and curricular requirements (Davis et al., 2006). Without targeted professional development, teachers may continue utilizing a one-size-fits-all approach rather than tailoring instruction to student needs and curriculum goals. This can limit student engagement, motivation, and attitudes, especially among struggling learners (Cuevas et al., 2005; Olasehinde & Olatoye, 2014).

Several dominant themes arise across the analysis of the interview responses concerning the research questions. Regarding factors impacting attitudes, the heads emphasized the critical role of teacher-student relationships. Positive relationships marked by care and support were viewed as beneficial (HT1), while difficult relationships could undermine engagement (HT2, HT12). As Wentzel (1997) found, perceived caring from teachers predicted students' motivation and enjoyment of school. The responses also highlighted pedagogy as an influential factor, with student-center, active learning regarded as better for improving attitudes (HT3, HT11). This echoes Jones (2018), who advocated moving away from transmissive practices to inspire students' intrinsic motivation.

Concerning student perceptions of pedagogy, multiple heads critique teacher-cantered approaches as unengaging (HT9, HT20). The need to embrace more student-driven pedagogies aligns with social constructivist principles, where knowledge is co-constructed between learners based on activity and prior understanding (Powell & Kalina, 2009). Heads advised using visual aids, experiments, discussions, and to make science exciting and meaningful for students (HT8, HT13, HT15). These findings concur with Laboy-Rush's (2011) study showing enhanced attitudes and achievement via learner-led discovery. The heads provided a unique lens into factors shaping the affective domain from an insider perspective. Their recommendations validated key theories around constructivist, culturally responsive pedagogy and intrinsic motivation.

Relationship between Teachers' Pedagogy and Students' Attitudes

Concerning the first research hypothesis, the result on the insignificant relationship between teachers’ pedagogy used in teaching primary science and students’ attitudes implied that the teachers’ self-reported pedagogical approaches were not strongly associated with students’ science attitudes based on this sample. As Posner et al. (1982) discussed, improving attitudes requires meaningful changes in instructional practices and not just superficial techniques. It may be the case that teachers require more training on research-based methods that stimulate inquiry, engagement, and enthusiasm. Additionally, other variables not measured here, like teacher-student rapport, peer interactions, and home environment, may have significant influences on science attitudes (Papanastasiou & Zembylas, 2004). This correlation suggests teachers’ current pedagogy itself bears no significant relationship to student attitudes.

Influence of Teacher Pedagogy and Students’ Attitudes on Students’ Academic Performance in Science

Also, the second hypothesis, about the influence of a teacher’s pedagogy and student attitudes on students’ academic performance, revealed that teachers’ pedagogy and students’ attitudes weakly influenced students’ academic performance in science. Previous research (Minner et al., 2010) has shown that traditional, teacher-centered pedagogy often led to worse academic results than more student-driven, inquiry-based approaches. For the teachers surveyed, their predominant instructional strategies appeared deficient in supporting robust science learning. This highlights the imperative need for professional development and training to equip teachers with evidence-based and engaging pedagogical techniques shown to enhance outcomes. As Posner et al. (1982) emphasized, substantive shifts in instructional mindsets and methods are essential for adapting teaching practices to optimize student success. Based on this sample, the teachers' pedagogical approaches, student attitudes appeared to be associated with lower academic achievement. This significant result highlights the need to closely examine the instructional methods and techniques being utilized by teachers in the Left Bank2B district.

Summary of Chapter Four

The analysis of the quantitative survey data revealed that both teachers and students believed a variety of factors influenced science attitudes, including teaching techniques, instructional materials, classroom environment, gender differences, and parental involvement. However, students reported very limited exposure to hands-on, technology-integrated, and interactive teaching methods, instead indicating science instruction remained heavily lecture-based.

Qualitative findings from the interviews with heads of schools pointed to some strong as well as difficult teacher-student relationships across different school contexts. Heads advised enhancing attitudes and engagement by incorporating more visual aids, experiments, demonstrations, and relating to the content of students' lives. Current assessment practices emphasized testing over gauging conceptual understanding. Teaching styles were critiqued as overly teacher-center, underscoring the need for more student-driven pedagogical approaches. While acknowledging diversity in students' needs and backgrounds, heads focused substantially on deficits rather than building on inherent strengths.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The previous chapter discussed the results from the qualitative and quantitative data analysis. This chapter summarizes the entire research and presents the key findings from the analysis and discussion. The research presents the key findings in tandem with some previous studies. The research draws conclusions from the key findings and provides recommendations for pedagogy, educational policy, and further research.

Summary of the Study

Against the backdrop that the recent reduction in students' favorable attitudes toward science and the declining number of students choosing to pursue science had sparked intense societal concern, this research explored the influence of teaching pedagogy on students' attitudes toward primary science in Left Bank2B District, Liberia. Two hypotheses and two research questions guided the study. The research adopted an eclectic theoretical approach, focusing on theories such as Social Constructivism, Constructivist Theory of Teaching Pedagogies, and Cognitive Apprenticeship Theory.

Drawing on a mixed-method design based on an explanatory sequential approach, the study used an accessible population of 377. The sample size comprised 337 students, 20 teachers, and 20 headteachers. Semi-structured interview guides and adapted questionnaires were employed to gather the data from this population. All respondents participated and responded to the data collection tool, which resulted in a 100% response rate. The data were then analyzed and discussed.

Descriptive statistics, means and standard deviation, and influential statistics, Pearson moment correlation coefficient and Multiple Linear Regression analyses were used to analyze the data. Specifically, means and standard deviation addressed Research Questions One and Two; while Pearson moment correlation coefficient tested Hypothesis One, and Multiple Linear Regression analyses tested Hypothesis Two. Thematic analysis analyzed the qualitative data.

Key Findings

The following are key finding of the study:

1. The analysis revealed approximately 88.50% of the students responded in total agreement with varied, innovative teaching methods that sparked interest and engagement (Gehlbach et al., 2016; Barmby et al., 2008). This notwithstanding, gender differences seemed to have a weaker influence on students' attitudes toward science, aligning with research showing neutral attitudes between genders in primary school (Caleon & Subramaniam, 2008).
2. Teachers believed their qualifications, attitudes, and instructional materials shaped students' attitudes. However, they were divided on the impact of their own methods and other factors like parental influence. This variability suggests a need for clarity on how specific practices affect attitudes.
3. Interviews with head teachers revealed that enhancing visual, hands-on, and interactive techniques could motivate students to learn, which is consistent with social cognitive perspectives (Kong & Wang, 2021).

Heads acknowledged collaborative, play-based, and relevance-focused learning.

4. The student survey revealed limited use of hands-on, technology-enhanced, discussion-based, and critical thinking-focused instruction, as evidenced by skewed distributions and low ratings. Collaborative learning had mixed perceptions. That is, student-center techniques appeared scarce, signalling need for professional development.
5. Interviews with head teachers revealed that assessment emphasized summative testing over conceptual evaluation. Teaching was perceived as teacher-driven with rare hands-on learning.
6. The results showed a weak, statistically non-significant correlation between teachers' self-reported pedagogy and students' science attitudes. This implies that the teachers' current instructional approaches could not strongly predict students' attitudes toward primary science.
7. The study also revealed that improving students' attitudes likely requires more substantive changes to teaching practices through professional training on evidence-based and engaging methods. Other variables beyond just pedagogy may also shape students' attitudes.
8. Another significant finding from the study was that, about 99% of the variation in students' academic performance could not be explained by teacher pedagogy and students' attitude. There might be other factors accounting for the low performance of students in the study area and these factors need to be explored.

Conclusions

Building upon the findings presented in the previous section, the following conclusions are drawn in accordance with the research questions. The first research questions sought to find out the factors influencing students' attitudes towards primary science in basic schools in the Left Bank2B District. From the findings, the study concludes that supportive teacher-student relationships, hands-on materials, and enriched classroom environments also emerged as influential factors, consistent with prior research. Gender differences appeared relatively subdued, aligning with existing findings of neutral attitudes between genders in primary education. The conclusion emphasizes the pivotal role of effective instructional techniques, while also highlighting the need for ongoing professional development and intrinsic motivation strategies to address challenges in fostering positive science attitudes among young learners.

The second research question examined the students' perceptions of teachers' pedagogy used in teaching primary science in the basic schools in the Left Bank2B District, Liberia. In this regard, the study concludes that there is a negative perception of teachers' pedagogy used in teaching primary science. That is, the prevalence of passive, teacher-centric pedagogy revealed through the data signifies a crucial need to transform science instruction to more interactive, inquiry-based models focused on conceptual thinking and hands-on experimentation to boost engagement, students' performance, and positive lifelong science interests among primary students. This informs a shift in the assessment paradigm towards more comprehensive and conceptually oriented evaluations while simultaneously addressing the challenge of catering to diverse student needs.

The study's findings shed important light on the complex relationships that exist between basic school students' attitudes about primary science, teachers' pedagogy, and academic achievement in Liberia's Left Bank2B District.

Overall, these data seem to indicate that although pedagogy by instructors is a significant component in determining students' attitudes toward basic science, there is a complicated and varied interaction between several elements that affect academic achievement. These findings highlight the need for a more thorough comprehension of the different factors that affect students' performance in science classes and offer insightful information to researchers, educators, and policymakers who are trying to improve the standard of primary science education in comparable settings.

Recommendations

Based on the findings from the study, the following recommendations are made to improve primary science pedagogy and learning experiences for students in the Left Bank2B District, Liberia.

1. Science teachers should substantially increase their use of hands-on, inquiry-based learning activities that actively engage students in the scientific process and develop critical thinking skills. Having students conduct experiments, make observations, analyse data, and draw conclusions allows them to directly experience and take ownership of scientific learning while honing analytic abilities.

2. Science teachers should facilitate peer discussions, collaborative group work, and open-ended questioning, enables important dialogue, debate, and knowledge sharing to attract students to the science subject. Through the facilitation, students articulate their thought processes. Teachers asking more open-ended questions center on big ideas also promote higher-order thinking versus rote recall.
3. Teachers should employ constructivist teaching strategy an evidence-based technique that engages learners to participate in their learning. Implementing this strategy calls for teachers' training to enhance students' participatory learning. Education stakeholders should therefore train primary science teachers the constructivist strategy to enhance its application in the science class.
4. Diversifying teaching strategies is necessary because of the substantial influence that instructors' pedagogy has on students' perceptions about elementary science. Motivate teachers to use a variety of interactive, inquiry-based, and experiential teaching methods that accommodate different learning preferences and create a welcoming atmosphere for students.
5. Encourage ongoing research into additional elements that may impact students' performance in science education, as the study reveals a significant amount of the range in academic accomplishment remains unexplained. Examine how cultural factors, parental participation, and socioeconomic factors affect pupils' academic performance.

6. Several policy initiatives employed by education ministry could help actualize pedagogical improvements to bolster primary science learning.
7. Heads of schools should invest in thorough training programmes for teachers that provide them a toolkit of educational techniques that work. In addition to subject matter competence, training should include the development of dynamic, student-center teaching strategies that encourage favourable attitudes toward science.
8. Science curricula should focus on illuminating big ideas, student-driven inquiry, and real-world application rather than passive absorption of facts. Teachers should adopt frameworks that are center on active investigation and local relevance to better promote engagement and attitudes.
9. An overreliance on summative assessment like multiple choice tests should be limited by science teachers, adding more project- and problem-based evaluations that reveal multidimensional skills. Evaluating authentic work better informs teaching and learning.
10. Once-in-a-lifetime workshops should be supplemented with ongoing, job-embedded professional development opportunities to make training sustainable, relevant, and actionable.
11. Through instructional coaching, peer observations, and professional learning communities, teachers can continuously improve their pedagogies with collegial support. With these policies enacted, primary science education can shift towards inspiring the next generation of innovators.

Suggestions for Further Study

1. Classroom observational studies are needed to directly assess the impact of specific instructional techniques recommended by the literature, like inquiry-based learning. Direct observations provide more objective data on implementation fidelity and outcomes.
2. Research should include student voices more directly through interviews, focus groups, and attitudinal surveys. Their perspectives on optimal and actual practices may differ from teacher self-reports.
3. Research should systematically identify which professional development methods most effectively change classroom practices to inform training. This will aim at how teachers improve their professional self and develop the students as well.
4. Studies must disaggregate impact on students of different ages, skill levels, socioeconomic backgrounds, and genders. Science attitudes may diverge along demographic lines based on instructional fit.

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APPENDICES

Appendix A: ETHICAL APPROVAL

UNIVERSITY OF CAPE COAST
INSTITUTIONAL REVIEW BOARD SECRETARIAT

TEL: 0558093143 / 0508878309
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IORG #: IORG0011497

7TH NOVEMBER, 2023

Ms Burnis Kabay Williams
Department of Basic Education
University of Cape Coast

Dear Ms Williams,

ETHICAL CLEARANCE - ID (UCCIRB/CES/2023/127)

The University of Cape Coast Institutional Review Board (UCCIRB) has granted Provisional Approval for the implementation of your research Influence of Teaching Pedagogy on Students' Attitude toward Primary Science in Left Bank2B District, Liberia. This approval is valid from 7th November, 2023 to 6th November, 2024. You may apply for an extension of ethical approval if the study lasts for more than 12 months.

Please note that any modification to the project must first receive renewal clearance from the UCCIRB before its implementation. You are required to submit a periodic review of the protocol to the Board and a final full review to the UCCIRB on completion of the research. The UCCIRB may observe or cause to be observed procedures and records of the research during and after implementation.

You are also required to report all serious adverse events related to this study to the UCCIRB within seven days verbally and fourteen days in writing.

Always quote the protocol identification number in all future correspondence with us in relation to this protocol.

Yours faithfully,

Kofi F. Amuquandoh
Ag. Administrator

APPENDIX B: CONSENT FORMS

C1: Consent Form for Primary Six Students

Part I: Information Sheet

Title: *"Influence of Teaching Pedagogy on Students' Attitude toward Primary Science in Left Bank2B, District, Liberia"*
Principal Investigator: Burnis Kabay Williams
Address: Department of Basic Education, University of Cape Coast
Phone Numbers: +231-778228676 / +233256655897
Email Address: burnis.williams@stu.ucc.edu.gh)
Supervisor Name: Pro. Isaac Buabeng
Department: Basic Education, University of Cape Coast
Phone Number: +233501042479

Dear Participant,

You are encouraged to participate in a research study by Burnis Kabay Williams, a candidate for a MPhil degree in Basic Education (Primary Science) from the University of Cape Coast, Ghana. Understanding the study details, risks, benefits, and factors affecting your participation is advisable. Feel free to ask the researcher any questions before you consent.

Hence, this study examines factors influencing students' attitudes towards primary science in Left Bank2B District, Liberia, evaluating teachers' pedagogical skills and assessing the relationship between pedagogy and students' attitudes.

Procedure

You will be asked to provide your answers to the questionnaires if you agree to take part in the study. You will be encouraged to tick (√) the statement that best suits your view, providing clear responses with options to disagree, agree, or be neutral. Meanwhile, the answers you will offer will remains private and anonymous, and your character will remain unaffected. The process will last for an hour.

Possible Risks and Discomforts

There are no known risks associated with filling out these questionnaires. You are free to disengage if any psychological problem or discomfort occurs and you wish not to continue filling out the questionnaire.

Possible Benefits

Your participation with this study will lead to the findings that would inform the researcher about factors influencing students' attitudes towards primary science and the perceptions about the science teacher's pedagogy use in the classroom. Meanwhile, after participating in this study, you will be compensated 2 USD to get a snack.

Confidentiality

The collected information will be used solely for the study. We will protect your information provided to us by choosing not to use your identity for any identifying purposes, we will strive to provide you with the best possible service.

Consent

I have looked through the document and learn more about the various risks and benefits associated with conducting this research. I have been given an opportunity to ask any question about the research and this has been answered to my satisfaction. I agree to participate as a volunteer.

Participant's Identification Number: ___________________________________

Participant's Signature: _____________

Date: ________________

By filling out this form, you confirm that you have authorized this survey and are aware of the information collected.

Thank you for your participation.

Contacts for Additional Information

If you have any questions, or concerns or would like additional information about this study, you can contact the researcher or the assistants through these phone numbers (+231-778228676 / +233256655897 or better email us through burnis.williams@stu.ucc.edu.ghs

Contact of Ethical Review Board

This research has been reviewed and approved by the Institutional Review Board of the University of Cape Coast (UCCIRB). If you have any questions about your rights as a research participant you can contact the Administrator at the IRB Office between the hours of 8:00 am and 4:30 p.m. through the phone lines 0558093143/0508878309 or email address: irb@ucc.edu.gh.

PART II: VOLUNTEER'S AGREEMENT

I have read the above document describing the benefits, risks and procedures for the research title *"Influence of Teaching Pedagogy on Students' Attitudes Towards Primary Science in Left Bank2B District, Liberia".* I have been given an opportunity to ask any question about the research and this has been answered to my satisfaction. I agree to participate as a volunteer.

Volunteer's name: ____________________________________

Volunteer's Signature/Thumbprint: _____________

Date: ________________

I certify that the nature and purpose, the potential benefits, and possible risks associated with participating in this research have been explained to the above individual.

Researcher's Name: ……………………………………...

Researcher's Signature/Thumbprint…………………….

Date: ……………………………………………………….

C2: CONSENT FORM FOR SCIENCE TEACHERS

Part 2: Information Sheet

Title: *"Influence of Teaching Pedagogy on Students' Attitude toward Primary Science in Left Bank2B, District, Liberia"*

Principal Investigator: Burnis Kabay Williams

Address: Department of Basic Education, University of Cape Coast

Phone Numbers: +231-778228676 / +233256655897

Email Address: burnis.williams@stu.ucc.edu.gh)

Supervisor Name: Pro. Isaac Buabeng

Department: Basic Education, University of Cape Coast
Phone Number: +233501042479

Dear Participant,

You are encouraged to participate in a research study by Burnis Kabay Williams, a candidate for a MPhil degree in Basic Education (Primary Science) from the University of Cape Coast, Ghana. Understanding the study details, risks, benefits, and factors affecting your participation is advisable. Feel free to ask the researcher any questions before you consent.

Henceforth, this study examines factors influencing students' attitudes towards primary science in Left Bank2B District, Liberia, evaluating teachers' pedagogical skills and assessing the relationship between pedagogy and students' attitudes.

Procedure

You will be asked to provide your answers to the questionnaires if you agree to take part in the study. You will be encouraged to tick (√) the statement that best suits your view, providing clear responses with options to disagree, agree, or be neutral. Meanwhile, the answers you will offer will remains private and anonymous, and your character will remain unaffected. The process will last for an hour.

Possible Risks and Discomforts

There are no known risks associated with filling out these questionnaires. You are free to disengage if any psychological problem or discomfort occurs and you wish not to continue filling out the questionnaire.

Possible Benefits

Your participation with this study will lead to the findings that would inform the researcher about factors influencing students' attitudes towards primary science and the perceptions about the science teacher's pedagogy use in the classroom. Meanwhile, after participating in this study, you will be compensated 2 USD to get a snack.

Confidentiality

The collected information will be used solely for the study. We will protect your information provided to us by choosing not to use your identity for any identifying purposes, we will strive to provide you with the best possible service.

Consent

I have looked through the document and learn more about the various risks and benefits associated with conducting this research. I have been given an opportunity to ask any question about the research and this has been answered to my satisfaction. I agree to participate as a volunteer.

Participant's Identification Number: ________________________________

Participant's Signature: ____________

Date: _______________

By filling out this form, you confirm that you have authorized this survey and are aware of the information collected.

Thank you for your participation.

Contacts for Additional Information

If you have any questions, or concerns or would like additional information about this study, you can contact the researcher or the assistants through these phone numbers (+231-778228676 / +233256655897 or better email us through burnis.williams@stu.ucc.edu.ghs

Contact of Ethical Review Board

This research has been reviewed and approved by the Institutional Review Board of the University of Cape Coast (UCCIRB). If you have any questions about your rights as a research participant you can contact the Administrator at the IRB Office between the hours of 8:00 am and 4:30 p.m. through the phone lines 0558093143/0508878309 or email address: irb@ucc.edu.gh.

PART II: VOLUNTEER'S AGREEMENT

I have read the above document describing the benefits, risks and procedures for the research title *"Influence of Teaching Pedagogy on Students' Attitudes Towards Primary Science in Left Bank2B District, Liberia".* I have been given an opportunity to ask any question about the research and this has been answered to my satisfaction. I agree to participate as a volunteer.

Volunteer's name: ________________________________

Volunteer's Signature/Thumbprint: ____________

Date: _______________

I certify that the nature and purpose, the potential benefits, and possible risks associated with participating in this research have been explained to the above individual.

Researcher's Name: ……………………………………...

Researcher's Signature/Thumbprint…………………….

Date: ……………………………………………………….

C3: CONSENT FORM FOR HEAD TEACHES

Part 3: Information Sheet

Title: *"Influence of Teaching Pedagogy on Students' Attitude toward Primary Science in Left Bank2B, District, Liberia"*

Principal Investigator: Burnis Kabay Williams

Address: Department of Basic Education, University of Cape Coast

Phone Numbers: +231-778228676 / +233256655897

Email Address: burnis.williams@stu.ucc.edu.gh)

Supervisor Name: Pro. Isaac Buabeng

Department: Basic Education, University of Cape Coast

Phone Number: +233501042479

Dear Participant,

You are cordially invited to participate in a study about the influence of pedagogy on the attitudes of primary school students toward science in Liberia's Left Bank2B district. The research, which is being conducted by Burnis Kabay-Williams, under the supervision of Pro. Isaac Buabeng, seeks to identify the factors that influence the students' perceptions of the teaching methods in the classroom.

Procedure:

As a head teacher, your participation in this study will involve a semi-structured interview. During the interview, we will discuss your insights and experiences related to primary science education, the teaching methods used in your school, and the overall teaching and learning environment.

Possible Risks and Discomforts

There are no known risks associated with participating in this semi-structured interview. You are free to disengage if any psychological problem or discomfort occurs and you wish not to continue.

Possible Benefits:

Your participation with this study will lead to the findings that would inform the researcher about factors influencing students' attitudes towards primary science and the perceptions about the science teacher's pedagogy use in the classroom. Meanwhile, the data that will be collected will help us improve primary science instruction in Liberia's Left Bank2B District, increase student interest in science, and influence educational policy. After participating in this study, you will be compensated with 2 USD to get a snack.

Voluntary Participation and Right to Withdraw:

Your participation in this study is entirely voluntary. You have the right to refuse to participate or withdraw from the study without any negative consequences. Your participation will not affect your standing or relationship with the school.

Confidentiality

Your participation and the information shared during the interview will be kept confidential. Your identity and the information provided will remain private. The data will be reported in aggregate form, and no personally identifiable information will be disclosed.

Consent

I, the undersigned, understand the nature of the study and agree to participate in the research titled "Influence of Teaching Pedagogy on Students' Attitude toward Primary Science in Left Bank2B District, Liberia."

Participants Identification Numbers : ___________________________________

Participants Signature : _____________

Date: ________________

By filling out this form, you confirm that you have authorized this survey and are aware of the information collected. Please sign and return this form to indicate your consent to participate in the research.

Thank you for your valuable contribution to this important study.

Contacts for Additional Information

If you have any questions, or concerns or would like additional information about this study, you can contact the researcher or the assistants through these phone numbers (+231-778228676 / +233256655897 or better email us through burnis.williams@stu.ucc.edu.ghs

Contact of Ethical Review Board

This research has been reviewed and approved by the Institutional Review Board of the University of Cape Coast (UCCIRB). If you have any questions about your rights as a research participant you can contact the Administrator at the IRB Office between the hours of 8:00 am and 4:30 p.m. through the phone lines 0558093143/0508878309 or email address: irb@ucc.edu.gh.

PART II: VOLUNTEER'S AGREEMENT

I have read the above document describing the benefits, risks and procedures for the research title *"Influence of Teaching Pedagogy on Students' Attitudes Towards Primary Science in Left Bank2B District, Liberia".* I have been given an opportunity to ask any question about the research and this has been answered to my satisfaction. I agree to participate as a volunteer.

Volunteer's name: ____________________________________

Volunteer's Signature/Thumbprint: _____________

Date: ________________

I certify that the nature and purpose, the potential benefits, and possible risks associated with participating in this research have been explained to the above individual.

Researcher's Name: ……………………………………...

Researcher's Signature/Thumbprint…………………….

Date: ……………………………………………………

C4: CONSENT FORM FOR PARENTS OF PRIMARY SIX STUDENTS

Part 4: Information Sheet

Title: *"Influence of Teaching Pedagogy on Students' Attitude toward Primary Science in Left Bank2B District, Liberia"*

Principal Investigator: Burnis Kabay Williams

Address: Department of Basic Education, Faculty of Educational Foundation, College of Education Studies, University of Cape Coast

Phone Numbers: +231-778228676 / +233256655897

Email Address: burnis.williams@stu.ucc.edu.gh)

Supervisor Name: Pro. Isaac Buabeng

Department: Basic Education, University of Cape Coast

Phone Number: +233501042479

Dear Parent:

We invite your child to participate in a research study titled "Influence of Teaching Pedagogy on Students' Attitude toward Primary Science in Left Bank2B District, Liberia." This study aims to understand the factors that affect students' attitudes toward primary science and their perceptions of teaching methods used in the science classroom. Burnis Kabay Williams is conducting this research under the supervision of Pro. Isaac Buabeng.

Procedure:

Your child will be asked to participate in this study by completing a questionnaire related to their experiences in the science classroom. The questionnaire will cover topics such as their attitudes towards science, their experiences with different teaching methods, and their thoughts about their science teacher's teaching style.

Possible Risks and Discomforts

There are no known risks associated with your child filling out this questionnaire. Your child is free to disengage if any psychological problem or discomfort occurs and he/she wishes not to continue filling out the questionnaire.

Duration:

The questionnaire will take roughly an hour to complete. Your child will be given adequate time to finish the questionnaire, and it will be conducted during a convenient time at school.

Possible Benefits

While there are no direct benefits to your child for participating in this study, the information gathered will help us improve the teaching and learning of primary science in Left Bank2B District, Liberia. This research will enhance teaching methods, make science more engaging for students, and inform educational policies. After participating in this study, your child will be compensated with 2 USD to get a snack.

Confidentiality:

Your child's participation will be kept confidential. No personally identifiable information will be shared, and their responses will be anonymized. Only the researchers and authorized individuals will have access to the data. Your child's identity will remain private.

Voluntary Participation and Right to Withdraw:

Your child is free to withdraw their consent at any time. Your child is free to decline participation and to leave the research at any moment without facing any negative consequences. Your child's status or relationship with the school won't be impacted if they withdraw or choose not to participate.

Contact Information:

Don't hesitate to contact any of the above numbers with any questions or concerns regarding this study.

Consent:

I, the undersigned, understand the nature of the study and agree to allow my child to participate in the research "Influence of Teaching Pedagogy on Students’ Attitude toward Primary Science in Left Bank2B District, Liberia."

Parent/Guardian Identification Number:

Parent/Guardian’s Signature:

Date:

Signing and returning this form will show that you agree to your child's participation in the study.

I am grateful for allowing your child to participate in this study.

Contacts for Additional Information

If you have any questions, or concerns or would like additional information about this study, you can contact the researcher or the assistants through these phone numbers (+231-778228676 / +233256655897 or better email us through burnis.williams@stu.ucc.edu.ghs

Contact of Ethical Review Board

This research has been reviewed and approved by the Institutional Review Board of the University of Cape Coast (UCCIRB). If you have any questions about your rights as a research participant you can contact the Administrator at the IRB Office between the hours of 8:00 am and 4:30 p.m. through the phone lines 0558093143/0508878309 or email address: irb@ucc.edu.gh.

PART II: VOLUNTEER'S AGREEMENT

I have read the above document describing the benefits, risks and procedures for the research title *"Influence of Teaching Pedagogy on Students' Attitudes Towards Primary Science in Left Bank2B District, Liberia".* I have been given an opportunity to ask any question about the research and this has been answered to my satisfaction. I agree to participate as a volunteer.

Volunteer's name: ___________________________________

Volunteer's Signature/Thumbprint: ____________

Date: _______________

I certify that the nature and purpose, the potential benefits, and possible risks associated with participating in this research have been explained to the above individual.

Researcher's Name: ……………………………………...

Researcher's Signature/Thumbprint…………………….

Date : ……………………………………….

APPENDIX C : TEACHER SURVEY QUESTIONNAIRE

Questionnaire for General Science Teachers

I appreciate your time and advanced participation in filling out this questionnaire. This questionnaire aims to collect information regarding Students' Attitudes towards general science and the methods teachers use in teaching sciences. This study is purely academic. Your genuine, timely response is vital to determine this study's success.

No need to write your name. Your information will be kept confidential and used only for this study. There is no "right" or "wrong" answer here, and instead, what is required is to show the level of your opinion of each item.

Section A

Demographic Information of General Science Teachers

1. Teacher Identification Number [ ]
2. Sex: Male [ ] Female [ ]
3. Age: 20-25 years [ ] 26-30 years [ ] 31-35 years [ ] 36-40 years [ ] > 40 years [ ]
4. Educational Qualification: Diploma [ ] BSC/BA/BED [ ] Others [ ]
5. Work Experience: Below 5 years [ ] 5-10 years [ ] 11-15 years [ ] 16-20 years [ ] > 20 years [ ]

Section B

Factors influencing students' attitudes toward science. Please respond to the following statements by ticking the appropriate box by choosing one of the following scales of responses.

1. strongly disagree
2. disagree
3. neutral
4. agree
5. strongly agree

	Statements	1	2	3	4	5
1	Teachers' teaching methods can influence the attitudes of students toward science.					
2	Teachers' qualifications can influence students' attitudes toward science.					
3	The learning environment has an impact on students' attitudes toward science.					
4	Instructional materials affect students learning of science					
5	The perception of the students affects their' attitudes toward Science					
6.	Gender differences impact students' attitudes toward science.					
7.	Peer influence affects students' attitudes toward science.					
8.	Parental influence affects students' attitudes toward science.					
9.	Lack of motivation from teachers influences students' attitudes toward science.					
10.	Teachers' attitudes toward the subject can influence the students' attitudes toward science.					

Section C

Student's perception of teacher pedagogy used in the classroom.Please respond to the following statements by ticking the appropriate box by choosing one of the following scales of responses.

1. strongly disagree
2. disagree
3. neutral
4. agree
5. strongly agree

No	Statement	1	2	3	4	5
11	The lesson or activity used by the teacher helps pupils grasp a scientific concept.					
12	The teacher encourages collaboration and teamwork among students in science activities or projects.					
13	The teacher helps a student overcome their scientific illiteracy.					
14	The teacher motivates the students to think creatively and critically in class.					
15.	Science teachers encourage teamwork and collaboration among their students.					
16.	The teacher approach science teaching with varying needs and learning styles.					
17.	The teaching methods used by the science teacher make the subject interesting and engaging.					
18.	The teacher changes his/her pedagogy to accommodate the curriculum or science lesson.					
19.	The teacher frequently incorporates hands-on experiments and practical activities into science lessons.					
20.	The teacher engages the pupils in scientific learning and fosters a sense of curiosity.					

Appendix D : GRADE SIX STUDENTS SURVEY QUESTIONNAIRE

Student Survey Questionnaire

This academic questionnaire collects data on students' attitudes towards general science, their perceptions of teacher pedagogical skills in teaching primary science, and methods used by teachers. It consists of three sections: Section A contains respondents' demographic information, Section B contains factors influencing students' attitudes toward science, and Section C has items relating to students' perceptions of teachers' pedagogical skills. The questionnaire is confidential and requires a genuine and timely response. Respondents are encouraged to ask for clarification and use a pen to complete the survey.

Section A

Demographic Information of Respondents

1. Students' Identification Number: ☐
2. Sex: Male ☐ Female ☐
3. Age: A: 10-11 years ☐ B: 11-12 years ☐
C: 12-13 years ☐ D: 13-14yea ☐

Section B

Question Two*: *Factors influencing students' attitudes towards primary sciences in basic schools in the Left Bank2B District, Liberia.

This section captures ten items containing information on factors influencing students' attitudes toward primary science. Please properly read, and indicate a checkmark in one of the five spaces below using the ***five-point*** Likert Skill under the option that best suits the statements.

1. strongly disagree 4. agree
2. disagree 5. strongly agree
3. neutral

No	Item	1	2	3	4	5
1.	The relationship between the science teacher and the students is cordial.					
2.	The teaching pedagogies of science teachers are more effective in improving students' attitudes toward primary science					
3.	Peer pressure is one of the factors that influence students' attitudes toward learning science.					
4,	Using instructional materials and science equipment promotes students' attitudes toward science.					

5.	The science teacher supports and encourages students' participation in activities in the science class.					
6.	The science classroom environment is decorated with teaching materials that attract learning.					
7.	Gender differences impact students' attitudes toward science.					
8.	Parents' involvement influences students' attitudes toward science.					
9.	The teacher's knowledge of science subject is a key factor influencing students' attitudes toward science.					
10.	The teacher uses various teaching methods to enhance learning in the science class.					

Section C

***Question Two*: Students' perception of teacher pedagogy in teaching primary science in the classroom.**

This section also contains ten items, and you are encouraged to apply the same process in section A to checkmark ***using a five-point Likert scale below:***

. strongly disagree 4. agree
2. disagree 5. strongly agree
3. neutral

No	Items	1	2	3	4	5
1.	The science teacher effectively explains scientific concepts and ideas.					
2.	The science teacher incorporates hands-on experiments or practical activities in the classroom.					
3.	Science teachers encourage student participation and active learning during science lessons.					
4.	Your science teacher values and respects your ideas and opinions in the classroom.					
5.	Science teacher promotes a growth mindset and critical thinking in science learning.					
6.	The science teacher encourages creativity and innovation in science projects or assignments.					
7.	The science teacher encourages class discussions and student questions during science lessons.					
8.	The science teacher uses technology or					

	digital tools to enhance science instruction.					
9.	The science teacher supports your understanding of difficult or complex scientific topics.					
10.	The science teacher encourages student collaboration and teamwork in science activities or projects.					

Conclusion:
Thank you for sharing your thoughts by filling in the questionnaire. Your input is precious to us and will help us to improve the teaching methods and learning experience in science class. Thank you so much for your time and participation.

Appendix: E

INTERVIEW GUIDE FOR HEAD TEACHERS

Instruction

This interview is geared toward necessary information about Students' Attitudes towards General Science in the sixth grade and what factors influence such attitudes. The interview is prepared with open-ended questions. You are free to express yourself in-depth. Firstly, I am grateful for your willingness to participate in this interview. Therefore, I request responses to the following questions.

Section A

Demographic Information of Head Teachers

1. Sex: Male ☐ Female ☐
2. Age: 20-25 years ☐ 26-30 years ☐ 31-35 years ☐
3. 36-40 yea ☐ > 40 yea ☐
4. Educational Qualification: Diploma ☐ BSC/BA/BED ☐ Others ☐
5. Work Experience: Below 5 years ☐ 5-10 years ☐
11-15 years ☐ 16-20 years ☐
> 20 years ☐

Section B

1. ***Factors influencing students' attitudes towards primary sciences in basic schools in the Left Bank2B District, Liberia.***

a. How are the relationships between the teachers and students?

____

____

b. Have you noticed any particular teaching pedagogies that are more effective in improving students' attitudes toward primary science?

____

____

c. From your experience, please explain any factors that have a powerful impact on students' attitudes toward primary science.

____

____

d. What possible reasons for students losing interest in primary science?____

____

e. What measures can be taken to improve students' attitudes toward primary science?____

____

f. How can teachers adjust their pedagogy to improve students' attitudes toward primary
science?____

____

g. How do you encourage students to pursue further studies or careers in science-related subjects?____

____

h. How do you perceive students' overall attitudes towards primary science in your school?____

____

i. What support do you provide teachers to enhance primary science teaching and influence students' attitudes?____

____

j. What professional development opportunities do you provide your teachers to enhance their skills in teaching primary science?____

____

Section C

Evaluate students' perceptions of teachers' pedagogy used in teaching primary science in the primary schools in the Left Bank2B District, Liberia.

k. What methods do the science teachers use to assess students' perceptions of their teaching pedagogy?____

____

l. In your experience, what do students generally perceive to be the strengths and weaknesses of the teaching pedagogy in primary science?

____

____

m. Have you noticed differences in students' perceptions of the teaching pedagogy based on gender, socioeconomic status, or other demographic factors? Please explain.

____

____

n. What successful methods can science teachers use to help students relate and understand science better?

____

____

o. What can science teachers do to help students stay motivated and interested in the subject over time?____

____

p. What are the primary science teachers' most effective pedagogical strategies, in your opinion, as perceived by the students, and how do you encourage their use?____

____

q. Are there any particular teaching tools or materials elementary science teachers use to support their pedagogy?

____

____

r. How do you ensure that teachers in the primary science classroom encourage an inclusive and engaging learning environment?____

____

s. Have you observed differences in students' perceptions of teachers' pedagogy? What are they if so?____

____

t. How would you describe the teaching style of your science teacher?____

____

Conclusion:

Thank you for sharing your insights and experiences with us today. Your input is valuable in understanding the factors influencing students' attitudes toward primary science and improving the teaching methods used in primary schools in the Left Bank2B District, Liberia.