AKENTEN APPIAH-MENKA UNIVERSITY OF SKILLS TRAINING AND ENTREPRENEURIAL DEVELOPMENT

EFFECT OF CONTEXT-BASED APPROACH ON STUDENTS' ACADEMIC PERFORMANCE IN ECOLOGY IN SENIOR HIGH SCHOOLS

ANITA ASANTEWAA APPIAH-ADJEI

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BY

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A Thesis Submitted School of Graduate Studies, Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development in partial fulfilment of the requirements for the award of a Master of Philosophy degree in Biology Education

JUNE, 2025

DECLARATION

Candidate's Declaration

I hereby declare that this thesis, with the exception of quotations and references contained in published works which have been duly acknowledged; is the result of my own original work and that no part of it has been presented for another degree in this university or elsewhere.

Anita Asantewaa Appiah-Adjei

Signature: ……………………………… Date: ……………………………

Supervisors' Declaration

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development.

Dr. Charles Amoah Agyei (Principal Supervisor)

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Signature: ………………………………... Date: ………………………..

ABSTRACT

This study investigated the effectiveness of context-based teaching and learning approach on the academic performance of Senior High School students in Ecology across the Atwima Nwabiagya North and South, and Kwadaso Municipalities of the Ashanti Region, Ghana. A sequential explanatory mixed-method design was employed. The study involved a sample of 187 Senior High School Form 2 (SHS 2) elective Biology students, randomly selected from four public Senior High Schools. The research was guided by three research questions. Data were collected using the Ecology Performance Test (EPT) developed by the researcher and an interview guide. The collected data were analysed using mean, standard deviation, and independent sample t-tests at a 0.05 level of significance. The focus group/interview data were transcribed and analysed with Braun and Clarke's Thematic Analysis. The results showed that students taught Ecology with the context-based approach performed better than those taught using the conventional approach. Additionally, no significant difference was found between the academic performance of male and female students, indicating that gender does not influence performance in Ecology. The study also explored students' views and found that the context-based teaching approach significantly enhanced student engagement. The use of real-life examples and scenarios made lessons more relatable and engaging, which led to increased participation and enthusiasm. Based on these findings, this study recommends that SHS Biology teachers enhance their skills in linking lessons to real-world experiences by using local, real-life objects as teaching aids. Training programs, workshops, and seminars should be organized to equip the teachers with the knowledge and skills needed to implement context-based teaching approaches to improve students' performance in Ecology in Biology.

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DEDICATION

I dedicate this work to my father, Providence Kwame Appiah-Adjei, my mother, Agnes Antwiwaa Coffie, my siblings, Bestluck Asiedu Appiah-Adjei, Vashti Boakyewaa Appiah-Adjei and Bridget Ohenewaa Appiah-Adjei.

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LIST OF ACRONYMS (ABBREVIATIONS)

CBA	–	Context-based Approach
CA	–	Conventional Approach
SHS	–	Senior High School
WAEC	–	West Africa Examination Council
WASSCE	–	West Africa Senior Secondary Examination Council
EPT	–	Ecology Performance Test
EG	–	Experimental Group
CG	–	Control Group
AAMUSTED	–	Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development
SPSS	–	Statistical Package for the Social Sciences
ICC	–	Intraclass Correlation Coefficient

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter presents the background to the study, statement of the problem, purpose of the study, research objectives, research questions, significance of the study, scope of the study, limitations of the study, definition of terms and organization of the study.

1.1 Background to the Study

The understanding of biological sciences is crucial for enhancing the quality of life, as it provides insights into living organisms and their interactions with non-living organisms. By studying biological sciences, individuals gain knowledge about the environment, enabling them to improve their overall well-being. Education is not merely preparation for life but life itself, highlighting the continuous and evolving nature of the teaching process (Dewey, 1938). Teaching is a complex and dynamic process aimed at facilitating learning, where educators employ various strategies to impart knowledge, skills, values, and habits to learners. It plays a crucial role in shaping students' intellectual and personal growth. Effective teaching necessitates a deep understanding of the subject matter, a repertoire of pedagogical skills, and the ability to engage and motivate students.

Teaching methods are the systematic ways in which teachers deliver instruction to achieve learning objectives. These methods are pivotal in determining the efficiency and success of the learning process. The selection of appropriate teaching methods is influenced by factors such as the subject matter, the learners' characteristics, the educational context, and the intended learning outcomes (Borich, 2016). Effective teaching methods can enhance students' engagement, comprehension, and retention, thereby fostering a more profound educational experience. Teaching methods can broadly be categorized into two types: teacher-centred methods and student-centred methods.

In teacher-centred methods, the teacher assumes the central position as an authority figure, and students are typically passive recipients of knowledge. This approach is often exemplified by lectures and direct instruction, where the focus is on the delivery of content from teacher to student. During lecture-based learning, the teacher presents information systematically while students listen, take notes, and absorb the material. This method is efficient for covering a vast amount of content within a limited timeframe (Bligh, 2000). Here, the teacher is regarded as the fundamental provider of knowledge, responsible for explaining concepts and demonstrating procedures as well as control the pacing and sequencing of content delivery. The students are often required to memorize facts, formulas, and information. Their participation is minimal, usually confined to answering questions or participating in occasional discussions.

Student-centred methods emphasize active participation, collaboration, and the cultivation of analytical thinking and the capability of solving problems effectively. In this approach, students are active participants in their learning process. They engage in activities such as discussions, group work, and hands-on projects, actively constructing their understanding and knowledge (Prince, 2004) whilst the teacher guides, supports, and facilitates learning rather than simply transmitting information. The learning environment encourages exploration and inquiry, thus, focuses on deep understanding and application of knowledge rather than rote memorization. Learning involves interaction and collaboration among students. They collaborate to address challenges, accomplish tasks, and engage in discussions about concepts. As such, students are encouraged to think critically and make connections between ideas.

In most Senior High Schools, the elective Biology syllabus is often extensive and overloaded. Consequently, teachers frequently adopt the lecture method, as they perceive it to be an effective way to deliver a large volume of information to students within a limited timeframe (Achor et al., 2013). The purpose of Biology education for Senior High School students emphasizes engaging learners in science as an integrated discipline. Priority is placed on hands-on activities, experimentation with tools to validate textbook principles, and involvement in activities that promote analysis of environmental and health-related issues (Ministry of Education, 2010). Additionally, Biology education aims to foster students' comprehension, higher-order thinking skills, problem-solving abilities, and decision-making skills in daily life. However, it is frequently observed that teachers focus primarily on completing the prescribed syllabus and preparing students for examinations, often neglecting whether students truly understand the concepts or merely memorize answers.

Conventional teaching methods, which are predominantly content-focused, continue to dominate classrooms in Senior High Schools. Historically, these methods were deemed suitable for preparing students for tertiary education. However, conventional instructional approaches often fail to equip students with essential skills and attributes, limiting their ability to achieve desired learning outcomes for higher education. Furthermore, these methods typically lack the capacity to motivate students, encourage active participation, or foster engagement in the learning process (Duch et al., 2001). Despite these limitations, conventional approaches remain widely used in educational institutions, partly due to their economic advantages. For instance, such methods can accommodate large class sizes, allowing for the graduation of significant numbers of students over time. Teaching practices predominantly follow conventional, teacher-centred approaches, such as lecture-based learning (Asabere-Ameyaw et al., 2012). Teaching and learning approaches have traditionally been dominated by teachers, limiting opportunities for students to develop their own ideas. Consequently, educational outcomes have often been unsatisfactory (Parchmann & Luecken, 2010).

The current elective Biology syllabus is largely disconnected from real-life experiences, making the subject unappealing and challenging for many students. Bridging the gap between Biology instruction and everyday life is essential (Chamany et al., 2008). Scientific facts, concepts, and natural phenomena taught in schools should be contextualized within real-world situations (Holbrook, 2014). Effective teaching should build on students' prior knowledge, as connecting their experiences to biological concepts can enhance comprehension (Lu et al., 2010). Successful learning occurs when new knowledge is connected to meaningful and relevant contexts for students (Kukliansky & Eshach, 2014). To address the disconnect in the current syllabus, De Jong emphasizes the importance of integrating meaningful contexts into teaching and learning to promote deeper understanding (De Jong, 2008).

Context-based teaching approach is an innovative teaching approach that connects concepts to real-world contexts, enhancing students' conceptual understanding, and critical thinking skills thereby improving their academic performance (Bennett & Holman, 2002; Gilbert, 2006). This approach aims to foster and maintain a sense of awe and inquisitiveness in young individuals toward the natural world (Stolk et al., 2009). Context-based learning seeks to connect the students' daily knowledge with the content they learn in school. Context-based teaching provides a real-world framework for the material being taught, making it more meaningful and easier for students to retain when they can see how it applies in practical settings (Ahmad & Eli, 2018). These contexts encompass personal, economic, social, environmental, industrial and technological applications of science (Pilot & Bulte, 2007) and are typically chosen based on their relevance to students' everyday experiences, as determined by educators.

The context-based teaching approach aims to achieve key goals in science education, such as connecting scientific concepts to daily life (Avargil et al., 2012) and fostering an understanding of scientific principles and processes through engagement with real-world problems (Avargil et al., 2012; Wieringa et al., 2011). By doing so, it makes science education more meaningful (Pilot & Bulte, 2007) and addresses shortcomings in conventional teaching methods (Ültay & Çalık, 2012). Additionally, it demonstrates how the skills acquired during education can be applied in practice (Stanisavljević et al., 2016) and promotes greater student engagement in the learning process (Ültay & Çalık, 2012). Context-based teaching also redefines the roles of teachers and students, positioning students as active participants at the centre of the learning experience (Vos et al., 2010).

Ecology studies the interactions between organisms and their physical environment, as well as their relationships with one another. No plant or animal exists independently of its surroundings. For organisms to thrive, their environment must provide the necessary conditions for survival, as they are significantly influenced by their surroundings (Abimbola & Abidoye, 2013). Teaching these interactions requires methods that integrate ecological concepts into real-world contexts, such as studying organisms in their natural habitats, exploring local ecosystems, and addressing environmental issues. This approach, known as context-based teaching, bridges the gap between theoretical knowledge and practical application. Ecological studies focus on three levels of biological organization: the individual, the population, and the community. They also explore how organisms at each level interact harmoniously with the non-living components of their environment. At the Senior High School level, Ecology topics include fundamental ecological concepts, aquatic and terrestrial habitats, biological associations, population dynamics, ecological succession, and soil.

Ecology has numerous practical applications aimed at promoting a healthier and more sustainable biosphere for humans and other living organisms. It emphasizes the responsible use and management of natural resources, often referred to as conservation (Egwu & Okigbo, 2021). When students recognize the importance of science in their lives and see it as meaningful, they are more likely to find the knowledge they acquire throughout their education to be both valuable and effective. While research on the effect of context-based teaching on student performance in science is growing, there is still a notable lack of studies specifically examining how this teaching approach influences students' performance in Ecology.

Academic performance is influenced by the level of intellectual stimulation a student receives within the learning environment (Egwu & Okigbo, 2021). Blaiv (2000) defines performance as achieving success or accomplishing tasks through effort, skill, and determination. Similarly, Ahmad (2014) views academic performance as closely linked to mental health, which is rooted in physical health and intellectual abilities. These factors contribute to effective adjustment, social awareness, and a positive self-concept. Consequently, researchers are increasingly focused on strategies to enhance students' academic performance in science, particularly Biology (Abimbola & Abidoye, 2013; Ahmad, 2014; Wieringa et al., 2011). This study, therefore, investigates the effect of the context-based teaching approach on students' academic performance in Ecology.

Gender differences have become a significant focus of global concern, particularly for educators and researchers. In Biology education, the influence of gender on academic performance remains a key area of investigation. Some researchers, such as Akaneme and Ngwoke (2010), argue that effective teaching methods can benefit both male and female students equally, without bias. Studies by Ogechukwu et al. (2020) and Obialor (2016) revealed that gender does not significantly influence students' academic performance in Biology. Conversely, Okereke and Onwukwe (2011) reported that male students outperformed females in their study on the effects of gender on academic performance. Similarly, Afuwape and Oludupe (2008) identified notable differences in students' cognitive, affective, and psychomotor achievements based on gender.

However, findings on this issue remain inconsistent. While some studies suggest female students perform better than their male counterparts, others indicate the opposite, and many show no significant differences. This study seeks out to investigate the role of gender in Senior High School students' performance in Ecology, specifically through the use of a context-based teaching approach. By addressing gaps in the existing research, this work aims to contribute to the literature and offer valuable insights into how context-based teaching can enhance student outcomes in Ecology within Biology education.

1.2 Statement of Problem

The performance of Senior High School students in science subjects, particularly Biology, has shown a concerning decline in recent years, with poor outcomes in external examinations. This issue is evident in the performance trends of public Senior High School students based on the WASSCE results from 2016 to 2021. Reports from the West African Examinations Council (WAEC) Chief Examiner have consistently highlighted this decline in Biology performance in Ecology (West African Examinations Council, 2016, 2017, 2018, 2019, 2020, 2021). The reports attribute students' poor performance in Ecology to their inability to apply abstract reasoning to comprehend ecological concepts. This suggests that students struggle with understanding key topics, including Ecology, due to various factors. These include ineffective instructional methods that make the topics appear challenging (Babagana et al., 2018), a lack of conceptual frameworks to deepen understanding (Egwu & Okigbo, 2021), or the reliance on conventional teaching approaches, such as lectures, discussions, and indoor laboratory activities, which may not adequately engage students across all Biology concepts (Ahmad, 2014; Babagana et al., 2018).

Certain fundamental ecological concepts, such as population density and habitat, often require calculations when taught in Senior High Schools. However, these topics are frequently not adequately covered, as teachers tend to focus on the theoretical aspects rather than practical components like weighing and measuring (Egwu & Okigbo, 2021). The prevalent use of the conventional "talk-and-chalk" teaching method has become deeply ingrained among educators (Ahmad, 2014; Ajaja, 2010). Teachers often adopt a "master-knows-it-all" approach, delivering knowledge as though students are passive recipients capable of absorbing all presented information. This approach has proven ineffective for many Ghanaian students, hindering their ability to actively engage with and comprehend the material.

The Ghanaian elective Biology syllabus for Senior High Schools emphasizes teaching methods that equip learners with skills for critical thinking, meaningful decision-making, and problem-solving, underscoring the need for learner-centred instruction (Ministry of Education, 2010). Teaching ecological concepts in connection to real-world contexts is therefore anticipated to make Biology education more comprehensible, meaningful, relevant, engaging, and enjoyable for students (Gilbert, 2006; Teshager et al., 2021). In this regard, the context-based teaching approach has been recognized as an effective alternative. It seeks to make Biology education more meaningful by situating learning in real, relevant, and engaging environments (Bennett et al., 2006; Gilbert, 2006; King, 2012; Teshager et al., 2021).

The context-based teaching approach offers a valuable means of linking ecological concepts to students' everyday experiences and real-life applications (Bennett et al., 2003). However, despite its potential benefits, its implementation and effectiveness in

Ecology education within the Ghanaian context appear to be underexplored. This research addresses the limited adoption and understanding of the context-based learning approach in teaching Ecology at the Senior High School level. The study seeks to bridge this gap by investigating the impact of the context-based approach on students' academic performance in Ecology in Senior High Schools.

1.3 Purpose of the Study

The purpose of this study was to investigate the effectiveness of context-based teaching approach on students' academic performance in Ecology in Senior High Schools.

1.4 Research Objectives

The study has the following objectives:

a. Examine the impact of the context-based teaching approach on the academic performance of students in Ecology, in comparison to the conventional teaching approach.
b. Investigate the difference in academic performance between male and female students taught Ecology using context-based teaching approach.
c. Explore the views of students on context-based approach after their experience in the Ecology classroom.

1.5 Research Questions

The following research questions are set to guide the study:

a. What is the impact of the context-based teaching approach on the academic performance of students in Ecology, in comparison to the conventional teaching approach?
b. What is the difference in academic performance between male and female students taught Ecology using context-based teaching approach?
c. What are the views of students on context-based teaching approach after their experience in the Ecology classroom?

1.6 Significance of the Study

The findings of this study will assist Biology teachers in Senior High Schools in connecting their lessons to students' everyday life experiences, fostering meaningful learning and improving students' conceptual understanding of ecological concepts. This study will also benefit Senior High Schools students by enhancing their comprehension and engagement in Ecology education. Additionally, it will support teachers in Senior High Schools in adopting teaching and assessment strategies that are free from gender bias, enabling both male and female students to perceive themselves as equally capable of competing and collaborating in classroom activities.

Moreover, the results of this research could guide policymakers and Biology curriculum developers of Senior High Schools by providing insights into the current state of context-based teaching approach implementation. This knowledge could help in designing instructional strategies that promote meaningful learning experiences in Ecology in Biology.

Finally, the findings of this study will also contribute to the existing body of literature by offering valuable insights into the effectiveness of the context-based teaching approach in improving students' performance in Biology at the Senior High School level. The study will expand the knowledge base, serving as a reference for future researchers interested in exploring gender differences in Senior High School students' performance in Ecology in Biology.

1.7 Delimitations of the Study

To ensure this research was feasible and manageable, the following scopes were utilized:

- *Content:* This study focused on differences in teaching approaches to Biology students' performance in view of male and female students.
- *Geographic Scope*: This study was restricted to mixed-sex public Senior High Schools in the Atwima Nwabiagya North and South, and Kwadaso Municipalities in the Ashanti Region of Ghana, although there were mixed-sex private Senior High Schools in the region which offered Biology.
- *Level*: The study focused on second-year elective Biology students within the selected Senior High Schools and not students in other subject areas.
- *Concept*: The study focused specifically on the teaching of basic concepts in Ecology, study of specific habitats (aquatic and terrestrial, biotic and abiotic factors, food chains and food webs, ecological pyramids) and biological associations (symbiosis, mutualism, parasitism, epiphytism)

1.8 Limitation of the Study

Since the researcher conducted the teaching for both the experimental and control groups, there was a possibility of unintentional bias towards the experimental group, potentially enhancing their understanding and subsequently improving their academic performance in Ecology.

1.9 Organization of the Study

This study report is presented under five chapters:

Chapter One introduces the study by providing the background and outlining the statement of the problem, purpose of the study, objectives, research questions, significance, scope, delimitation, limitations, definitions of key terms, and the organization of the study.

Chapter Two reviews relevant literature and presents the theoretical and conceptual framework. It covers topics such as teaching methods and approaches, teaching Ecology in Senior High School, context-based teaching and models for developing context-based materials. It also examines the relationship between context-based teaching and academic performance in Biology, gender and context-based approach, conventional teaching approach, empirical review and concludes with a summary of the literature.

Chapter Three details the methodology, including the research approach, philosophical underpinnings, research design, sampling techniques, population and sample of the study, research instruments, pilot testing, validity and reliability of instrument, data collection methods, and data analysis procedures.

Chapter Four presents the results and discusses the findings. Section 4.3 focuses on the study's findings, guided by the research objectives, while Section 4.4 provides a discussion of these findings in relation to the research objectives, literature, and theoretical and conceptual foundations. The chapter concludes with a summary.

Chapter Five summarizes the major findings, presents conclusions, offers recommendations and suggestion for further research. It evaluates the effectiveness of the context-based teaching approach in enhancing Senior High School students' academic performance in Ecology. Conclusions are aligned with the research objectives, providing insights into the implications of the study.

1.10 Definition of Terms

The main terms used in this study are defined as follows:

Context-based approach: A teaching method in science education where contexts and applications of science serve as the starting point for developing scientific concepts, in contrast to conventional methods that prioritize scientific concepts before briefly mentioning applications (Bennett et al., 2006, p.348).

Conventional approach: A teacher-centred teaching method in which the teacher introduces concepts, presents theories, and provides notes, with limited demonstration of experiments. Students primarily listen, take notes, and occasionally ask questions or provide comments. For this study, the term refers to the "business as usual" classroom teaching approach (Taasoobshirazi & Carr, 2008, p.157).

Performance: The level of achievement or success demonstrated by an individual or organization in completing a specific task or set of tasks (Blaiv, 2000).

Academic Performance: The extent to which a student achieves success in a given academic task, typically measured through formal testing of what has been taught.

Ecology performance: The measurement of success in achieving Biology course objectives related to Ecology. In this study, it is specifically assessed using the Ecology Performance Test (EPT).

Gender: The categorization of students based on their biological sex (male or female) in mixed public schools.

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

The review of the relevant literature to the study is included in this chapter. The theoretical and conceptual framework pertaining to the study is also included. The chapter contains teaching methods and teaching approaches, teaching Ecology at Senior High Schools and context-based teaching approach. Also, present in this chapter are context-based teaching and academic performance in Ecology, gender and context-based approach, conventional teaching approach, empirical review and summary of the literature review.

2.1 The Theoretical Framework of the Study

The theoretical framework serves as the foundation upon which a research study is based. In educational research, the theoretical framework provides an understanding of the key theories that guide the research problem, methodology, and analysis. For this study, the effects of context-based approach on students' academic performance in Ecology will be grounded in social constructivism.

2.1.1 Social Constructivism

Constructivism is a broad theory that suggests learners build their knowledge from their own experiences rather than passively receiving information. Social constructivism, influenced by the work of Lev Vygotsky, argued that learning is inherently social and is facilitated through interaction with others, particularly within cultural and environmental contexts. In the realm of education, social constructivism emphasizes that the most effective learning occurs when students actively participate in a social process that requires frequent thorough interactions and collaboration with teachers, peers, and the surrounding environment (Vygotsky, 1978). In that, learning is an active, social procedure where learners construct their understanding based on the interplay between their previous experiences and new knowledge.

Social constructivism is a learning theory that emphasizes the role of social interaction, collaboration, and cultural context in the development of knowledge and understanding. Unlike conventional theories of learning that view knowledge as something that is transferred from teacher to student, social constructivism suggests that learners actively construct their own understanding of the world, often in collaboration with others. The context-based approach aligns well with social constructivism as it incorporates real-world scenarios that relate directly to students' lives, thereby facilitating the construction of knowledge in a meaningful way. Social constructivism is therefore relevant to the context-based approach in teaching because it stresses the importance of situating learning in authentic, real-world contexts that are relevant to students' lives. In the study of Ecology, which deals with living organisms and their environments, learning that is grounded in actual ecological systems allows students to better relate theoretical concepts to the world around them. This makes social constructivism an ideal theoretical foundation for the study.

2.1.2 Social Constructivism and Context-Based Teaching Approach

Context-based teaching approach aligns well with the principles of social constructivism. It emphasizes learning in authentic, real-world contexts where students actively engage with the material in meaningful ways. This approach contrasts with traditional, decontextualized teaching methods that often fail to relate classroom knowledge to real-world situations, thus, drawing heavily on the idea that learning is most effective when it occurs in situated, relevant contexts. Social constructivists believe that knowledge is not a standalone entity; instead, it is embedded in specific social, cultural, and environmental contexts (Lave & Wenger, 1991). The ecological context is particularly relevant because it represents a complex system where real-world interactions and relationships are central. By framing lessons within real ecological issues, such as biodiversity, students can better relate to the material, leading to a deeper and more meaningful understanding. Aspects of social constructivism to consider are collaborative and situated learning, scaffolding and authenticity of learning.

Social constructivism underscores the importance of collaboration in learning. In a context-based teaching approach, students engage in group discussions, peer-led projects, and collaborative problem-solving activities that mirror the interactions found in real ecosystems. These collaborative activities allow students to co-construct their knowledge, refining their understanding through dialogue and feedback (Osborne, 2001). The concept of situated learning (Lave & Wenger, 1991) emphasizes that knowledge is most effectively acquired in settings that closely resemble how it will be applied in the real world. In Ecology, students benefit from learning in environments that reflect the actual conditions of ecosystems. Fieldwork, case studies, and problem-based learning are examples of how the context-based approach situates learning in real-world ecological scenarios.

Social constructivists argue that authentic tasks promote deeper learning because students can apply their knowledge in meaningful ways by engaging in real-world issues. In an Ecology class, investigating local environmental problems or developing solutions for conservation initiatives provides students with opportunities to apply ecological principles in practical, socially relevant contexts (Schreiner & Sjøberg, 2004).

2.1.3 Review of Literature on Social Constructivism and Context-Based Approach

Literature supports the notion that context-based approach, grounded in social constructivism, is an effective pedagogical strategy. While Vygotsky's work forms the core of social constructivism, subsequent researchers have expanded upon his ideas to apply them more broadly to education. Social constructivism emphasizes that students are not passive recipients of information but are actively engaged in constructing their knowledge through interaction with their peers, teachers, and the broader social and cultural context (Palincsar, 1998).

Driver et al. (1994) argued that students construct scientific knowledge more effectively when they are given opportunities to explore ideas in social and contextual environments. In their view, science education should move away from rote memorization and toward approaches that engage students in inquiry-based, collaborative learning. Bennett et al. (2006) explored the impact of context-based learning on secondary science education, finding that students taught within relevant, real-world contexts outperformed those who learned through conventional approaches. This was especially true in terms of their ability to understand and apply scientific concepts, including those related to Ecology.

Moreover, Gilbert (2006) found that context-based approaches in science education help students bridge the gap between theoretical knowledge and practical application. In his study, students engaged with real-world problems, which made abstract concepts more tangible and understandable. Schreiner and Sjøberg (2004) further highlighted the importance of context-based learning for engaging students emotionally and cognitively. They argue that students are more likely to take ownership of their learning when it is connected to issues they care about, such as biodiversity and environmental sustainability. This is particularly important in the study of Ecology, where understanding complex relationships between organisms and their environments is essential for fostering an ecological mindset.

According to recent studies in science education, learning is viewed as a process where students engage with more experienced individuals – in this case Biology teachers – to create their own meanings from their experiences (Taconis & Jochems, 2013). As a result, the use of context-based approach in Ecology instruction in this study is based on the idea that students can actively construct their own knowledge with the teacher's assistance acting as a facilitator and bringing Biology lessons to life by relating them to the students.

2.2 The Conceptual Framework of the Study

The conceptual framework of this research visually illustrates how the context-based teaching approach influences student outcomes in the study of Ecology. This framework draws upon Hung's 3C3R model for problem-based learning (PBL), which incorporates three core elements (Content, Context, and Connections) and three process elements (Researching, Reasoning, and Reflecting) (Hung, 2006).

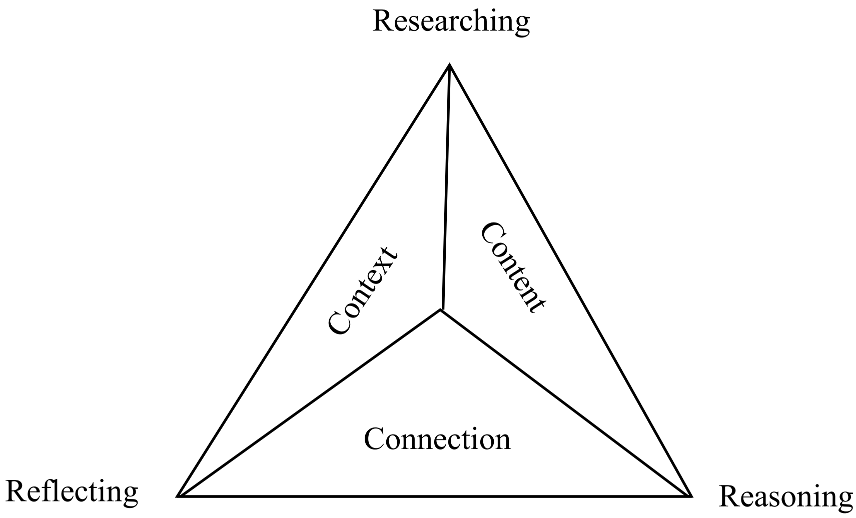

Figure 2.1: The Hung Model For Problem-based Learning Design

The 3C3R model is structured into two main categories: the core components, comprising the 3Cs, and the process components, encompassing the 3Rs. Given that the primary aim of this intervention study was to enhance students' understanding of ecological concepts and their higher order thinking skills advancement, Hung's model was thought to be helpful in offering a suitable framework for answering the research questions. The 3C3R model was modified for this investigation to include two component classes: the core component and the process component.

- ***Core component***

The content, context, and connections make up the core components of the current study's conceptual framework. The concepts, ideas, principles, and theories of Ecology that will be taught are part of the content element. The situations and experiences – personal, societal, environmental, and scientific and technological – that the students themselves recognized as the means by which the material was taught comprise the contexts. The connections, on the other hand, involve the relationships between the content and the contexts (that is, the content was integrated into the contexts, which remained centred on the study of Ecology concept).

The goal of the core component's content element is to meet learners' needs in terms of content knowledge proficiency. In the current educational systems, students must possess content knowledge in order to achieve competitive scores on national examinations that serve as a means of verifying their accomplishments (such as Ghana's WASSCE). In these tests, students are evaluated based on predetermined achievement criteria (Hoffman & Ritchie, 1997). In context-based approaches to Biology education, where there have been reports of scarce content depth and exposure, it is especially critical to prioritize content proficiency in educational innovation (Bennett et al., 2006).

The context component places learning in context and motivates students. According to Biggs (1989), when students are intrinsically motivated – for instance, by a desire to satisfy an interest or curiosity about the subject – they will attempt to maximize their comprehension of the matter. According to Brown et al. (1989) learning materials and skills are easier to remember and retain when they are taught in contexts that are similar to the ones in which they will be used. Furthermore, according to Prawat (1989), learners' challenges in applying concepts they have learned to real-life situations may be explained by a lack of contextual knowledge. In order to improve classroom motivation and performance, the context element was utilized to make the teaching and learning materials more relevant.

The development of connections between concepts and contexts is the third core component. Two techniques were used in this study to connect the learned materials. In order for learners to comprehend how different concepts are interrelated, first connections between concepts were established by using distinct concepts to examine a certain circumstance (context). Second, in order to help students understand how concepts might be applied to various real-world scenarios, connections between contexts and concepts were established through repeatedly using the same concepts in various contexts.

Collectively, all three core components – content, context and connections – were designed to help learners develop integrated mental conceptual and contextual frameworks, contextualize learned knowledge, and improve conceptual comprehension. These three components were utilized in the creation of the materials, their execution, and the evaluation of student learning.

- ***Process component***

The reasoning, reflection, and research that students did in relation to the study materials comprised the process component. Thus, the materials' instructional and learning activities were its main focus. Questions concerning problems and the relationship between contexts and content were frequently addressed during the activities. Debates, questions and answers sessions, group discussions, brainstorming sessions, tests, and role plays were all part of these educational exercises.

The reasoning component is essential for comprehending the framework's central idea as well as for assisting students in building their knowledge and honing their analytical abilities (Hung, 2006). Students in this study had to use reasoning to draw logical connections between the material they were studying and the contexts they were considering. Higher-order thinking abilities like decision-making, critical and analytical thinking, problem-solving, formulation of hypothesis, and interpretation of data were all part of the cognitive exercise used to make these connections. In learner reflections, preconceptions about a particular situation were evaluated in light of new information learned during instructional periods, and the suitability of those preconceptions was examined. Researchers (Brown et al., 1989; Duell, 1986) support this method of learning by arguing that learners can improve their learning by assessing their own problem-solving and decision-making techniques, investigating scenarios, and looking at different theories and solutions.

The process component also included research (investigations) that students conducted as they investigated the applications of the ideas and situations they were studying. Through reasoning, reflections, and research, learners attempted to understand the contexts using the provided content, which was the focus of the process component. The conceptual framework put forward that the context-based teaching approach directly influences the learning outcomes in Ecology by situating the content in familiar, real-life contexts. The approach is expected to enhance student engagement, making abstract ecological concepts more tangible and relatable. The framework assumes that when students work together in solving real-world problems, they develop a deeper, more critical understanding of ecological concepts. The role of the teacher is to support students in this process, providing guidance where needed and encouraging independent thinking.

2.3 Teaching Method and Teaching Approach

Teaching is defined as the process of imparting knowledge, skills, and values to learners through structured activities and interactions (Eggen & Kauchak, 2012). Teaching is a fundamental activity in educational institutions, aiming to facilitate learning through various methods and approaches. It involves not only the transmission of information but also the fostering of critical thinking, problem-solving abilities, and lifelong learning skills. Dewey (1938) emphasized that education is not just a preparation for life but a continuous and dynamic aspect of life itself. Effective teaching requires educators to be adaptable, knowledgeable, and responsive to the diverse needs of their students (Borich, 2016). Educators must understand and effectively implement diverse teaching strategies to enhance student engagement, comprehension, and overall learning outcomes.

Teaching methods are systematic procedures or strategies employed by teachers to facilitate learning. They can be broadly classified into two categories: teacher-centred and student-centred methods. Teacher-centred methods, such as lectures and direct instruction, position the teacher as the primary authority and source of knowledge. Students are passive recipients of information (Bligh, 2000). This approach is efficient for delivering large amounts of content quickly and is often used in contexts where foundational knowledge is essential. This requires teachers to present information in a structured manner, allowing efficient coverage of extensive material (Bligh, 2000). Thus, the teacher-centred method ensures consistent delivery of curriculum across different classrooms since teachers can maintain control over the pacing and sequencing of content. This may lead to student disengagement and lack of active participation, focused more on memorization than on developing higher-order thinking skills (Borich, 2016).

Student-centred methods prioritize active participation, collaboration, and critical thinking. These methods view students as active agents in their learning process, promoting deeper understanding and retention. They involve students in discussions, group work, and hands-on activities, enhancing engagement and comprehension (Prince, 2004). In addition, these methods boost students' teamwork and communication skills, promote analysis, evaluation, and synthesis of information; fostering deeper understanding. However, these methods require more time and resources to implement effectively as students can be challenging to manage in larger classes (Borich, 2016).

Teaching approaches encompass the overarching philosophies and strategies that guide the selection and implementation of specific teaching methods. These approaches are influenced by educational theories and the desired learning outcomes. Ersoy (2016) asserts that the context-based approach does not employ any special education techniques. After a thorough review of the literature on science education, hardly any studies were found that discussed the connection between teaching approach and method. Conversely, there is an implementational technique that is appropriate for use in a classroom setting. In order to achieve an immediate goal, this technique has its own unique trick. The fundamental idea is actually that the techniques should align with a specific method and, consequently, correspond to a broader teaching approach (Peşman, & Özdemir, 2012).

In essence, a teaching approach represents a set of interconnected principles and beliefs about the nature of teaching, within which various teaching methods can be utilized. Conversely, a teaching method and technique refer to the comprehensive planning and implementation of instruction (Peşman, 2012). When choosing teaching strategies, it is essential to consider the intended learning outcomes, the needs of the students, and the educational context. A more dynamic and productive learning environment can be produced by integrating diverse techniques and strategies.

2.3.1 Teaching Ecology at Senior High Schools

The study of living things in their natural environments or habitats is known as Ecology. Ecology, according to Usman (2008), is the study of how organisms interact with their surroundings and with each other. Therefore, consider Ecology to be about organism populations. According to Ajaja (2010), Ecology is the study of the interactions between living things and their physical or non-living environments. These definitions all point to the physical environment in which the organisms live and their biotic environment. It denotes that no organism can live in isolation instead it must interact with its environment which is simply referred to us "Ecology". The undoubted interest that learners have in living things is at once and advantage and a trap to the teacher of Biology (Jean, 2001). The teacher must make sure that the learners understand the Ecology of the specimens under study and that they have some appreciation of its fellow species and possibly its place in the food chain.

Since Ecology deals with the interactions between living things and the inanimate elements of the environment, it is important to raise students' awareness of the subject at a young age (Nzewi, 2008). Some fundamental ecological concepts that are expected to be taught in Senior High Schools, such as habitat and population density, call for some simple calculations and measurements. Anything involving calculations naturally terrifies both teachers and students. These educators and learners would favour a theoretical component that involves weighing and measuring. In the West African Senior Certificate Examinations, this tendency has led to the overall subpar performance of the candidates in question when it comes to ecological concepts (Ajaja, 2010).

The Senior High School Biology curriculum places the basic ecological concepts to be studied under year two with some units including the ecological concepts, biotic and abiotic factors, environment, biosphere, habitat, biome, food web, food chain, measuring instruments, population dynamics, etc. The curriculum specified the performance objectives to be achieved as well as the activities to be carried out in the course of teaching and learning to facilitate understanding of the concepts being taught (Ministry of Education, 2010). In this study, therefore, an investigation was made on the effects of context-based teaching approach on academic performance of students in Senior High Schools. It links real word experiences such as observation and interpretation of the substances in their natural surroundings to their lessons in the classroom. This may help the students to remember and understand what they have seen in its natural environment, thus improving the students' academic performance in Biology.

2.4 Context-Based Teaching Approach

Bennett et al. (2005), describe context, in its comprehensive sense, as encompassing the cultural and social environment of students. More specifically, it can refer to the application of scientific concepts. Context is often defined through stories, topics, customs, issues, or situations (Bennett, 2005; Pilot & Bulte, 2007; Wieringa et al., 2011). In the context-based teaching approach, "context" involves utilizing real-world scenarios, challenges, or applications as a framework to introduce and explore scientific ideas. This method moves away from teaching abstract concepts in isolation, instead presenting them within meaningful contexts, such as environmental challenges or technological advancements, making the learning experience more engaging and relevant to students' lives (Bennett et al., 2006). This approach seeks to bridge the divide between theoretical knowledge and its practical applications, fostering a deeper understanding of Biology and its significance in everyday life (King, 2012).

Context-based approaches in science education involve using real-world scenarios and applications as the foundation for introducing and developing scientific concepts. This method contrasts with conventional approaches, where scientific principles are taught first, followed by their applications. In context-based learning, practical situations and applications serve as the entry point for understanding scientific ideas, unlike conventional methods that prioritize theoretical knowledge over practical relevance (Bennett et al., 2006). This approach offers an alternative to conventional teaching methods by engaging students in scenario-based, student-centred learning processes. Students are presented with a context and guided to hypothesize, leading to the identification of their own learning needs. These learning needs are then explored collaboratively using current research and resources, culminating in the students presenting their findings to peers. Context-based teaching emphasizes group learning, where collaborative efforts foster discussions that drive students toward solution-focused outcomes (Trimmer et al., 2009).

The primary objective of context-based approaches is to link scientific concepts to real-world experiences. This method begins by emphasizing students' daily experiences to bridge the gap between classroom learning and everyday life. Context-based learning integrates the social and practical dimensions of the learning environment, focusing on real, tangible situations. It is grounded in the principle that learning is inherently a social activity (Bennett et al., 2005; Gilbert, 2006). Through peer interactions, students can test and refine concepts essential for solving specific problems, assess their understanding, exchange ideas on the material taught, and gain fresh perspectives from their classmates (Gilbert, 2006).

Unlike conventional teaching methods, which often relies on direct instruction, the context-based approach incorporates a variety of strategies, including presentations, group discussions, role-playing, and small-group collaboration (Bennett et al., 2006). This approach tailors instruction to align with the interests and daily experiences of students (Bennett et al., 2006; Gilbert et al., 2011) enabling them to relate classroom material to real-life situations. Research suggests that context-based learning activities enhance students' retention of subject matter, as they facilitate learning at a conceptual level (Cabbar & Senel, 2020; Hasanah et al., 2019). The context-based approach emphasizes that learning should occur within diverse physical, social, and cultural contexts that promote conceptual understanding (Cabbar & Senel, 2020). It encourages collaborative learning through group work, where students can listen to one another, exchange ideas, offer support, and build collective knowledge. In contrast, conventional learning tends to focus on individual knowledge construction based on each student's understanding (Hasanah et al., 2019). Teachers play a crucial role in guiding students to connect theoretical concepts with real-world applications (Ersoy, 2016).

In contrast to conventional teaching methods, context-based teaching incorporates a wider range of instructional strategies, including student presentations, discussions, role-playing, and small group activities (Bennett et al., 2006). Bennett contends that rather than the pervasive belief that science is irrelevant and dry, students will be more motivated to learn if science issues are made relevant to them, their families, and their peers. A representative curriculum can be created and overload can be avoided by beginning the design of plans, programs, and lesson units with context (Bennett et al., 2006).

Context-based teaching, as an inductive approach to learning, incorporates trial-and-error strategies in the classroom, with group discussions serving as a significant driver of learning (Trimmer et al., 2009). Educators adopting the context-based approach take on the role of facilitators (King, 2012), guiding students in developing creativity and critical thinking within an open and interactive learning environment. However, a key challenge in implementing this approach is teachers' reluctance to transition from a content-driven model to a student-centred one. The shift in responsibility from being an instructor to a facilitator is often the most complex aspect of this method to grasp. The facilitator's duty is to lead, challenge, and ask questions; some teachers find it difficult to accept the idea of "not being in control" (Trimmer et al., 2009). Context-based learning involves group processes and cooperative learning. It is necessary to set aside time for group process evaluation and brainstorming. Facilitators need to be able to share their subject- and non-subject-matter expertise and handle problems as they arise.

To implement a context-based approach in the classroom, educators must develop comprehensive learning packages that align with the curriculum's content and learning objectives. This process involves careful instructional design, including selecting appropriate media, organizing content, creating the learning package, and ensuring it encourages inquiry-based learning. Since scenarios are a core element of the context-based approach, educators must practice them, identify the necessary background knowledge, and ensure that learning outcomes are tailored to meet both the programs and students' needs. However, implementing this model presents significant challenges for teachers (Avargil et al., 2012), making teacher training a critical component (Parchmann & Luecken, 2010; Pilot & Bulte, 2007).

The context-based approach is expected to enhance student performance, stimulate natural curiosity, and facilitate the learning process (Bennett et al., 2005; Wieringa et al., 2011). Additionally, it holds promise as an effective method for educating students about ecological concepts.

2.4.1 Principles for Developing Context-based Materials

Gilbert (2006) asserts that the following guidelines ought to direct the creation of successful context-based instructional materials:

1. Context-based materials should offer a social environment where students can experience events that are the focus of their attention in their minds.
2. The setting in which the mental interactions occur needs to be one of authentic inquiry, mirroring the circumstances in which scientists work.
3. Students should develop their conversational style in the classroom.
4. It is necessary to use learners' preconceptions and investigate their explanatory sufficiency.

Despite the guiding principles of context-based teaching, several models exist that emphasize different aspects of contextualized instruction. These models focus on factors such as the types of contexts used to develop instructional materials, the extent to which contextual principles are integrated, the sequence of material presentation, and the role of context in teaching and learning. Gilbert (2006) and De Jong (2008) categorized these models into frameworks for developing and implementing context-based materials, respectively.

2.4.2 Models for Developing Context-based Materials

Gilbert (2006) classified the models for creating context-based materials into four categories based on the types of contexts (i.e., social, environmental, or personal) that underpin the materials and the extent to which these materials align with contextual teaching principles. Below is a discussion of these models.

Model 1: Context as the Straight Application of Concepts

This model views the application of concepts as an “add-on” to theoretical treatments, resulting in a rigid, one-way relationship between concepts and their applications

(Gilbert, 2006). There is no social setting provided to engage students mentally with the context, and it emphasizes abstract acquisition of ideas without considering the behavioural environment or social context. As a result, this model lacks effective learning activities and opportunities for students to develop a coherent use of scientific language (Gilbert, 2006). Due to these limitations, this model was deemed unsuitable for this study.

Model 2: Context as Reciprocity between Concepts and Applications

In this model, context-based materials link concepts to their applications, allowing the applications to influence the meanings attributed to the concepts. By juxtaposing concepts and applications, the model creates a context within learners' cognitive structures (Gilbert, 2006). However, the distinction between subgroups of contexts can lead to confusion for both teachers and students. While this model helps students connect knowledge to their beliefs and use scientific language coherently, it does not emphasize the importance of respecting the social contexts in which interactions occur (Gilbert, 2006). These factors led to its exclusion from the study.

Model 3: Context Offered by Individual Mental Activity

In this model, scientific concepts and ideas are taught and learned in a social context through the use of historical narratives. To put it another way, historical event narratives are connected to a scientific theme in order to clarify and illustrate the ideas within the theme. As a result, the model offers a social context in which a particular scientific language could be successfully created. Additionally, the model utilizes the prior knowledge of the learners. Gilbert et al. (2011) developed an example of this model by identifying historical events or situations from books and other sources that were meant to serve as unofficial science education. These instances were "intertwined" into narratives/stories which fit into "contexts" for interpretation.

This model's potential challenge is that using historical events may necessitate extensive background knowledge and preparation in order for students to value and correctly depict the circumstances as they happened. As a result, learners may not be able to access the necessary background information, which could prevent them from appreciating the narrative's significance or worth (Gilbert, 2006). Even if they did, students might not relate to the problems being portrayed or explained because, in their opinion, the contexts' relevance and importance may have become outdated (Pilot & Bulte, 2007). Thus, this model essentially lacks the social component of contextualized instruction (Gilbert, 2006). The said challenges led to the model being deemed unsuitable for this investigation.

Model 4: Context as Social Conditions

This model emphasizes the social dimensions of context by linking scientific concepts to real-world problems encountered in students' daily lives. It aligns with activity theory and situated learning, where students and educators see themselves as part of a "community of practice" (Greeno, 1998). Learning activities in this model are activity-oriented and based on sustained inquiry within meaningful settings. Context influences the meaning of the content and vice versa, fostering active student participation (Gilbert, 2006). The fourth model adheres to key guidelines for developing context-based science teaching materials. It provides students with a valued social environment, facilitates engagement with meaningful events, and employs activities that emphasize a behavioural environment. These activities help students grasp scientific concepts and develop coherent use of scientific language (Gilbert, 2006). Authentic inquiry and active student involvement are central to this model, making it the foundation for creating the resources used in this study.

2.4.3 Development of Context-based Teaching Materials

The development of context-based materials generally involves the creation of learning and assessment activities, alongside the selection of contexts and content.

- ***Selection of contexts for development of context-based materials***

In most cases, curriculum developers and implementers select the contexts for creating context-based materials, often without considering students' preferences or perspectives (Bennett, 2003). For instance, in large-scale context-based projects such as the Salters Projects (Bennett & Lubben, 2006), Chemie in Kontext (Parchmann et al., 2006), and ChemCom (American Chemical Society [ACS], 2002), the contexts were primarily chosen by curriculum developers. In such projects, developers typically design and supply instructional materials to teachers. In other instances, teaching professionals collaborate with university experts to develop resources (Parchmann et al., 2006; Pilot & Bulte, 2007).

Unfortunately, learners' opinions and educational goals are rarely considered during the development of these materials, whether on a large or small scale. This oversight can lead to a misalignment between the contexts used in the materials and those deemed relevant, meaningful, or engaging by students. Researchers have raised concerns about excluding students from decisions about their learning materials, noting that contexts selected solely by adults may fail to resonate with students (Harp

& Mayer, 1998; Shiu-sing, 2005). Thus, incorporating students' perspectives when selecting contexts is essential to ensure that the materials are meaningful and effective.

- ***Development of learning activities***

Incorporating contexts and content to learning activities is the next step in the materials' development process. These exercises are typically intended to promote the growth of analytical and critical thinking abilities. These activities include investigations, role-playing exercises, small-group discussions, and decision-making or problem-solving tasks, both individually and in groups (Bennett & Holman, 2002). In order to motivate learners and foster conceptual understanding, these exercises are designed to be intellectually challenging. Additionally, these activities are seen as less intimidating than conventional teacher-centred approaches. They help develop various learning skills and give students greater control over their learning process (Bennett, 2003). The materials created for this study included both hands-on and mind-on activities for teaching and learning in line with these goals.

- ***Development of assessment tasks***

The final phase in developing context-based materials is designing assessment tasks to evaluate students' understanding and skills. Context-based assessment tasks are ideal as they assess students' knowledge, comprehension, and application of scientific concepts in both familiar and novel contexts (Bennett, 2003). However, conventional assessment tasks in contextualized teaching often focus on students' ability to understand, apply, and evaluate abstract scientific concepts (Bennett, 2003). This focus may reflect the priorities of examination boards and tertiary institutions, whose goals often differ from those of contextualized teaching. For this study, the assessment tasks were designed to evaluate students' ability to comprehend, apply, and critically assess scientific concepts within real-life.

2.4.4 Approaches for Implementation of Context-based Materials

Context-based lessons typically involve varying proportions of contexts and content at different stages of the learning sequence. The order and purpose of context presentation can influence the effectiveness of contextualized teaching, as argued by De Jong (2008). Based on the purpose and sequence of context presentation, he proposed three approaches to implementing context-based materials:

Approach 1: Conventional context-based instruction

For these methods, scientific ideas are taught first, then relevant contexts. The contexts are used to give students the chance to apply the concepts they have learned and to demonstrate them (De Jong, 2008).

Approach 2: More contemporary approaches to context-based instruction

In this approach, an examination of a specific context is presented prior to the introduction of related scientific concepts. Contexts are used to increase motivation for learning new scientific concepts and to provide justification or a place to start when teaching them (De Jong, 2008).

Approach 3: Current approaches to context-based instruction

Approaches that expose learners to contexts prior to the introduction of content fall under the third category. Students are exposed to various contexts following the introduction of scientific concepts. Depending on various approaches, the contexts that are introduced after the concepts are used to illustrate and apply the scientific concepts, while the contexts that are introduced before the concepts are used to support the teaching of scientific concepts and to encourage students to learn new ones (De Jong, 2008). The third category of context-based approaches served as the foundation for the context-based strategy employed in this investigation. According to De Jong (2008), this method considered the four purposes of contexts: the justification for educating scientific concepts, the incentive to learn new concepts, and the application and illustration of scientific concepts. Similar to De Jong's third approach, other researchers have suggested context-based teaching strategies (Campbell et al., 2000).

2.4.5 Using Context-based Teaching Resources in Science Classrooms

The implementation of context-based teaching materials often relies on a “need-to-know” approach, where scientific concepts, principles, and ideas are introduced only when they contribute to understanding or enhancing knowledge about the context being explored (Bennett & Holman, 2002). This method allows for the iterative revisitation of scientific concepts in a “spiral” or “drip-feed” fashion, presenting information in small, manageable portions that are revisited as needed to address subsequent themes or contexts (Bennett & Lubben, 2006).

To ensure learning materials are relevant, comprehensible, and transferable, a variety of learning activities are employed to connect contexts with content. These activities may include experiments, debates, simulations, field trips, scientific investigations, class presentations, and exercises in decision-making and problem-solving (Bennett &

Lubben, 2006; Parchmann et al., 2006). Such activities not only make learning more engaging but also help develop a range of skills, including cognitive abilities essential for both specialists and general learners in science (Bennett, 2003; Gilbert, 2006; Schreiner & Sjøberg, 2004).

2.5 Context-based Teaching and Academic Performance in Biology

Ecology, an aspect of Biology, offers numerous opportunities to integrate real-world contexts due to its connection to living organisms, health, ecosystems, and environmental issues. Holbrook (2014) notes that biological concepts are often perceived as boring and difficult for students to grasp. To address this, teaching must be closely linked to students' everyday lives. It is essential to consider the context in which scientific facts, concepts, and natural phenomena are taught, using students' prior knowledge as the foundation. By linking their personal experiences to biological concepts, students can achieve a deeper understanding. Kukliansky and Eshach (2014) argue that meaningful learning occurs when students can connect acquired knowledge to activities, they find relevant. The context-based teaching approach has gained prominence in science education, particularly in Biology, as it integrates biological concepts with real-world applications. This approach enhances student engagement, promotes a deeper understanding, and improves academic performance by demonstrating the relevance of Biology to everyday life.

In this study, a context-based approach in Ecology is defined as teaching where the 'context' or the application of concepts to real-world scenarios is central. Ecology concepts are introduced on a 'need-to-know' basis – when students require them to understand a real-world application. The concept-context approach serves two key purposes: it makes scientific ideas more relatable by linking them to real-world situations and makes the science curriculum more meaningful by tailoring it to students' interests. To emphasize the importance of Biology, contextualizing biological knowledge is strongly recommended. Empirical studies consistently highlight that the context-based approach (CBA) significantly enhances students' conceptual understanding of biological concepts.

Gilbert (2006) conducted a study in secondary schools and found that students taught Biology through a context-based curriculum exhibited a much deeper comprehension of core concepts compared to those taught using conventional methods. When biological processes such as photosynthesis and respiration were presented in the context of real-world issues like agriculture and climate change, students demonstrated a better understanding of the relevance of these processes. This was evident in improved test scores and an enhanced ability to apply the concepts to novel situations. Similarly, Agyei (2022) reported that students exposed to CBA outperformed their peers taught using conventional methods. His findings emphasized that the context-based approach significantly improves students' understanding of genetics, enhances their problem-solving and decision-making skills, and fosters their ability to generate hypotheses. These results underscore the effectiveness of CBA in promoting deeper learning and practical application of biological concepts.

Other researchers (Achor et al., 2024; Ahmad & Eli, 2018; Sunday et al., 2021) have shown a significant difference in the performance of students taught using the context-based approach compared to those taught using the conventional lecture method, with the context-based approach leading to greater improvements in student performance. Bennett et al. (2006) conducted a meta-analysis of research on context-based approaches in science education, including Biology, and found that context-based learning consistently enhanced students' conceptual understanding of scientific concepts. This approach helped bridge the gap between theoretical knowledge and practical application, resulting in deeper comprehension. The improved understanding was associated with better academic performance on both formative and summative assessments.

Correspondingly, the context-based teaching approach has been shown to improve student engagement and motivation, which are essential factors in academic performance. When students perceive the material as relevant to their lives, they are more likely to be motivated, actively engage with the content, and achieve better academic results. King and Ritchie (2013) explored the impact of context-based learning on high school students' interest in Biology and found that students taught using this approach showed a stronger interest in the subject and were more inclined to explore related topics outside of class. This increased interest led to improved academic performance, as students became more engaged in learning activities and developed a deeper understanding of the material.

Furthermore, Wieringa et al. (2011) reason that the foundation of meaningful learning lies in a deeper understanding of the material, which is fostered through the use of context-based teaching. This approach is expected to enhance students' academic performance, promote effective learning, and stimulate their natural curiosity. The context-based approach aims to link abstract biological concepts with real-world experiences, making them more relevant and engaging for students. Although challenges exist in implementing CBA, particularly in teacher training, empirical evidence indicates that its benefits significantly outweigh the challenges, making context-based teaching a highly effective strategy for improving academic performance in Biology.

2.6 Gender and Context-Based Approach

In conventional Biology classrooms, boys are often seen to outperform girls, particularly in areas that require higher-order thinking and abstract reasoning. However, several studies suggest that CBA can help level the playing field by providing learning experiences that are more aligned with the strengths and preferences of female students. This teaching method connects biological concepts to real-world contexts, helping students understand how concepts learnt relates to their lives. Gender differences in educational experiences and outcomes are a well-researched area, and studies exploring the intersection of gender and context-based teaching reveal how different genders might benefit from or engage with CBA in unique ways.

Empirical studies on the impact of CBA on gender-specific academic performance in Biology suggest that both male and female students benefit from the approach, albeit in varying ways. Stolk et al. (2009) explored how context-based teaching affected how well male and female students performed in genetics unit in Biology. Academic performance improved for both sexes, according to the study, although the effect was stronger for female students. However, the impact of CBA on male students should not be underestimated. Bennett et al. (2005) found that while female students may benefit more from the contextual aspects of CBA, male students also showed improved academic performance when the material was framed in ways that allowed them to engage with hands-on, problem-solving activities. Eseine-Aloja (2021) observed from her study that a significant disparity existed in the academic performance of male and female Biology students attending extra-mural classes, with the male students outperforming their female colleagues.

According to Etobro and Fabinu (2017), gender does not significantly influence students' perceptions of challenging Biology topics, suggesting that these topics present a similar level of difficulty to both male and female students. Similarly, Fikadu and Shimeles (2019) hold the fact that the gender-based differences in academic performance were not statistically significant. In addition, Achor et al. (2024) reported no notable difference in the academic performance of male and female students. Studies have shown that CBA enhances student engagement in Biology by making the subject more relevant and relatable to everyday life. This keen engagement is particularly important for female students, who often express a preference for learning science in ways that emphasize its real-world relevance and ethical implications.

Bennett et al. (2006) conducted a comprehensive review of context-based teaching approaches in science education, including Biology, and found that female students were more likely to engage with the material when it was presented in a context they found meaningful. In a study by King and Ritchie (2013), the use of a context-based approach in teaching environmental Biology was found to increase engagement among female students more than among male students. The researchers introduced lessons on ecosystems and biodiversity through discussions of climate change and conservation. Female students showed a marked increase in participation due to the relevance of these topics to broader societal and ethical concerns, areas where girls tend to express more engagement.

2.7 Conventional Teaching Approach

Expository teaching is referred to as the conventional approach, whereas informational teaching is carried out through the use of textbooks, lectures, or other forms of media. Regarding extremely academic courses, which were taught primarily through talk and chalk, there were sadly fewer classroom demonstrations and almost no learning activities for students (Ersoy, 2016). All students receive active practice in problem solving as the instructor goes over prior knowledge, introduces new Biology material, and solves some illustrative Biology problems that are connected to the material. Instructors may or may not incorporate demonstrations in their teaching, while students typically listen to lectures, take notes, and rarely engage by asking questions. In most cases, students are not involved in any student-centred activities and, at best, perform confirmatory Biology experiments (Peşman, 2012; Taasoobshirazi & Carr, 2008).

Usman (2008) characterized the lecture method as a teacher-centred approach, emphasizing that it involves the transmission of subject matter, often requiring memorization, under close supervision by the teacher. Science educators often adopt this method to facilitate efficient coverage of the school syllabus (Egwu & Okigbo, 2021). The conventional teaching method is typically guided by the following principles:

a. Describe the lesson’s session and available time

b. Describe the topic or subject matter
c. Describe the lesson's goal
d. Describe prior knowledge
e. Introduction: The instructor provides background information on the new lesson.
f. Presentation: the instructor explains the new lesson in a logical order.
g. Evaluation: To assess students' skills and knowledge, teachers rewrite the lesson with them and pose tried-and-true questions.

Students exposed to such instructional practices tend to perceive science as a subject learned through rote memorization and calculations, preventing them from understanding the deeper conceptual connections inherent in scientific problems (Peşman, 2012). Conventional methods, characterized by passive lectures, procedural laboratory exercises, and algorithm-based problem-solving examinations, rarely incorporate interactive engagement techniques. Conversely, interactive engagement strategies focus on enhancing students' conceptual comprehension through hands-on and reflective activities that include immediate feedback via discussions with peers and/or instructors (Ersoy, 2016).

The teacher in a conventional Senior High School explains the material, solves problems on the board, and sometimes does lab demonstrations. While students may pay attention and take notes during lectures, they hardly ever ask questions or offer comments (Peşman, 2012; Taasoobshirazi & Carr, 2008; Ültay & Çalık, 2012). In these types of learning environments, students are expected to climb the entire ladder at once (overloaded curriculum) (Ültay & Çalık, 2012). Usman (2008) outlined the following negatives of this conventional teaching approach:

a. Teacher-centred, boring, and less demanding
b. Regards the pupils as a “tabular rasa,” a blank slate with nothing to contribute other than to sit and listen to the instructor (knowing nothing). As a result, they are unable to make insightful decisions or contributions when teaching. This promotes redundancy among students, particularly those who perform poorly.
c. Does not give students the chance to be creative and discover themselves so they can reason and investigate
d. Failure results from failing to encourage hard work and excellence. Teachers may not be adequately prepared because the method is instruction-centred and does not test their skills.

In support of the aforementioned, Ahmad (2014) maintained that it is a boring and repetitive, continuous verbal presentation given to an audience in a classroom setting by a single speaker. According to Eshetu and Assefa (2018), this approach involves the teacher lecturing while the students merely take notes and use the blackboard for illustration. Furthermore, despite the fact that talented and well-liked science teachers deliver the instruction, researchers claim that conventional teaching gives students little conceptual understanding (Hake, 1998).

Therefore, it is necessary to review alternative teaching strategies in order to foster academic excellence in science education. The conventional method, which is teacher-centred is a talk-chalk method that did not foster creativity or academic excellence. In order to prepare students in the control group to compete with students in the experimental group using a context-based teaching approach, the conventional teaching method would be used in this study. Thus, this study looked into how students' academic performance in Ecology concepts was affected by a context-based teaching approach.

2.8 Empirical Review

This section presents recent empirical studies that investigate the effectiveness of the context-based teaching approach on students' academic performance, with a focus on Ecology education at the Senior High School level. The review also explores how gender interacts with this instructional method.

2.8.1 Context-Based Teaching Approach and Academic Performance

Recent empirical research highlights the positive impact of the context-based teaching approach (CBA) on students' academic performance in Biology education. Achor et al. (2024) conducted a quasi-experimental study in Nigeria that examined how context-based instruction affects Senior High School students' understanding of Ecology concepts. Students exposed to CBA significantly outperformed their counterparts taught using the conventional method. The researchers attributed this improvement to the integration of everyday environmental contexts into the teaching of ecological topics such as food chains, biotic and abiotic factors, and population dynamics.

Similarly, Agyei (2022) explored the effects of CBA on Senior High School students in Ghana, focusing on genetics. Though not directly tied to Ecology, the study found that students in the experimental group demonstrated a deeper conceptual understanding, better problem-solving abilities, and improved performance on post-tests. The study concluded that the CBA promoted critical thinking and engagement, which are essential for mastering Ecology-related concepts.

These findings are echoed in the work of Sunday et al. (2021) in Kenya, who implemented context-based instruction to teach environmental science. The study reported significant gains in students' academic performance, especially in Ecology units. Students taught using CBA were more capable of applying scientific knowledge to real-life environmental issues, thereby improving their comprehension and exam scores.

2.8.2 Context-Based Teaching Approach in Ecology Education

Ecology, being closely tied to real-world environmental interactions, benefits particularly from contextual teaching. Hasanah et al. (2019) developed and tested context-based Biology modules focused on ecosystems in Indonesian schools. Their study found that students who learned through these modules showed improved academic performance compared to those taught with traditional methods. The success of the intervention was linked to the use of familiar, local environmental examples, which helped students better understand concepts like energy flow, trophic levels, and environmental conservation.

In Nigeria, Eseine-Aloja (2021) examined the influence of context-based instruction on students attending extra-mural classes in Biology. While not focused solely on Ecology, the study showed that students taught using contextualized content outperformed others in standardized assessments. The researcher recommended wider adoption of CBA in teaching of Biology, especially for abstract topics such as ecological succession and biodiversity, which often pose challenges to students.

2.8.3 Context-Based Teaching Approach and Gender

Several studies have examined how gender influences or interacts with the effectiveness of the context-based teaching approach. Sunday et al. (2021) reported that CBA narrowed gender-based performance gaps, with both male and female students benefiting equally from the strategy. This suggests that CBA may be a gender-inclusive instructional method.

Stolk et al. (2009) found that while both genders benefitted, the improvement in performance was more pronounced among female students. The researchers explained that context-based lessons, which often incorporate ethical, social, and environmental issues, resonate more with female learners, leading to greater engagement and academic gains.

However, other studies such as Eseine-Aloja (2021) and Achor et al. (2024) noted that male students sometimes slightly outperformed females, though the differences were not statistically significant. Overall, empirical evidence suggests that context-based teaching is effective across genders, with the potential to foster inclusivity in Biology and Ecology education.

2.9 Summary of the Literature Review

This study's literature review focuses on various teaching methods and approaches, particularly emphasizing context-based teaching in science education, with a specific focus on Ecology for Senior High School students. The theoretical framework is rooted in social constructivism, which asserts that knowledge is constructed through individual experiences and social interactions. Drawing from Vygotsky's principles, this framework highlights the role of collaboration and interaction, emphasizing that students learn most effectively when actively involved in socially engaging contexts.

The review outlines the conventional teaching approach, characterized by expository methods such as lecturing and textbook reliance. This conventional approach often leads to passive learning, where learners mainly listen and write notes, limiting opportunities for active participation and critical thinking. The conventional approach is criticized for its lack of creativity and failure to promote academic excellence, as it does not encourage students to explore or rationalize concepts independently. Researchers argue that this method provides limited conceptual understanding, even when delivered by skilled instructors.

The review categorizes context-based teaching into three approaches: traditional, modern, and recent. Traditional approaches teach scientific concepts first, followed by applicable contexts. Modern approaches introduce contexts before the scientific concepts to enhance motivation. Recent approaches expose learners to contexts before and after introducing scientific concepts, serving as a rationale for teaching and motivation for learning. The study adopts the recent context-based approach, which considers multiple functions of context in teaching.

The literature review also addresses the concept of academic performance, exploring how different teaching methods impact students' understanding of ecological concepts. It highlights the need for innovative teaching strategies that foster active learning and critical thinking to improve academic outcomes.

The review focus on empirical studies which consistently affirm that the context-based teaching approach significantly improves students' academic performance, particularly in Biology and Ecology. By connecting scientific concepts to real-life contexts, students develop a deeper understanding, recall information better, and become more engaged in the learning process. Furthermore, the approach supports equitable academic achievement across gender lines. These findings validate the use of context-based teaching in Senior High School Ecology education and support its integration into science instruction to improve learning outcomes.

In summary, the literature review underscores the limitations of conventional teaching methods and advocates for context-based approaches that promote active engagement and social interaction, ultimately aiming to enhance students' academic performance in Ecology.

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter outlines the methods employed for data collection and analysis. It details the research paradigms, design, population sample, sampling techniques, research instruments, data collection methods, and data analysis procedures used in the study.

3.1 Research Paradigm

There are four major worldviews within which research can be framed: the post-positivist worldview, which seeks to validate existing theories; the pragmatic worldview, which addresses practical, real-world issues; the constructivist worldview, which focuses on building knowledge through subjective experiences; and the participatory worldview, which aims to bring about systemic change through research findings (Creswell, 2012). This study adopts the pragmatic worldview, as it tackles real-life issues such as the decline in academic performance and environmental challenges, both of which stem from practical scenarios. Pragmatism is often cited as the most suitable paradigm for mixed-methods research (Creswell & Clark, 2011; Johnson & Gray, 2010).

The pragmatic approach places less emphasis on philosophical assumptions, while still acknowledging their relevance. It bridges positivist/post-positivist and constructivist paradigms, employing both quantitative and qualitative methods depending on the research questions (Teddlie & Tashakkori, 2009). As demonstrated by mixed-methods designs (Creswell & Clark, 2011; Teddlie & Tashakkori, 2009), pragmatism offers a balanced methodological and philosophical framework, combining both approaches to address research questions comprehensively (Johnson & Onwuegbuzie, 2004; Onwuegbuzie & Johnson, 2006).

Morgan (2007) presents a framework distinguishing the pragmatic approach from quantitative (positivist/post-positivist) and qualitative (constructivist) approaches in terms of their relationship between theory and data. While quantitative methods rely on deduction and qualitative methods on induction, the pragmatic approach uses abduction to alternate between the two. Pragmatism challenges the conventional separation of quantitative and qualitative research by blending objective and subjective methodologies. Researchers may adopt an objective stance when avoiding interaction with participants, and a subjective stance when engaging with them to co-construct realities (Teddlie & Tashakkori, 2009). A pragmatic approach provides researchers with flexibility, enabling them to select the most effective methods to address specific research questions. Furthermore, it fosters collaboration and communication between researchers employing different methodologies (Morgan, 2007). Pragmatism emphasizes shared understanding and cooperative action to achieve common objectives, facilitating interdisciplinary and methodological integration.

3.2 Research Design

This study adopted a mixed-methods approach, which combines qualitative and quantitative methodologies to collect and analyse data (Creswell & Tashakkori, 2007). Mixed-methods research integrates quantitative techniques such as experiments and surveys with qualitative approaches like interviews and focus groups (Creswell, 2003). Over recent years, this approach has gained popularity in research due to its ability to provide comprehensive and detailed data that align with research objectives and address research questions effectively (Bryman, 2006). Mixed-methods research involves the systematic integration of quantitative and qualitative methods within a single study to achieve a more complete understanding of a phenomenon. This integration can be designed so that each method retains its original structure and procedures, referred to as pure form mixed methods (Johnson & Onwuegbuzie, 2004).

The mixed-methods approach is particularly useful when a researcher aims to broaden the scope, depth, and breadth of a study by employing diverse techniques and inquiry methods, ultimately producing more robust findings. Its key advantage is that it leverages the strengths of both qualitative and quantitative methods, compensating for their respective limitations. Compared to using either method alone, mixed methods offer a more nuanced and comprehensive understanding of the research problem. However, this approach can present challenges, such as difficulty in resolving conflicting results during data interpretation, and it requires significant time and resources to plan and execute.

According to Teddlie and Tashakkori (2009), mixed-method research designs can take various forms, including sequential explanatory design, sequential exploratory design, concurrent triangulation design, concurrent nested design, and concurrent transformative design. This study employed the sequential explanatory design, which begins with the collection and analysis of quantitative data, followed by qualitative data collection and analysis. This design was selected to allow the quantitative findings to be clarified and enriched by the qualitative data, providing deeper insights into the research questions. Creswell and Clark (2011) stated that the sequential explanatory design is a two-stage mixed method design. This design first begins with the collection and analysis of quantitative data and followed by the collection and analysis of qualitative data.

In the sequential explanatory design, the researcher recognizes particular quantitative findings that need further explanation. In order to be able to explore in depth the quantitative data, the researcher then gathered qualitative data from participants who could assist in explaining these results. In the current study, the main focus is on the quantitative aspects. The strength of a sequential explanatory design is that it is easy to implement because the steps fall into clear separate stages. This design is therefore recognized as the easiest and straightforward of the mixed method designs (Creswell & Clark, 2011) because this design is easy to describe and the results easy to report. Although, sequential explanatory design has several advantages or strengths, they also have few limitations. It requires a substantial length of time to complete all data collection given in the two separate phases. A pictorial representation of the explanatory sequential mixed-methods is shown in Figure 3.1.

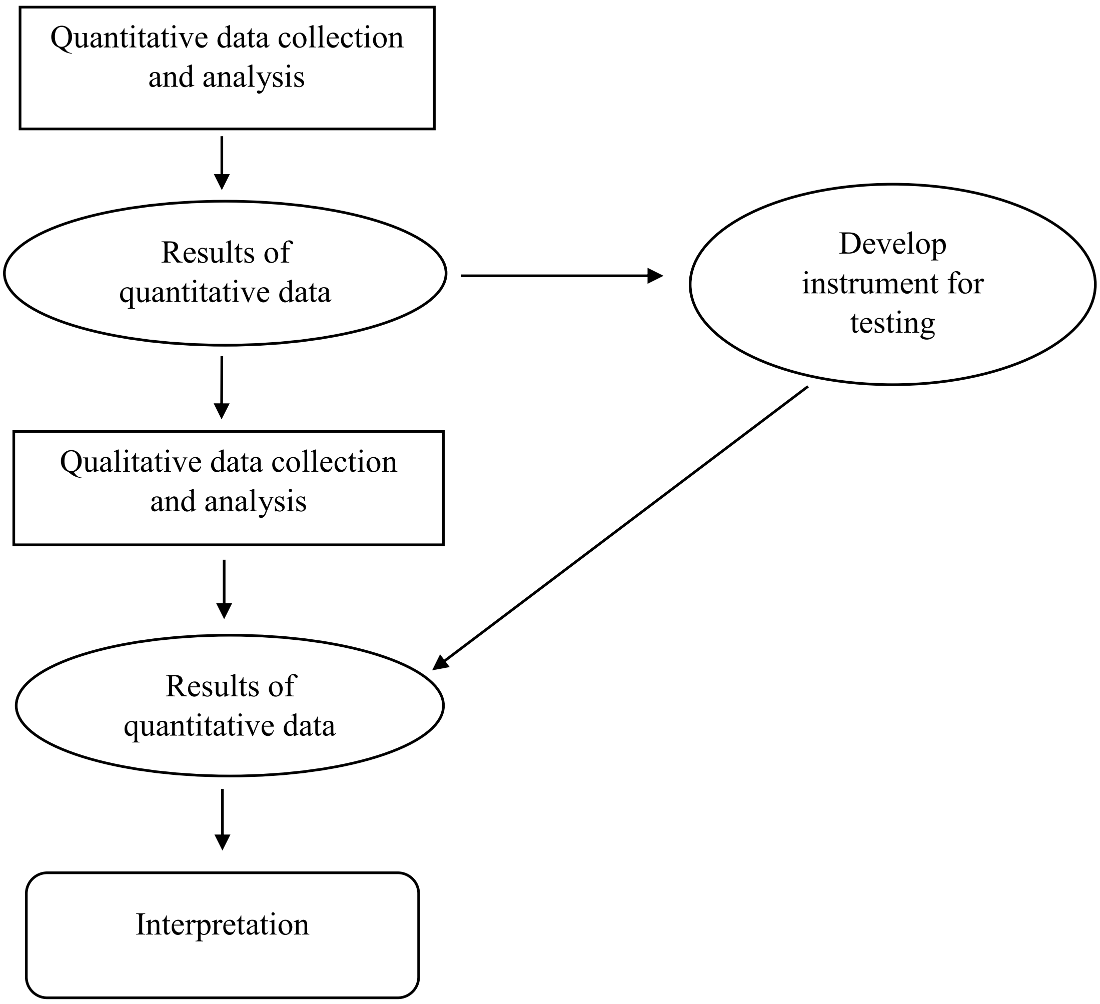

Figure 3.1: A Flow Chart of the Explanatory Sequential Mixed Method Design

Source: Creswell and Clark (2011)

A non-equivalent pre-test-post-test control group design was used to evaluate learners' Ecology performance. According to Babbie (2011), a non-equivalent quasi-experimental design involves the use of a pre-existing control group that resembles the experimental group, but the groups are not created through random assignment of participants. Due to the difficulties of randomly allocating students to the control and experimental groups in a school environment, this research used a non-equivalent quasi-experimental design (Gall et al., 2007; Shadish et al., 2002).

Symbolic representation of the research design is presented in Figure 3.2.

Experimental groups	O_1 X O_2
Control groups	O_1 O_2

Figure 2.2: Symbolic Representation of the Quantitative Research Design

Key to the symbols

O_1 and O_2 - represent pre-test and post-test measurements respectively.

X - represents an intervention (exposure to treatment).

__ - (horizontal line) represents the non-random assignment of participants to the experimental and control groups.

It is difficult to control extraneous factors in a non-equivalent quasi-experimental design, and comparing non-equivalent groups is statistically complicated since participants are not randomly assigned to the experimental and control groups (Trochim, 2006). Due to these restrictions, a number of steps were implemented in an effort to minimize the effect of differences between the two groups. To begin, schools were selected based on specific criteria aimed at balancing the two groups (schools that have been teaching Biology for at least five years, co-educational schools to ensure that participating boys and girls have similar learning environments, and schools with a minimum of one functional science laboratory is required to optimize the disparities in infrastructure and resource). Second, prior to the intervention, both groups took pre-tests to evaluate their knowledge of the measured learning objectives, and the results showed that they were on par (Creswell, 2012). Finally, qualitative information was gathered to round out the picture.

A focus group discussion was employed to collect qualitative data from students regarding their perceptions and views on the intervention, as part of the qualitative research approach. To Krueger and Casey (2014), focus groups are talks with a well-defined format intended at getting participants' perspectives on a particular subject in an open, non-threatening setting. Cooperative reasoning may improve student responses and bring to light previously forgotten facts in focus group interviews (Maree, 2007). While one-on-one information gathering may be scary to certain students, focus groups are more likely to deliver a wealth of information in a short amount of time. When it comes to Ecology education, focus groups are a great way to get students' opinions on how well they are doing in Ecology and how interested they are in learning more about it. Focus group interviews may have had the drawback of contributing to the "groupthink" phenomenon, which obscures individual points of view (Janis, 1982). But this flaw had minimal effect on the study's findings since the researcher was only interested in the groups' aggregate opinions.

3.3 Sampling Techniques

A list of all Senior High Schools in the Atwima Nwabiagya North and South, and Kwadaso Municipalities was obtained from the Ashanti Regional Education Directorate. The municipalities contained a total of seven Senior High Schools: two each in Atwima Nwabiagya North and South and three in Kwadaso Municipality. From this pool, four schools (57%) were purposively selected, exceeding the 10–15% threshold recommended by Van Dalen (1979) for sample size representation. Purposive sampling was used due to the presence of both single-sex and mixed-sex schools in the municipalities. To ensure a balanced gender representation, only mixed-sex schools were chosen for the study. For ease of identification, the selected schools were coded as Schools A, B, C, and D. Two of the schools (Schools A and C) were randomly assigned as experimental groups, where students were taught using the context-based approach. The other two schools (Schools B and D) were designated as control groups, receiving instruction through conventional teaching methods. Each school provided one intact class of second-year elective Biology students, resulting in four classes in total: two experimental and two control groups. This approach ensured that the sample was representative while maintaining the integrity of the study design.

3.4 Population and Sample of the Study

The target population for this study comprised all second-year elective Biology students from selected public Senior High Schools in Atwima Nwabiagya North, Atwima Nwabiagya South, and Kwadaso Municipalities in the Ashanti Region of Ghana. To select schools for the study, purposive sampling was employed, focusing on mixed-sex schools to ensure gender diversity among participants. Since the study design required working with intact classes, random sampling of students was not feasible. However, random assignment of treatments to these intact classes was implemented.

The study sample included 187 students, consisting of 127 males and 60 females from four purposively selected Senior High Schools in the aforementioned municipalities. The breakdown of students by school was as follows: School A had 43 students (35 males, 8 females), School B had 47 students (28 males, 19 females), School C had 52 students (39 males, 12 females), and School D had 46 students (25 males, 21 females). These are presented in Table 3.1:

Table 3.1: Sampling Distribution in the Mixed-sex Selected Schools

Schools	Male	Female	Total
A	35	8	43
B	28	19	47
C	39	12	52
D	25	21	46
Total	127	60	187

Out of the total sample, the experimental group, taught using the context-based approach, comprised 94 students (74 males and 20 females), while the control group, taught using the conventional approach, consisted of 93 students (53 males and 40 females). For effective treatment verification, one intact class was selected from each school through simple random sampling. These are presented in the Table 3.2 below:

Table 3.2: Sampling Distribution of Students in the Groups

Group/Gender	Male	Female	Total
Experimental	74	20	94
Control	53	40	93
Total	127	60	187

3.5 Research Instruments

The instruments used for this study include:

- Ecology Performance Test (EPT) and
- Focused Group Interview

3.5.1 Ecology Performance Test

The Ecology Performance Test (EPT) was utilized to measure students' academic success. Prior to administering the post-test, a pre-test was conducted using the EPT to assess students' baseline knowledge and ability levels. After the intervention, the EPT was re-administered as a post-test. The test comprised twenty (20) multiple-choice questions with four options for each question and six (6) theoretical questions requiring written responses. These questions were sourced from past WAEC examination papers covering a six-year period (2016-2021).

3.5.2 Focused Group Interview

To gather additional evidence on the intervention's impact, interviews were conducted with students in the experimental group following the treatment. A focus group interview technique was employed with students from the two experimental classes across the selected schools. The interviews were both interactive and semi-structured, using pre-designed questions as a guide. The sessions aimed to capture students' perspectives on the effectiveness of the context-based teaching approach compared to conventional methods.

Each focus group interview lasted approximately forty-five (45) minutes, during which notes were taken, and the conversations were audio recorded. These recordings and notes provided valuable data for analysis. Thematic analysis was conducted to identify recurring themes from the students' responses. Themes included enhanced classroom engagement, the significance of context-based approach to Ecology lessons in real life, improved understanding of Ecology concepts, practical applications of ecological studies, and increased interest in Ecology. These themes were used to address the research question: What are the views of students on context-based approach after their experience in the Ecology classroom?

3.6 Pilot Testing of Instrument

A pilot test of the research instrument was conducted before the main data collection to evaluate its validity and reliability. The Ecology Performance Test (EPT) was piloted on a representative sample from a school in the Atwima Mponua Municipality, which was not included in the main study. This process aimed to gather normative data and refine the instrument. The pilot test results were analysed using SPSS version 25, to determine the reliability coefficient of the instrument. Insights from the pilot test facilitated the restructuring of the performance test items to ensure they effectively elicited accurate responses. This step ensured the instrument was well-prepared for data collection in the main study.

3.7 Validity and Reliability of Instrument

3.7.1 Validity of Instrument

The Ecology Performance Test (EPT) and its marking scheme were reviewed by two lecturers from AAMUSTED, Asante Mampong. One reviewer holds a Ph.D. in Faculty of Science Education, and the other a Master’s degree in the Department of Biological Science Education. Additionally, a test and measurement specialist from Atebubu College of Education contributed to the evaluation. These experts assessed the instrument for content validity, focusing on the accuracy, clarity, and phrasing of test items. They also reviewed the relevance of the questions to the subject matter, coverage of the content area, language appropriateness, and clarity of purpose.

3.7.2 Reliability of Instrument

Reliability refers to the consistency of results obtained using a particular instrument. It measures the extent to which an instrument produces stable and consistent results over repeated trials. A reliable instrument will yield consistent outcomes when used repeatedly in data collection. The test items for the Ecology Performance Test (EPT) were derived from past WASSCE questions, which are considered standardized due to their development by experienced test and measurement experts in the Ministry of Education and subsequent moderation by the committee. Thus, the test items are assumed to be both valid and reliable.

After the pilot testing, the collected data were analysed using SPSS version 25 to determine the reliability coefficient of the instrument. The reliability of the multiple-choice questions in the EPT was assessed using Cronbach's Alpha, a standard statistic for evaluating internal consistency. The analysis yielded a Cronbach's Alpha value of 0.76, indicating a good level of internal consistency reliability. This suggests that the items on the EPT are well-connected and measure the same underlying construct effectively. According to established guidelines (George & Mallery, 2003), a Cronbach's Alpha value between 0.71 and 0.80 reflects good reliability, confirming that the EPT is suitable for use in this study.

For the essay-type questions, inter-rater reliability was assessed using the Intraclass Correlation Coefficient (ICC), which measures the consistency of ratings among multiple raters. Seven raters evaluated six essay-type questions, and the analysis using a two-way random effects model yielded an ICC value of 0.80. This indicates a high level of agreement among raters, suggesting that the assessment criteria and evaluation rubric were clear and reliable. According to conventional standards (Cicchetti, 1994; Koo & Li, 2016), an ICC value of 0.80 is considered good reliability, confirming the consistency of the ratings for this study. Thus, the EPT was deemed reliable and appropriate for gathering relevant data to address the research questions. All necessary adjustments were made to ensure the instrument could effectively collect quality and useful data.

3.8 Data Collection Technique

Data collection involved administering the Ecology Performance Test (EPT) to both the experimental and control groups under the researcher's strict supervision. The EPT included twenty (20) multiple-choice questions and six (6) essay-type questions. After administration, the test papers were collected, scored, and recorded. Each multiple-choice question was awarded two marks, while each essay question was graded out of ten using a structured marking scheme. The collected scores were categorized based on the experimental and control groups for subsequent analysis.

Additionally, a focus group discussion was conducted to gather the students' perspectives on using the context-based teaching approach during Ecology lessons. Students were encouraged to reflect on their learning experiences, teaching methods, and the perceived relevance of Ecology concepts to real-world applications.

3.9 Data Analysis Technique

Quantitative data collected from the students were analysed using the Statistical Package for the Social Sciences (SPSS), version 25 software. The responses to each item, in relation to the research questions, were analysed for all respondents across the sampled schools. Both descriptive statistics (means, standard deviations, percentages, and frequencies) and inferential statistics (independent samples t-test) were employed for analysis.

For research questions one and two, descriptive statistics such as means, standard deviations, and frequencies were calculated, followed by independent samples t-test to determine the significance of differences between the groups. The analysis adhered to the assumptions of parametric tests, including the normal distribution of sample scores, equal variances across groups, and measurement on an interval scale.

Research question one focused on evaluating the effect of context-based and conventional teaching approaches on students' academic performance in Ecology. An independent samples t-test was used for comparison. Research question two investigated gender differences in academic performance among students taught using the context-based approach, also analysed using the independent samples t-test.

For research question three, responses from focus group interviews were transcribed and analysed thematically. This thematic analysis aimed to capture the views of thirty-two Senior High School students who participated in an Ecology class taught ecological concepts using a context-based approach. This method integrated real-world contexts and applications into the teaching of ecological concepts. By using Braun and Clarke's thematic analysis, I systematically identified, analysed, and reported patterns within the students' feedback to understand the effectiveness and impact of this approach on their learning experiences and outcomes.

By integrating real-world contexts into the teaching of Ecology concepts, the thematic analysis followed Braun and Clarke's six-phase process:

Thematic Analysis Process

The data analysis followed Braun and Clarke's six phases of thematic analysis:

1. ***Familiarizing yourself with the data***: Data were transcribed and read multiple times to become thoroughly familiar with the content, and initial notes on possible codes were made.
2. ***Generating initial codes***: Systematic coding was conducted on the data, identifying significant phrases and statements related to students' views on the context-based approach. Codes such as "engagement," "significance," "understanding," "application," and "interest" were noted.
3. ***Searching for themes***: Codes were grouped into potential themes, such as "enhanced engagement," "significance of context-based approach to Ecology lessons in real life," "improved understanding," "practical application," and "increased interest in Ecology."
4. ***Reviewing themes***: The themes were refined and reviewed to ensure they accurately represented the data, with some themes merged and redefined.
5. ***Defining and naming themes***: Clear definitions and names were assigned to each theme, with detailed descriptions provided.
6. ***Producing the report***: The final themes were presented in a coherent narrative, supported by direct quotes from the students to illustrate their views.

3.10 Ethical Consideration

The study was conducted in accordance with established ethical standards governing academic research. Ethical clearance was obtained from the Committee on Human

Research, Publications and Ethics (CHRPE) of the Kwame Nkrumah University of Science and Technology (KNUST), with reference number CHRPE/AP/077/25 (Appendix VII) to ensure that the rights, safety, and well-being of all participants were protected throughout the research process.

In addition, an official letter of introduction was obtained from the Municipal Directorate of the Ghana Education Service (GES) to formally introduce the researcher to the selected public Senior High Schools within the Atwima Nwabiagya North, and South, and Kwadaso Municipalities. Upon presentation of the letter, permission was duly sought and obtained from the headteachers of the participating schools. The purpose and procedures of the study were clearly explained to school authorities, and their consent was secured prior to engaging with students.

Given that the study involved intact classes, individual random sampling of students was not feasible. However, participation in the study was voluntary, and students were informed accordingly. Participants were assured that there were no risks associated with the study and that their identities and responses would remain strictly confidential. No personal identifiers were recorded, and all data collected were used solely for academic purposes. To ensure fairness in the implementation of the intervention, random assignment of treatments was carried out at the class level. Mixed-sex schools were purposively selected to promote gender diversity and inclusiveness in the participant population. All ethical principles, including respect for persons, beneficence, and justice, were duly observed throughout the study.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Overview

This chapter presents the findings and discussion of this study. This chapter aims to present a comprehensive analysis of the collected data, beginning with a detailed examination of the demographic characteristics of the study participants. The chapter will further delve into more detailed analyses, including comparisons of academic performance between the experimental and control groups, as well as examinations of gender-specific outcomes and perceptions of the teaching methods. This structured presentation will facilitate a clear and insightful interpretation of the study's results.

4.1 Demographic Characteristics

The only demographic feature examined in this study is the gender of participants. The gender distribution within both the experimental and control groups is a critical component of the study's analysis, it provides insights into the demographic composition of each group and setting the stage for a more nuanced interpretation of academic performance outcomes.

Table 4.1: Gender Distribution in Experimental and Control Groups

Gender	Experimental Group	Control Group	Total
Male	74 (78.7%)	53 (56.4%)	127 (67.9%)
Female	20 (21.3%)	40 (42.6%)	60 (32.1%)
Total	94 (100%)	93 (100%)	187 (100%)

Source: Field of Study, 2024

4.1.1 Gender Distribution in the Experimental Group

Table 4.1 shows the gender distribution in experimental and control groups of the students' respondents. In the experimental group, which was taught Ecology using the context-based approach, there is a notable gender imbalance. Out of 94 students, 74 (78.7%) are males, while 20 (21.3%) are females. This skewed distribution suggests that the experimental group is predominantly male, which may influence the overall results and interpretations regarding the effectiveness of the context-based teaching approach.

4.1.2 Gender Distribution in the Control Group

It is observed from Table 4.1 that in contrast, the control group, taught Ecology using conventional methods, exhibits a more balanced gender distribution. Of the 93 students in this group, 53 (56.4%) are males and 40 (42.6%) are females. This distribution indicates a more even representation of genders in the control group compared to the experimental group. The difference in gender composition between the experimental and control groups could impact the analysis of academic performance. The higher proportion of male students in the experimental group may skew the results, as gender differences in academic performance could interact with the teaching approach. Consequently, it is essential to consider these gender differences when interpreting the effectiveness of the context-based approach relative to conventional methods.

4.2 Presentation of Assumptions for Parametric Tests

The Ecology Performance Test (EPT) scores from the pre-test served as independent variable and the post-test served as dependent variable for this study. These scores, which represent an interval scale, satisfy the assumption that the dependent variable is measured on an interval scale.

4.2.1 Assessing Normal Distribution of Data

To verify the normality of the data, pre-test and post-test scores from both the experimental and control groups were subjected to normality testing using both numerical and graphical methods (Appendix I). Similarly, the pre-test and post-test scores for male and female students within the experimental group were analysed for normality using the same methods (Appendix II). Numerical methods included the Kolmogorov-Smirnov and Shapiro-Wilk normality tests, while graphical methods involved examining histograms, normal Q-Q plots, detrended Q-Q plots, and box plots. These tests were used to assess the suitability of the data for parametric analysis by determining whether the data conformed to a normal distribution.

The skewness and kurtosis values were first evaluated to ensure the data met the assumption of normality. According to the guidelines by Tabachnick and Fidell (2013), values between -1 and +1 indicate acceptable normality. The results showed that the skewness and kurtosis values fell within this range, confirming compliance with the normality assumption.

Additionally, the Kolmogorov-Smirnov and Shapiro-Wilk tests were performed to further assess the distribution of the scores. The p-values for all test scores across different teaching approaches were found to be non-significant, indicating that the data were drawn from a normally distributed population. Table 4.2 demonstrates that the normality assumption was fulfilled for both the experimental and control group scores, while Table 4.3 confirms that this assumption was also met for male and female students. The results of the normality tests are presented in detail in Tables 4.2 and 4.3.

Table 4.2: Analysis of Compliance of Contest-based Approach and Conventional Approach Data to Normal Distribution

Teaching Approach	Test	Skewness	Kurtosis	Kolmogorov-Smirnov		Shapiro-Wilk	
				Statistics	*p*	Statistics	*p*
CBA	Pre-test	-.079	-.796	.089	.061	.977	.098
	Post-test	-.231	-.680	.078	.197	.975	.068
CA	Pre-test	.072	-.961	.086	.084	.970	.028
	Post-test	-.287	-.619	.086	.085	.972	.040

CBA: Context-based Approach CA: Conventional Approach

Table 4.3: Analysis of Compliance of Context-based Approach Gender Data to Normal Distribution

Gender	Test	Skewness	Kurtosis	Kolmogorov-Smirnov		Shapiro-Wilk	
				Statistics	*p*	Statistics	*p*
Male	Pre-test	.012	-.845	.100	.062	.976	.176
	Post-test	-.209	-.815	.090	.200	.971	.086
Female	Pre-test	-.378	.017	.170	.132	.970	.758
	Post-test	-.167	-.049	.136	.200	.970	.748

4.2.2 Assessing Homogeneity of Variance in Data

The pre-test and post-test scores from the experimental and control groups were analysed for homogeneity of variance using Levene's Test for Equality of Variances in an independent samples t-test. This test was conducted to determine if the data satisfied the homogeneity of variances assumption. The results confirmed that the data were homogeneously distributed and suitable for normal distribution, justifying the use of parametric tests for group comparisons.

Table 4.4: Levene Homogeneity of Variance Test Results of Context-based Approach and Conventional Approach Data

Instrument	**Group**	**Test**	**Levene's Statistics**	
			F	***p***
EPT	CBA-CA	Pre-test	0.285	0.594
		Post-test	0.844	0.359

EPT: Ecology Performance Test

CBA: Context-based Approach **CA: Conventional Approach**

In the table above, equal variances of data were assumed as non-significant values of 0.594 and 0.359 were obtained for pre-test and post-test scores respectively indicated that the assumption of equal variances was satisfied (Table 4.4).

Table 4.5: Levene Homogeneity of Variance Test Results of Context-based Approach Data

Instrument	Group	Test	Levene's Statistics	
			F	*p*
EPT	CBA	Pre-test	1.364	0.246
		Post-test	0.713	0.401

EPT: Ecology Performance Test CBA: Context-based Approach

As shown in Table 4.5, the pre-test and post-test scores from the experimental group yielded non-significant values of 0.246 and 0.401, respectively, indicating that equal variances were assumed. These findings confirm that the data collected from all measurement tools were consistently distributed across groups.

4.3 Presentation and Discussion of Main Results

This section focuses on addressing each research question to validate or challenge the literature reviewed in Chapter Two. The results of the data collected are presented and discussed in alignment with each research objective.

4.3.1 The Impact of the Context-based Teaching Approach on the Academic Performance of Students in Ecology, in Comparison to the Conventional Teaching Approach

The first research question aimed to determine whether there was a difference in academic performance between students taught Ecology using a context-based approach and those taught using conventional approach. To address this, students completed pre-tests and post-tests comprising questions from Senior High School elective Biology examinations. An independent samples t-test was used to evaluate whether the context-based teaching approach significantly impacted students' academic performance. The analysis covered both pre-test and post-test scores to capture performance changes attributable to the teaching strategies. The results are presented in Tables 4.6 and 4.7.

Table 4.6: Results of Independent Samples T-test on the Pre-Test Scores of Students Taught Ecology Using Context-based Approach and Those Taught Using the Conventional Approach

Teaching approach	N	M	SD	t	df	*p*	M Diff.	CI (95%)
CBA	94	33.73	7.219	1.021	185	0.309	1.100	-1.025 - 3.225
CA	93	32.63	7.509					

CBA: Context-based Approach CA: Conventional Approach

Source: Field of Study, 2024

Table 4.6 presents the independent samples t-test results for pre-test scores of students' academic performance in Ecology. The findings indicate no significant difference between students taught using the context-based approach (M = 33.73, SD = 7.219) and those taught using the conventional approach (M = 32.63, SD = 7.509; t (185) = 1.021, p = 0.309, two-tailed). This demonstrates that students in both groups had same comparable performance levels before the intervention, providing a reliable basis for comparing their post-test results.

Table 4.7: Results of Independent Samples T-test on the Post-Test Scores of Students Taught Ecology Using Context-based Approach and Those Taught Using the Conventional Approach

Teaching approach	**N**	**M**	**SD**	**t**	**df**	***p***	**M Diff.**	**CI (95%)**
CBA	94	82.79	7.356	29.804	185	0.001	33.658	31.430-35.886
CA	93	49.13	8.075					

CBA: Context-based Approach CA: Conventional Approach

Source: Field of Study, 2024

Table 4.7 shows the independent samples t-test results for post-test scores. The results reveal a significant difference in academic performance between the two teaching methods. Students taught using the context-based approach achieved higher scores (M = 82.79, SD = 7.356) compared to those taught using the conventional approach (M = 49.13, SD = 8.075; t (185) = 29.804, p = 0.001, two-tailed). The effect size (eta squared = 0.8) (Appendix III) indicates a substantial impact of the context-based approach on student performance. These findings suggest that the significant improvement in post-test scores for the experimental group can be attributed to the context-based teaching method, as no pre-existing differences were observed. This highlights the effectiveness of the context-based approach in enhancing students' understanding and academic achievement in Ecology.

4.3.2 The Difference in Academic Performance between Male and Female Students taught Ecology using Context-based Approach

The second objective of the study was to investigate whether there were differences in academic performance between male and female students taught Ecology using the context-based approach. An independent samples t-test was conducted on the pre-test and post-test scores of male and female students in the experimental group. The results are presented in Table 4.8.

Table 4.8: Results of Independent Sample T-test on the Pre-Test Scores of Male and Female Students Taught Ecology Using Context-based Approach

Gender	N	M	SD	t	df	*p*	M Diff.	CI (95%)
Male	74	33.03	7.236	-1.850	92	0.067	-3.323	-6.890 - 0.244
Female	20	36.35	6.691					

Source: Field of Study, 2024

Table 4.8 provides the independent samples t-test results for pre-test scores. The findings show no significant difference between male students (M = 33.03, SD = 7.236) and female students (M = 36.35, SD = 6.691; t (92) = 1.850, p = 0.067, two-tailed). This indicates that both male and female students performed at similar levels prior to the intervention, validating the comparison of their post-test results. The analysis confirms that any observed performance differences in post-test scores are likely due to the context-based teaching approach rather than inherent differences in prior knowledge or ability levels between genders.

Table 4.9: Results of Independent Samples T-test on the Post-Test Scores of Male and Female Students Taught Ecology Using Context-based Approach

Gender	N	M	SD	t	df	*p*	M Diff.	CI (95%)
Male	74	82.23	7.460	-1.421	92	0.159	-2.620	-6.282 - 1.041
Female	20	84.85	6.730					

Source: Field of Study, 2024

Table 4.9 presents an independent samples t-test of the post-test scores of male and female students' academic performance in Ecology using context-based approach. The results from the post-test reveal a non-significant difference in academic performance in gender. The results showed that post-test scores between male students (M = 82.23, SD = 7.460) and female students (M = 84.85, SD = 6.730; t (92) = 1.421, p = 0.159, two-tailed) indicated no significant difference between the two groups. This suggests that sex alone does not have a significant impact on students' academic performance when taught using context-based approach. The analysis demonstrates that the context-based approach does not differentially impact academic performance based on gender. There is no significant effect of gender on academic performance in Ecology when taught using the context-based approach. This means that both male and female students perform similarly under context-based approach, with no substantial differences attributable to their gender.

These findings, together with the results from the first objective, underscore that the context-based teaching approach itself has a significant impact on academic performance, while gender does not play a significant role in moderating this effect. The context-based approach significantly enhances academic performance in Ecology, while the conventional approach's effectiveness remains same. These results support the efficacy of the context-based teaching approach in enhancing student performance, regardless of gender, thereby providing strong evidence for its implementation in Senior High School Ecology education. The significant improvement in post-test scores for students taught using the context-based approach underscores its potential to elevate academic outcomes in Ecology education across diverse student populations.

4.3.3 Views of Students on Context-based Teaching Approach after Their Experience in the Ecology Classroom

The third objective explored the views of students on context-based approach after their experience in the Ecology classroom. This study used Braun and Clarke's thematic analysis to capture and analyse the views of thirty-two Senior High School students who participated in the Ecology class, taught using context-based approach. This method integrated real-world contexts and applications into the teaching of ecological concepts. The goal was to understand the effectiveness and impact of this approach on students' learning experiences and outcomes.

Theme 1: Enhanced Classroom Engagement

Many students reported that the context-based teaching approach significantly increased their engagement with colleagues in the classroom during learning of Ecology. The use of real-world examples and scenarios made the lessons more interesting and relatable. Some views of the students from the focused group discussions included:

Emma: "I find the context-based teaching approach very engaging. It helps me relate ecological concepts to real-world scenarios. I think this method makes the lessons more practical and less abstract."

Emelia: "Group projects and discussions are great. They allow us to share ideas and learn from each other, enhancing our understanding."

James: "Interactive learning keeps me engaged and is a welcome change from conventional lecture-based teaching."

Kate: "I found myself looking forward to each class because we were always discussing something that felt relevant to my life."

Grace: "I appreciate the diverse learning strategies, from discussions to projects. It keeps things interesting and dynamic. I enjoy the variety of learning activities in this approach"

Michael: "The context-based approach makes learning more interactive as I enjoy the connections we make between Ecology and other subjects."

Joy: "The way the teacher connected ecological concepts to everyday issues kept me engaged and interested. I never felt bored because the topics were always tied to real-world events."

Theme 2: Significance of Context-based approach to Ecology Lessons in Real Life

Students appreciated the practical applications of ecological concepts to real-world problems. This relevance helped them understand the importance of what they were learning. Some views of the students from the focused group discussions were transcribed as:

Olivia: "This method makes the lessons more practical and less abstract, which is great for someone like me who learns better with concrete examples. Seeing examples from our local environment really helps me grasp how ecosystems function. It makes the lessons feel more relevant."

Noah: "Connecting concepts to real-life situations helps me understand them better and makes the lessons more effective therefore studying Ecology through this method is enjoyable and makes the subject feel less abstract."

Benjamin: "This approach makes the lessons relevant to our daily lives, which helps me see the importance of what we are learning; case studies and real-world examples are engaging and show the practical side of what we are learning".

Marie: "Learning about Ecology through real-world contexts showed me how important this subject is for our future. It made the lessons more meaningful because I could see how they applied to things happening around us."

Jack: "The context-based teaching approach keeps the subject engaging and relevant to our lives. Learning about local environmental impacts helps me appreciate the importance of Ecology."

Joan: "Overall, I feel this teaching approach prepares me better for future studies in Ecology. This method makes me more aware of ecological issues in our community. Seeing the direct impact of Ecology on the environment and society was eye-opening."

Ben: "Addressing current environmental issues in class helps me feel connected to global and local ecological concerns."

Theme 3: Improved Understanding of Ecology Concepts

The context-based approach helped students achieve a deeper understanding of ecological principles. They found it easier to grasp complex concepts when they were presented in a real-world context. Some students' views from the focused group discussions were recorded as:

Abigail: "The method helps me retain information better because it's linked to real experiences. It's easier to understand how ecosystems work when we see examples from our local environment."

Christian: "Discussions and group projects enhance our understanding by allowing us to explore different viewpoints."

Ella: "Linking information to real experiences helps me retain it better. This approach is much more effective for me than conventional methods."

Vince: "My grasp of the subject improved significantly because I could relate the concepts to everyday life. That is, it was easier to remember and understand the concepts when they were linked to real-life examples."

Joe: "Practical applications made the lessons stick better in my mind. I understood the concept better because we discussed them in real-life contexts."

Theme 4: Practical Application of Ecology Studies

Students highlighted the value of applying what they learned in practical ways. The hands-on activities and projects helped solidify their understanding and skills.

Lucas: "The practical applications of Ecology make the subject more interesting and I like how we can see the impact of ecological principles in our environment."

Anna: "I like how the context-based approach makes learning about Ecology practical and interesting. This method makes studying Ecology more enjoyable and less theoretical."

Sam: "Practical applications make the subject easier to grasp and more applicable to real life. The variety of learning activities, from field trips to group projects, keeps things exciting and informative."

Matthew: "While the hands-on activities can be challenging, they are ultimately rewarding and beneficial."

Dan: "I think the approach is good, but it can be challenging to keep up with the practical work. Sometimes, I struggle with the group work, but overall, the approach is effective."

Paul: "Field trips, projects and hands-on activities are a great way to see ecological concepts in action and enhance our understanding. Wow! They made a big difference because I could apply what I learned immediately."

Theme 5: Increased Interest in Ecology

Many students expressed an increased interest in Ecology and environmental issues as a result of the context-based approach. They felt more motivated to learn and explore the subject further.

John: "The approach makes me more interested in studying Ecology. I find the real-world connections very helpful making me appreciate the interdisciplinary nature of our lessons."

Maggie: "I wasn't very interested in Ecology before, but this class changed that. The context-based approach made me realize how important Ecology is, and I want to learn more. Now I'm thinking about studying it in college."

Araba: "My interest in Ecology has grown, and I'm more motivated to learn about it. So, I'm now considering a career in environmental science because of this class."

Kobby: “The context-based approach made me more aware of environmental issues and sparked a genuine interest in finding solutions. This made me realize how important Ecology is and I want to learn more.”

The findings from the thematic analysis indicated that the context-based approach to teaching Ecology was highly effective in enhancing student engagement, understanding, and interest. By linking ecological concepts to real-world contexts, students found the material more relevant and meaningful. This approach not only improved their comprehension of the subject matter but also motivated them to apply their knowledge in practical ways and pursue further studies in the field.

4.4 Discussion of Findings of the Study

This section discusses the findings of the study in relation to the research questions. The study examined whether the context-based approach enhances the academic performance of Biology students more effectively than the conventional method. Given the sample included both male and female students, gender was incorporated as a moderating variable. The findings are discussed based on the study’s variables, guided by the results of the research questions.

4.4.1 The Impact of the Context-based Teaching Approach on the Academic Performance of Students in Ecology, in Comparison to the Conventional Teaching Approach

The introduction of the context-based teaching approach for the Senior High School students in the experimental group significantly improved their academic performance in Ecology, with a mean post-test score of 82.79 (Table 4.7). The results in Table 4.7 demonstrate a significant difference in post-test mean scores between students taught using the context-based approach and those taught using the conventional approach ($p = 0.001$ at a 0.05 significance level). This indicates that the context-based approach is more effective than conventional teaching in enhancing students' performance in Ecology. The findings suggest that the context-based approach fosters a deeper understanding of Ecology concepts, leading to improved academic outcomes. The positive interaction between teachers and students, facilitated by the context-based method, is likely a key factor contributing to this high performance. The results confirm that meaningful and interactive instruction, particularly through context-based teaching, can significantly enhance students' learning experiences and outcomes.

These findings align with prior studies. For instance, Kukliansky and Eshach (2014) found that integrating biological concepts with real-world contexts through context-based teaching significantly enhances learning outcomes. Similarly, Gilbert (2006) reported that students in secondary schools taught using a context-based curriculum demonstrated a deeper understanding of core Biology concepts compared to those in conventional settings. Agyei (2022) also highlighted that, students exposed to the context-based approach exhibited superior content understanding, problem-solving abilities, and decision-making skills compared to those taught with conventional methods. In agreement, Achor et al. (2024) found that students taught hydrocarbons in chemistry using context-based instruction performed significantly better than those taught using lecture methods.

Bennett et al. (2007) emphasized that context-based teaching bridges the gap between theory and application, leading to improved conceptual understanding and academic performance. Sunday et al. (2021) similarly observed significant differences in achievement scores between students taught using context-based and conventional approaches, favouring the experimental group. Bacay and Herrera (2020) also demonstrated that context-based teaching enhances both the quantity and quality of students' knowledge. Through context-based instruction, students connect academic content with real-life situations, enabling them to better understand and apply knowledge. This approach fosters the integration of new knowledge with prior experiences, helping students build a cohesive understanding of the subject matter. As a result, students develop a broader perspective and an appreciation for the relevance and application of learned concepts.

Numerous studies in Biology education support these findings, showing that lessons tied to everyday life are more engaging and effective (Abu-Rasheed et al., 2023; Stanisavljević et al., 2016). Weber (in Stanisavljević et al., 2016) demonstrated that teaching botanical concepts linked to students' prior experiences yielded better learning outcomes. Additionally, Avargil et al. (2012) and Wieringa et al. (2011) found that context-based teaching encourages active engagement, such as logical argument and discussion, while fostering independent learning and boosting student confidence (Bennett, 2005). Context-based teaching approach as an experimental instructional approach in the present study employs teaching contexts that make content materials meaningful to students. The use of context-based teaching approach makes learning realistic and relevant to students by situating learning tasks in real-life situations to which students relate and reflect. This method enabled students to construct knowledge based on their experiences, leading to a significant improvement in their academic performance in Ecology. Consequently, the findings underscore the value of adopting context-based teaching to enhance learning outcomes in Biology education.

4.4.2 The Difference in Academic Performance between Male and Female Students Taught Ecology Using Context-based Approach

The second research objective sought to explore gender differences in students' academic performance when taught Ecology using context-based teaching approach. Findings from the study revealed that gender did not significantly influence students' performance in Ecology. As shown in Table 4.9, there was no significant difference in post-test scores (p = 0.159) between male and female students taught with the context-based approach. This indicates that gender does not play a determining role in academic performance in Ecology, suggesting that the approach is equally effective for both genders. The post-test results further revealed that while female students achieved a slightly higher mean score (84.85) compared to male students (82.23), this difference was not statistically significant (p = 0.159). These findings suggest that the context-based teaching approach is gender-inclusive and supports academic performance in Ecology for both male and female students.

This finding aligns with studies by Achor et al. (2024) and Sunday et al. (2021) , which found no significant gender differences in students' academic performance when taught using context-based teaching methods. Similarly, Stolk et al. (2009) observed that both genders experienced improvements in academic performance, but the effect was more pronounced for female students. The researchers attributed this to the fact that female students tend to respond better to teaching methods that emphasize collaboration, discussion, and real-world applications, all of which are integral to CBA. Bennett et al. (2005) found that while female students may benefit more from the contextual aspects of CBA, male students also showed improved academic performance when the material was framed in ways that allowed them to engage with hands-on, problem-solving activities. In bridging the academic performance gap, Etobro and Fabinu (2017) found no significant gender differences in students' perception of challenging Biology topics, suggesting that such topics present similar levels of difficulty to both male and female students.

The finding of this study agrees with Fikadu and Shimeles (2019) that gender gap was not significant on the treatment group, hence the approaches could work for both groups. In the same view, Owoeye and Agbaje (2016) found no significant relationship between gender and academic performance in Biology when using innovative teaching methods. In addition, Achor et al. (2024) discovered no significant difference in the academic performance of male and female students. However, contrasting findings by Eseine-Aloja (2021) indicated that male students outperformed female students in Biology when attending extra-mural classes, while King and Ritchie (2013), found greater engagement among female students in environmental Biology lessons taught with a context-based approach. The researchers introduced lessons on ecosystems and biodiversity through discussions of climate change and conservation.

The findings of this study reaffirm that the context-based teaching approach fosters a collaborative learning environment where students, regardless of gender, can work together to share ideas, communicate effectively, and discover new concepts. By promoting teamwork and mutual goal achievement, the approach turns Biology lessons into valuable peer-driven activities. Thus, the context-based approach is a gender-friendly instructional method that effectively supports the academic success of both male and female students in Ecology.

4.4.3 Views of Students on Context-based Teaching Approach after Their Experience in the Ecology Classroom

The third research objective explored the views of students on the context-based teaching approach after experiencing it through Ecology lessons in their classroom. The views of the students were recorded from focused group discussions, transcribed and analysed with Braun and Clarke thematic analysis (Byrne, 2022). The thematic analysis of thirty-two students' views on the context-based approach to teaching Ecology reveals several key insights. The majority of students found that this teaching method significantly enhanced their engagement with the subject. The use of real-world examples and scenarios made the lessons more interesting and relatable, which in turn increased student participation and enthusiasm. Engagement is a critical factor in effective learning. According to research, students who are actively engaged in their learning process tend to perform better academically and retain more information (Fredricks et al., 2004). The context-based approach used in this study significantly increased student engagement by making lessons more relevant and relatable. This finding is consistent with previous studies that highlight the importance of contextualizing education to enhance student interest and participation (Gilbert, 2006).

Moreover, students appreciated the relevance of the ecological concepts to real-life situations. This relevance helped them understand the importance of what they were learning, making the lessons more meaningful and impactful. The ability to connect theoretical knowledge to practical applications not only improved their understanding but also highlighted the significance of Ecology in addressing real-world environmental issues. Relevance to real life is another crucial aspect of effective teaching. When students see the practical applications of what they are learning, they are more likely to value the subject matter and understand its importance (Darling-Hammond, 2000). In this study, students appreciated the practical applications of ecological concepts to real-world problems, which made the lessons more meaningful. This aligns with the theory of situated learning, which emphasizes the significance of learning within a context that reflects real-life situations (Lave & Wenger, 1991).

The context-based approach also facilitated a deeper understanding of complex ecological principles. Students reported that they found it easier to grasp and remember the Ecology concept when it was presented in a context they could relate to. This method of teaching made abstract concepts more tangible and accessible, resulting in better comprehension and retention. By means of linking theoretical concepts to real-world scenarios, students found it easier to grasp and remember the various topics. This finding is supported by cognitive learning theories, which suggest that learning is more effective when it is contextualized and connected to prior knowledge and experiences (Bransford et al., 2000).

Additionally, the emphasis on practical application through hands-on activities and projects was highly valued by the students. These practical experiences allowed them to apply their knowledge in real-world situations, reinforcing their learning and enhancing their skills. The hands-on nature of the lessons made the subject matter more engaging and relevant, further contributing to their overall understanding and interest. Experiential learning theories hypothesize that hands-on experiences are crucial for deep learning and skill development (Kolb, 1984). In this study, the emphasis on practical application helped students solidify their understanding and develop relevant skills, reinforcing the importance of incorporating experiential learning opportunities in education.

Finally, the context-based approach sparked an increased interest in Ecology and environmental issues among the students. Many expressed a newfound passion for the subject and a desire to pursue further studies or careers in this field. This heightened interest suggests that teaching methods that connect academic content to real-world contexts can inspire students and motivate them to explore the subject more deeply. This is significant because fostering a passion for learning is one of the primary goals of education. Research shows that students who are interested in a subject are more likely to engage deeply with the material and pursue further studies in that area (Hidi & Renninger, 2006). The increased interest in Ecology observed in this study suggests that context-based teaching methods can inspire students and motivate them to explore the subject more deeply.

The thematic analysis of the views of thirty-two Senior High School students demonstrates that the context-based approach to teaching Ecology is highly effective in enhancing student engagement, understanding, and interest. By integrating real-world contexts into the curriculum, this approach makes learning more relevant, meaningful, and impactful. The positive outcomes observed in this study highlight the potential of context-based teaching methods to improve educational experiences and inspire a passion for learning in students. The detailed student feedback underscores the importance of employing teaching strategies that connect academic content to real-world applications, fostering a deeper understanding and appreciation of the subject matter.

4.5 Summary of Findings

From the results of the study, the following findings were recorded:

From the study, it was found that the experimental students performed better than the control group of students in the Ecology performance test. This resulted from the experience of context-based teaching approach by the experimental group being able to understand and apply the concept during answering of questions.

It was also found that the performance of both male and female students taught with context-based approach was not significant. Therefore, students' academic performance in the Ecology classroom did not depend on gender.

Finally, the study revealed that the views of the students exposed to context-based teaching approach were positive.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Overview

This chapter provides a summary of the key findings from the study. It also presents the conclusions drawn from these findings and offers recommendations for improving teaching and learning practices in Ecology. Additionally, suggestions for further research are outlined to build on the outcomes of this study.

5.1 Summary of Key Findings

The main purpose of this study was an investigation of the effectiveness of context-based teaching approach on the academic performance of Senior High School in Ecology. Specifically, the study aimed at examining: what is the impact of the context-based teaching approach on the academic performance of students in Ecology, in comparison to the conventional teaching approach?, What is the difference in academic performance between male and female students taught Ecology using context-based teaching approach?, and, what the views of students on context-based approach after their experience in the Ecology classroom?

The findings of the study revealed that students taught with context-based approach performed better than student taught with conventional approach which was statistically proven as significant. The results also showed that there is no significant difference in the performance of male and female students after taking the post-test. Finally, the views of the students exposed to context-based teaching approach were positive.

5.2 Conclusions

The study concluded that the context-based teaching approach is a more effective method for teaching Ecology than the conventional approach. The findings showed a significant improvement in the academic performance of students taught with this method, highlighting its potential to enhance understanding of ecological concepts.

Additionally, the context-based teaching approach was found to be gender-friendly, as there were no statistically significant differences in performance between male and female students. This demonstrates that the approach equally supports learning for all students, fostering a reassessment of Ecology's relevance and encouraging greater interest and understanding of its concepts.

Finally, students in the experimental group found the approach engaging and beneficial. The use of storytelling, case studies, and real-life activities made the learning process more interactive, creative, and meaningful, resulting in active student participation and enhanced learning outcomes.

5.3 Recommendations

Based on the findings and conclusions, the following recommendations are made for teachers, educators, policymakers, and other stakeholders in Senior High Schools:

1. *Biology Teachers:* Biology teachers in Senior High Schools should integrate context-based teaching strategies into their instructional methods to help students relate ecological concepts to real-life experiences.

2. *Teaching Practices:* Educators should adopt the context-based teaching approach as it effectively enhances the academic performance of both male and female students in learning ecological concepts.
3. *Professional Development:* Training programs, workshops, and seminars should be organized to equip Senior High School Biology teachers with the knowledge and skills needed to implement context-based teaching approaches. Municipal assemblies and educational authorities should take the lead in organizing these capacity-building initiatives.
4. *Teaching Aids:* Biology teachers should utilize real-life objects and examples from students' immediate environments to create more engaging and meaningful learning experiences.

5.4 Suggestion for Further Research

The study offers this suggestion for future research:

- Further studies on effect of context-based teaching and learning approach on the academic performance of students in ecological concepts in Senior High Schools may be carried out by the researcher training the existing teachers of each school to teach the concepts.

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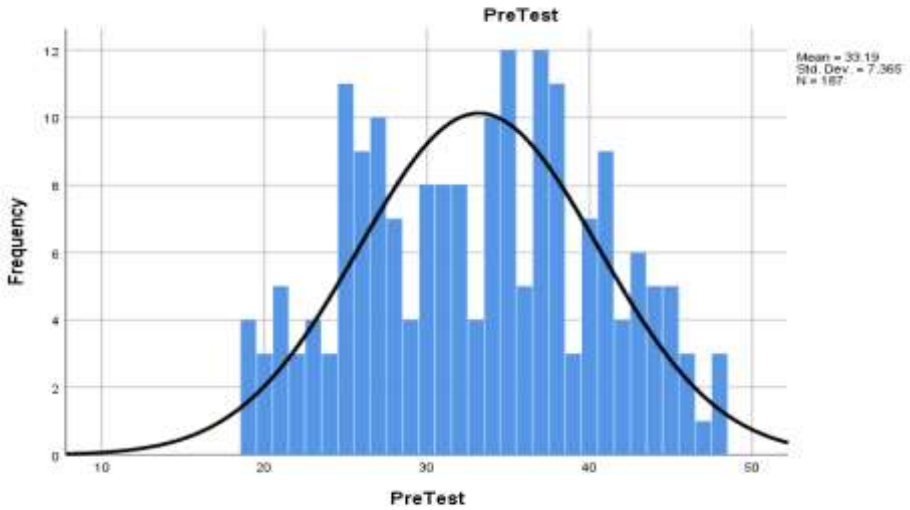
APPENDICES

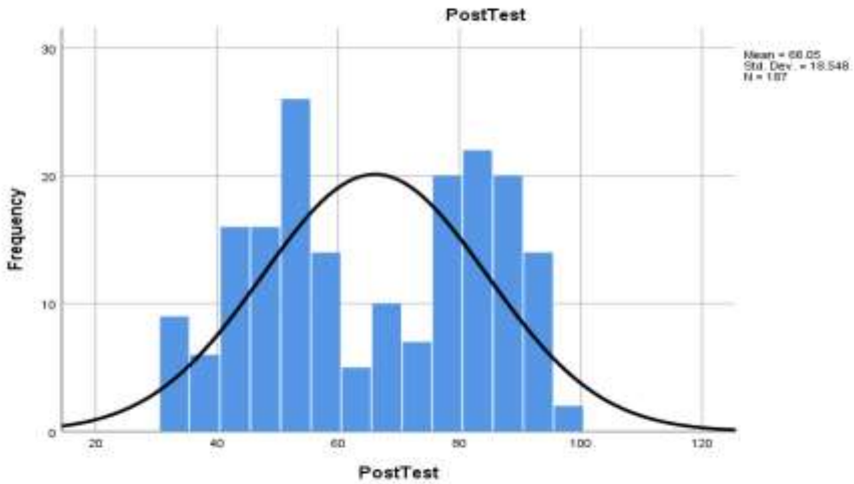
Appendix I: SPSS Outputs for Research Question One

Descriptive Statistics of Pre-test and Post-test scores for Experimental and Control Groups

		Pre-Test	Post-Test
N	Valid	187	187
	Missing	0	0
Mean		33.19	66.05
Median		34.00	67.00
Std. Deviation		7.365	18.548
Variance		54.250	344.035
Percentiles	25	27.00	50.00
	50	34.00	67.00
	75	38.00	83.00



Normal distribution graph for pre-test scores for experimental and control groups



Normal distribution graph for post-test scores for experimental and control groups

Descriptive Statistics of Pre-test scores for Experimental and Control Groups

	Teaching Approach			Statistic	Std. Error
Pre-Test	Context-based Approach	Mean		33.73	.745
		95% Confidence Interval for Mean	Lower Bound	32.26	
			Upper Bound	35.21	
		5% Trimmed Mean		33.74	
		Median		34.50	
		Variance		52.111	
		Std. Deviation		7.219	
		Minimum		19	
		Maximum		48	
		Skewness		-.079	.249
		Kurtosis		-.796	.493
	Conventional	Mean		32.63	.779

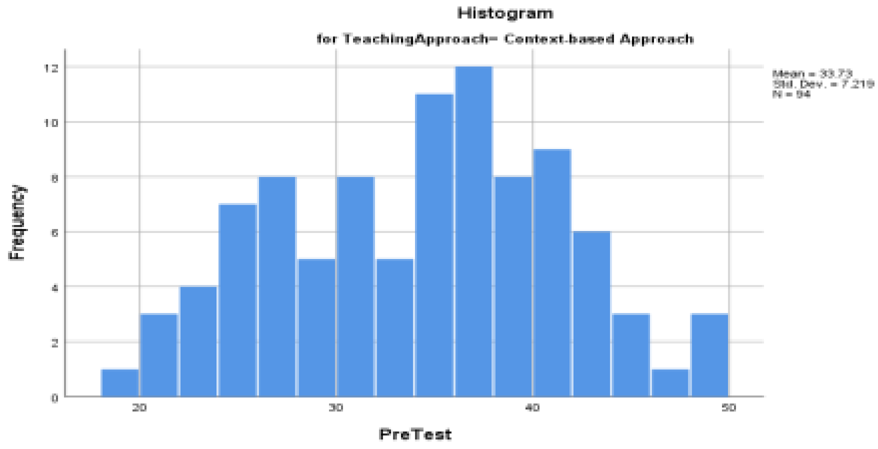
	Approach	95% Confidence Interval for Mean	Lower Bound	31.09	
			Upper Bound	34.18	
		5% Trimmed Mean		32.63	
		Median		32.00	
		Variance		56.387	
		Std. Deviation		7.509	
		Minimum		19	
		Maximum		47	
		Skewness		.072	.250
		Kurtosis		-.961	.495

Tests of Normality

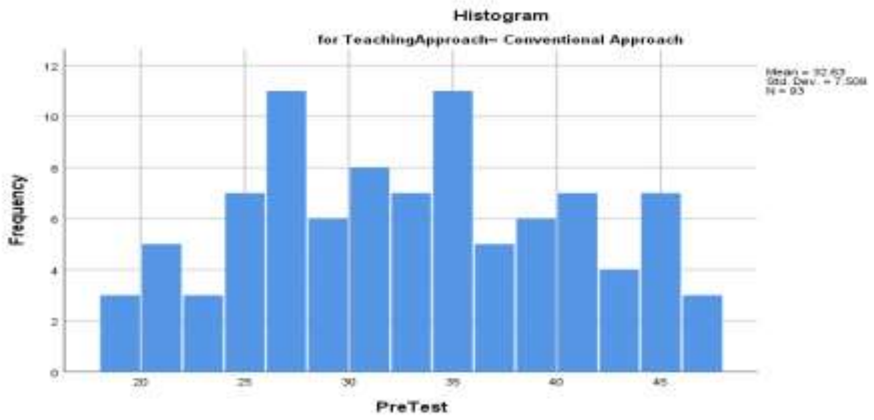
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Teaching Approach	Statistic	df	Sig.	Statistic	df	Sig.
Pre-Test	Context-based Approach	.089	94	.061	.977	94	.098
	Conventional Approach	.086	93	.084	.970	93	.028

[a]. Lilliefors Significance Correction

Histogram of Pre-Test scores for Experimental and Control Group of Students

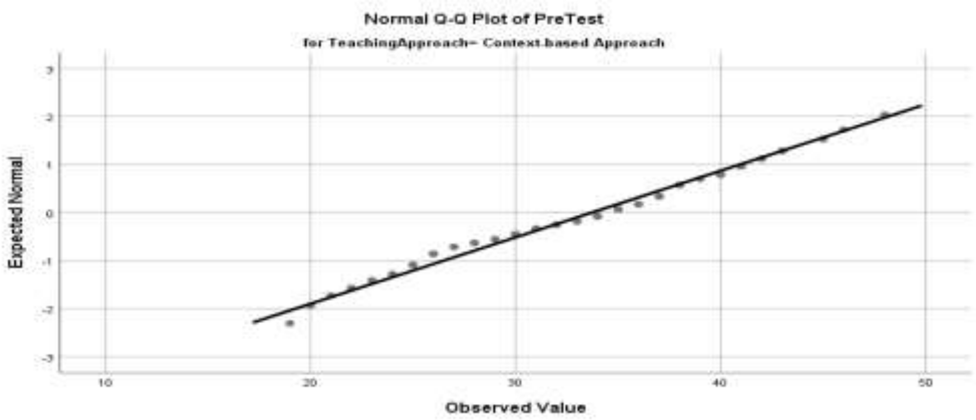


Histogram of pre-test scores for experimental (context-based) students

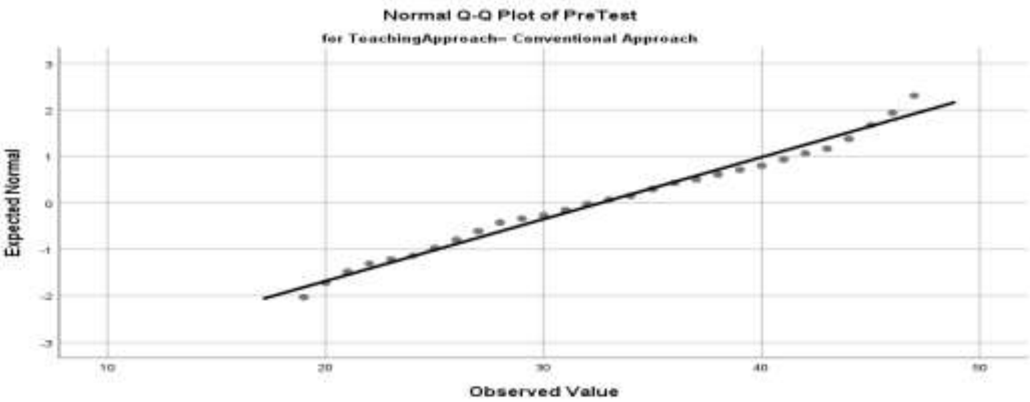


Histogram of pre-test scores for control (conventional) students

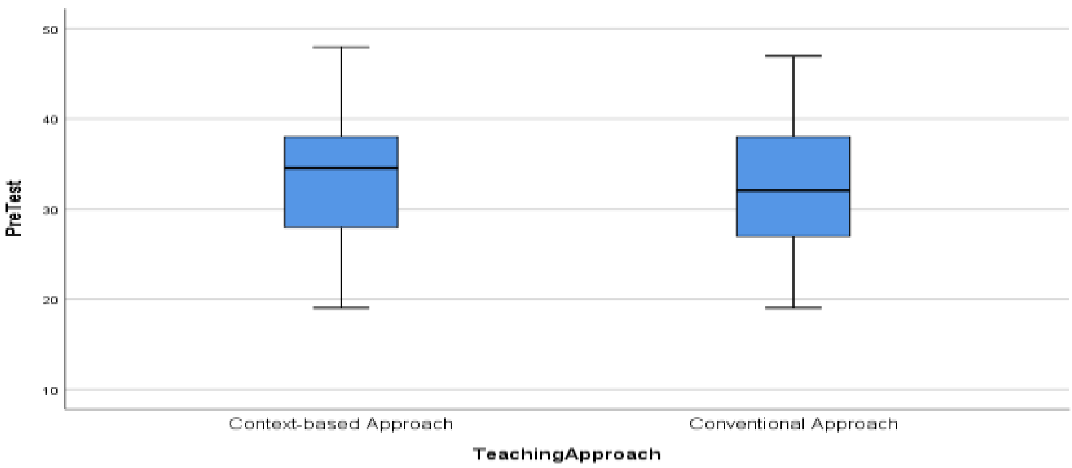
Normal Q-Q Plots of Pre-Test for experimental and control group of students



Normal Q-Q plot of pre-test scores for experimental (context-based) students



Normal Q-Q plot of pre-test scores for experimental (context-based) students



Box plots of pre-test scores for experimental (context-based) and control (conventional) students

Descriptive Statistics of Post-test scores for Experimental and Control Groups

	Teaching Approach			Statistic	Std. Error
Post-test	Context-based Approach	Mean		82.79	.759
		95% Confidence Interval for Mean	Lower Bound	81.28	
			Upper Bound	84.29	

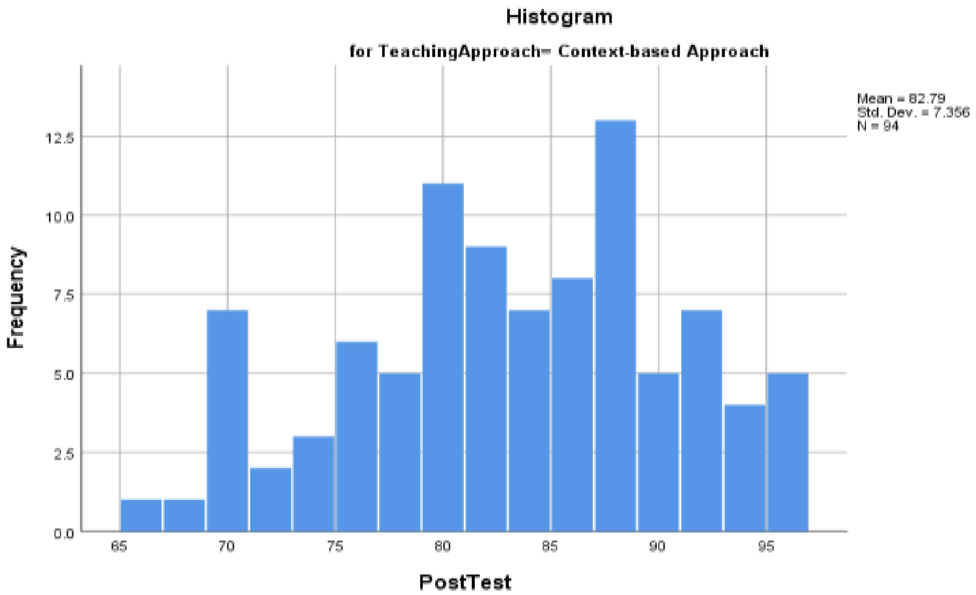
	5% Trimmed Mean		82.87	
	Median		83.00	
	Variance		54.105	
	Std. Deviation		7.356	
	Minimum		66	
	Maximum		96	
	Skewness		-.231	.249
	Kurtosis		-.680	.493
Conventional Approach	Mean		49.13	.837
	95% Confidence Interval for Mean	Lower Bound	47.47	
		Upper Bound	50.79	
	5% Trimmed Mean		49.20	
	Median		50.00	
	Variance		65.201	
	Std. Deviation		8.075	
	Minimum		33	
	Maximum		67	
	Skewness		-.287	.250
	Kurtosis		-.619	.495

Tests of Normality

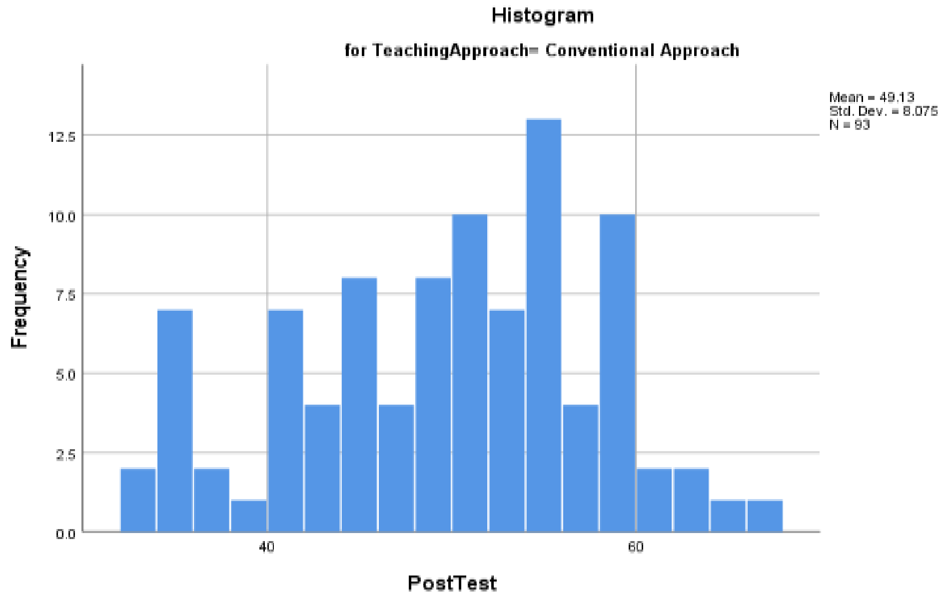
	Teaching Approach	Kolmogorov-Smirnov[a] Statistic	df	Sig.	Shapiro-Wilk Statistic	df	Sig.
Post-Test	Context-based Approach	.078	94	.197	.975	94	.068
	Conventional Approach	.086	93	.085	.972	93	.040

a. Lilliefors Significance Correction

Histogram of Post-Test scores for Experimental and Control Group of Students

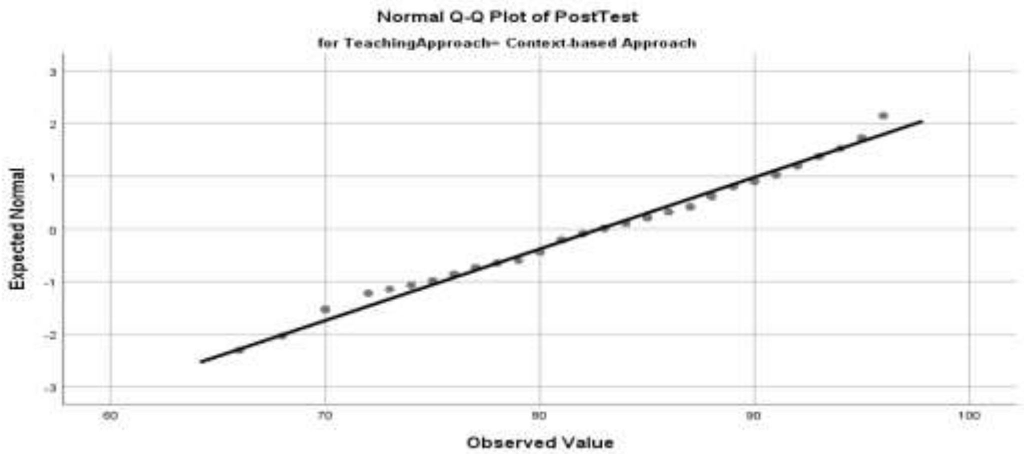


Histogram of post-test scores for Experimental (Context-Based) Students

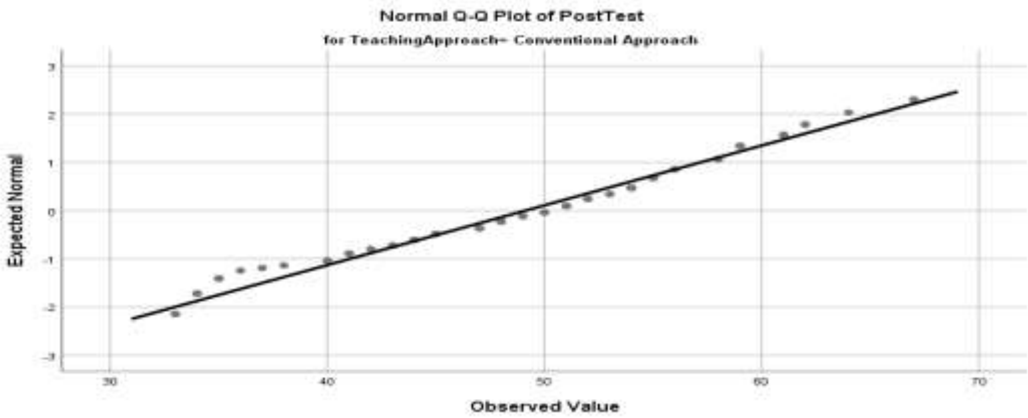


Histogram of post-test scores for control (conventional) students

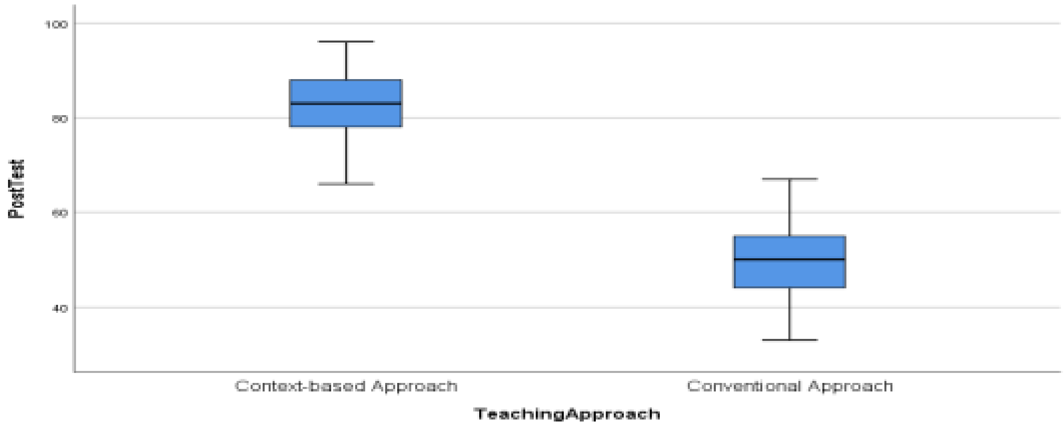
Normal Q-Q Plots of Post-Test for experimental and control group of students



Normal Q-Q plot of post-test scores for experimental (context-based) students



Normal Q-Q plot of post-test scores for control (conventional) students



Box plot of post-test scores for experimental (context-based) and control (conventional) students

T-Test

Group Statistics

	Teaching Approach	N	Mean	Std. Deviation	Std. Error Mean
Pre-Test	Context-based Approach	94	33.73	7.219	.745
	Conventional Approach	93	32.63	7.509	.779
Post-Test	Context-based Approach	94	82.79	7.356	.759
	Conventional Approach	93	49.13	8.075	.837

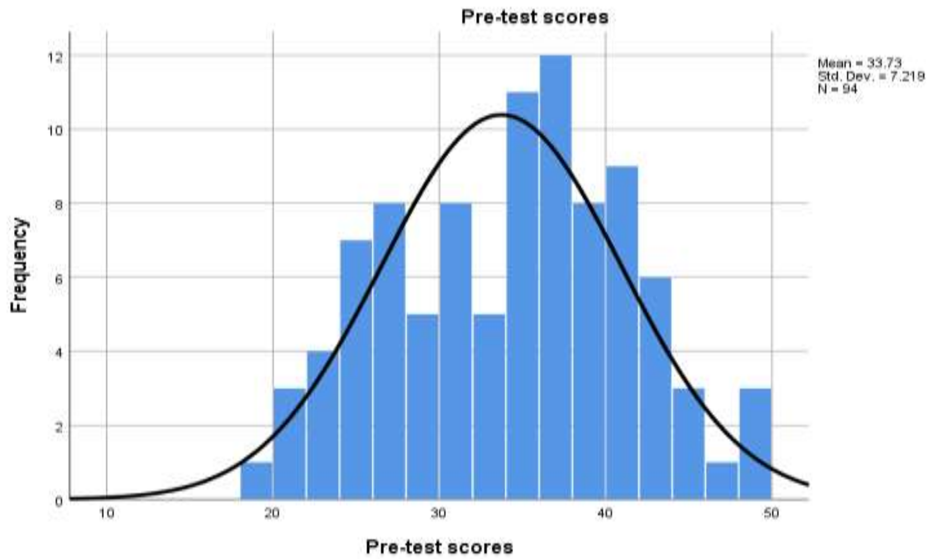
Independent Samples T-Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Diff.	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	Lower	Upper
Pre-Test	Equal variances assumed	.285	.594	1.021	185	.309	1.100	1.077	-1.025	3.225
	Equal variances not assumed			1.021	184.536	.309	1.100	1.077	-1.026	3.225
Post-Test	Equal variances assumed	.844	.359	29.804	185	.001	33.658	1.129	31.430	35.886
	Equal variances not assumed			29.789	183.031	.001	33.658	1.130	31.429	35.887

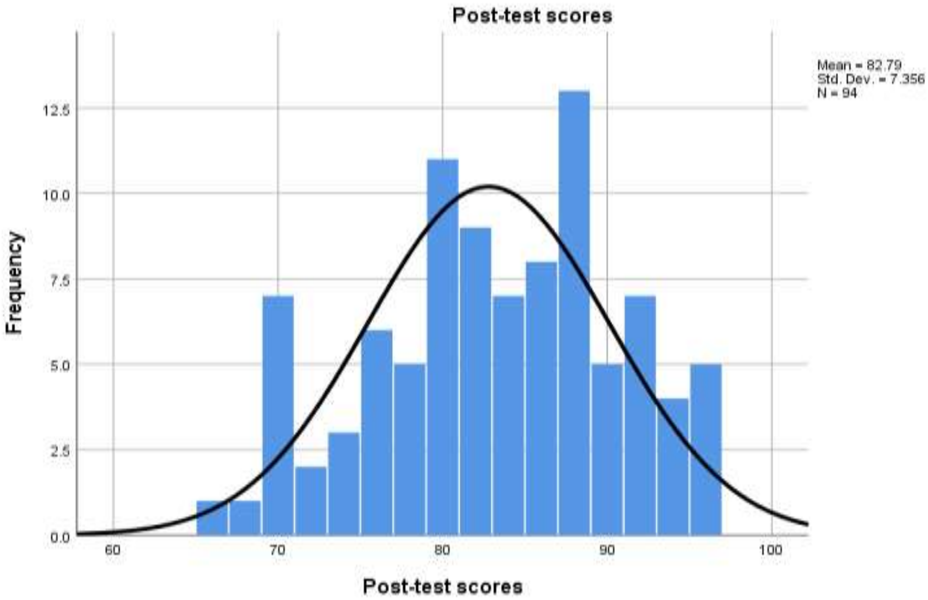
Appendix II: SPSS Outputs for Research Question Two

Descriptive Statistics for Experimental Group of Students

		Pre-test scores	Post-test scores
N	Valid	94	94
	Missing	0	0
Mean		33.73	82.79
Median		34.50	83.00
Std. Deviation		7.219	7.356
Variance		52.111	54.105



Normal distribution graph for pre-test scores for experimental (context-based) group



Normal distribution graph for post-test scores for experimental (context-based) group

Descriptive Statistics of Pre-test scores for Gender in Experimental Groups

	Gender			Statistic	Std. Error
Pre-test scores	Male	Mean		33.03	.841
		95% Confidence Interval for Mean	Lower Bound	31.35	
			Upper Bound	34.70	
		5% Trimmed Mean		32.98	
		Median		34.00	
		Variance		52.355	
		Std. Deviation		7.236	
		Minimum		19	
		Maximum		48	
		Skewness		.012	.279
		Kurtosis		-.845	.552

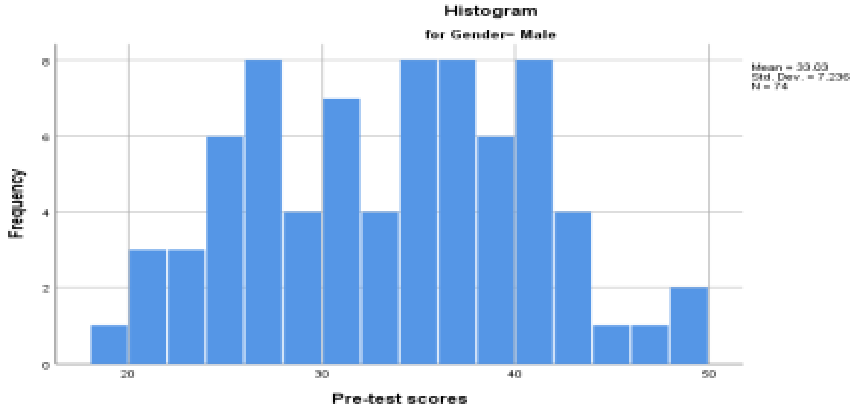
	Female	Mean		36.35	1.496
		95% Confidence Interval for Mean	Lower Bound	33.22	
			Upper Bound	39.48	
		5% Trimmed Mean		36.50	
		Median		36.50	
		Variance		44.766	
		Std. Deviation		6.691	
		Minimum		22	
		Maximum		48	
		Skewness		-.378	.512
		Kurtosis		.017	.992
		Kurtosis		-.049	.992

Tests of Normality

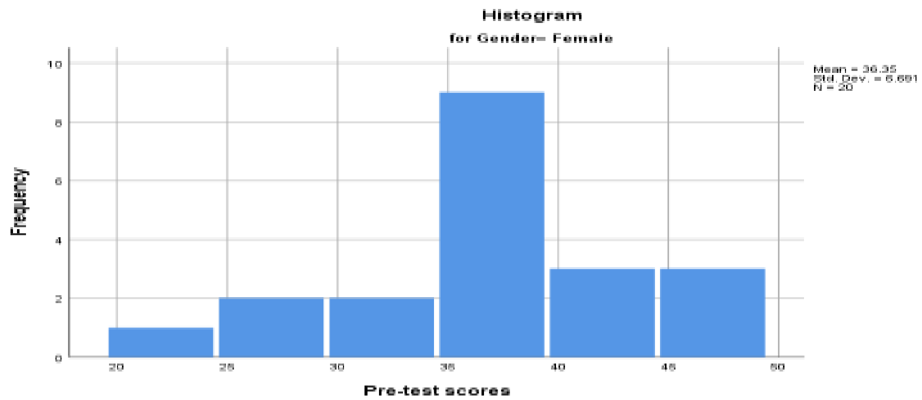
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Gender	Statistic	df	Sig.	Statistic	df	Sig.
Pre-test scores	Male	.100	74	.062	.976	74	.176
	Female	.170	20	.132	.970	20	.758

a. Lilliefors Significance Correction

Histogram of Pre-Test scores for Gender in Experimental Group of Students

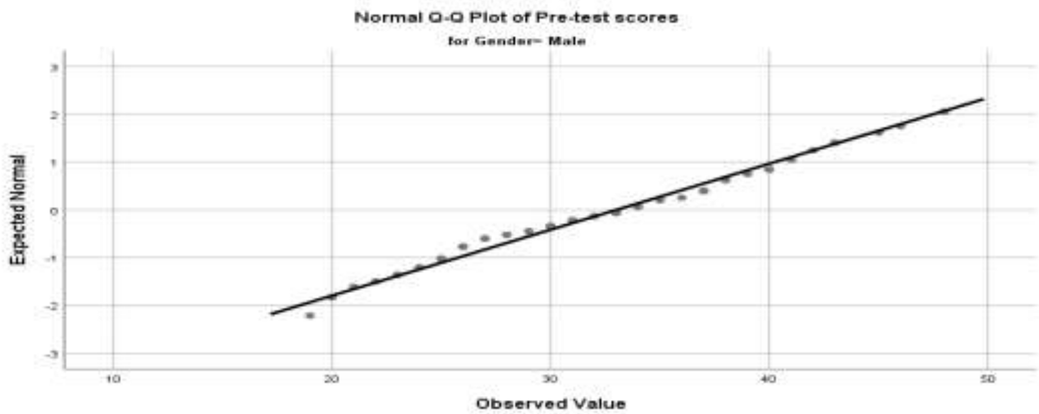


Histogram of pre-test scores for experimental (context-based) male students



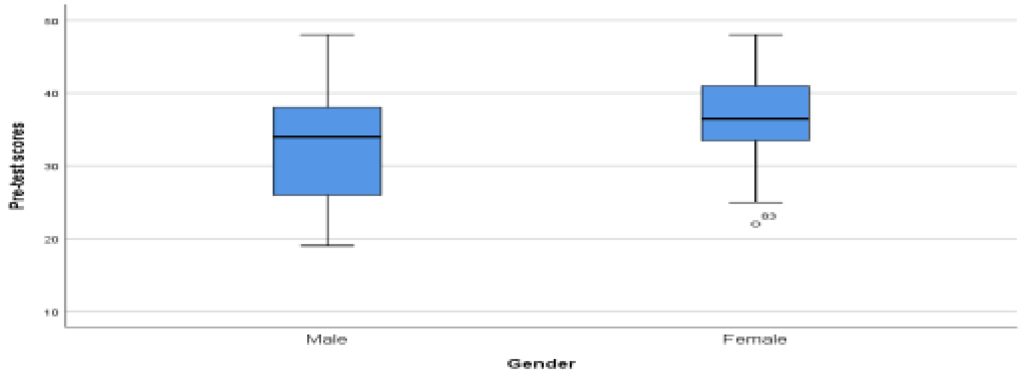
Histogram of pre-test scores for experimental (context-based) female students

Normal Q-Q Plots of Pre-Test for Gender in Experimental Group of Students



Normal Q-Q plot of pre-test for experimental (context-based) male students

Normal Q-Q plot of pre-test scores for experimental (context-based) female students



Box plot of pre-test for experimental (context-based) male and female students

Post-test scores

Descriptives

	Gender			Statistic	Std. Error
Post-test scores	Male	Mean		82.23	.867
		95% Confidence Interval for Mean	Lower Bound	80.50	
			Upper Bound	83.96	
		5% Trimmed Mean		82.30	
		Median		82.00	
		Variance		55.659	

		Std. Deviation	7.460	
		Minimum	66	
		Maximum	95	
		Skewness	-.209	.279
		Kurtosis	-.815	.552
	Female	Mean	84.85	1.505
		95% Confidence Interval for Mean Lower Bound	81.70	
		95% Confidence Interval for Mean Upper Bound	88.00	
		5% Trimmed Mean	85.06	
		Median	84.00	
		Variance	45.292	
		Std. Deviation	6.730	
		Minimum	70	
		Maximum	96	
		Skewness	-.167	.512
		Kurtosis	-.049	.992

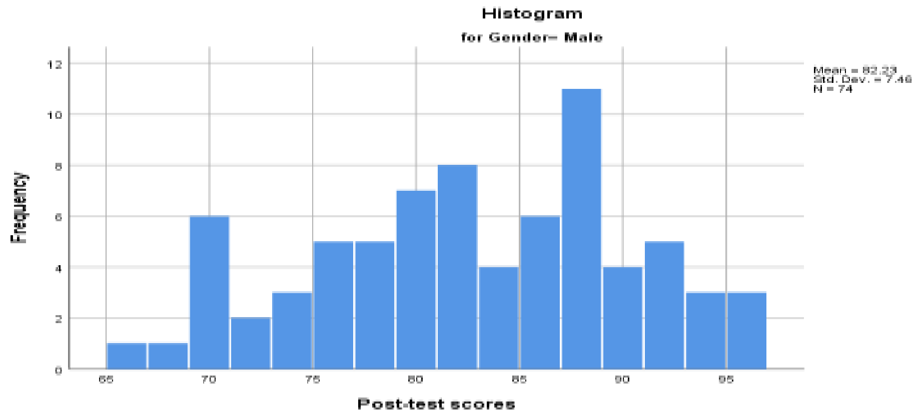
Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Gender	Statistic	df	Sig.	Statistic	df	Sig.
Post-test scores	Male	.090	74	.200*	.971	74	.086
	Female	.136	20	.200*	.970	20	.748

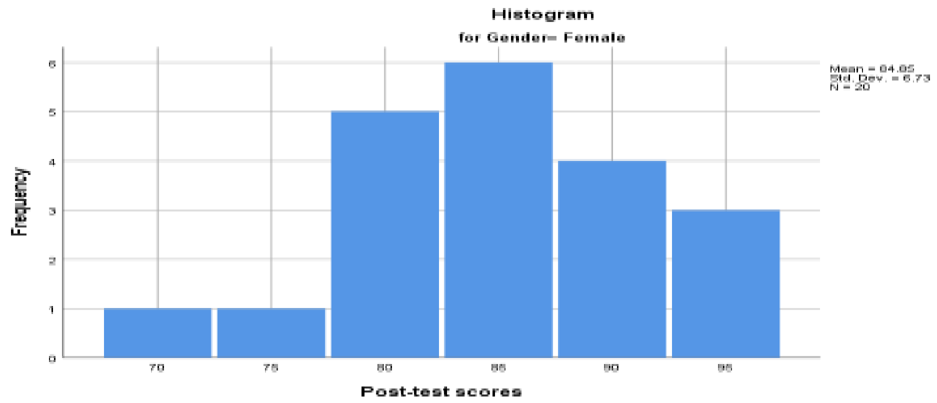
*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Histograms of Post-Test scores for Gender in Experimental Group of Students

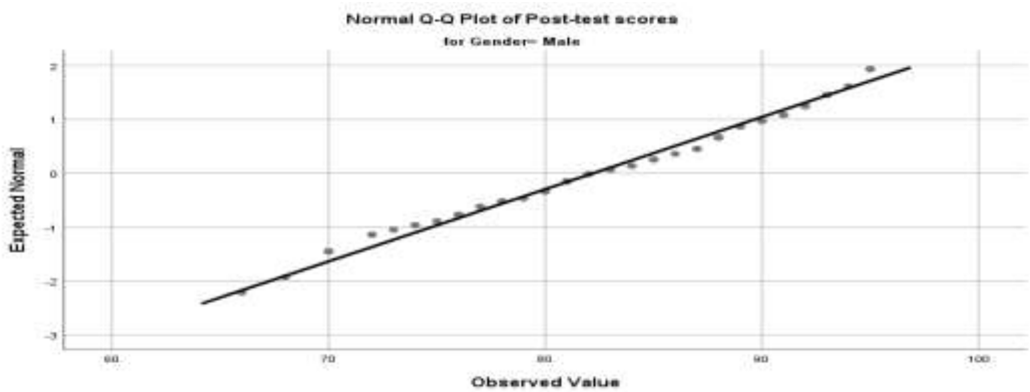


Histogram of post-test scores for experimental (context-based) male students

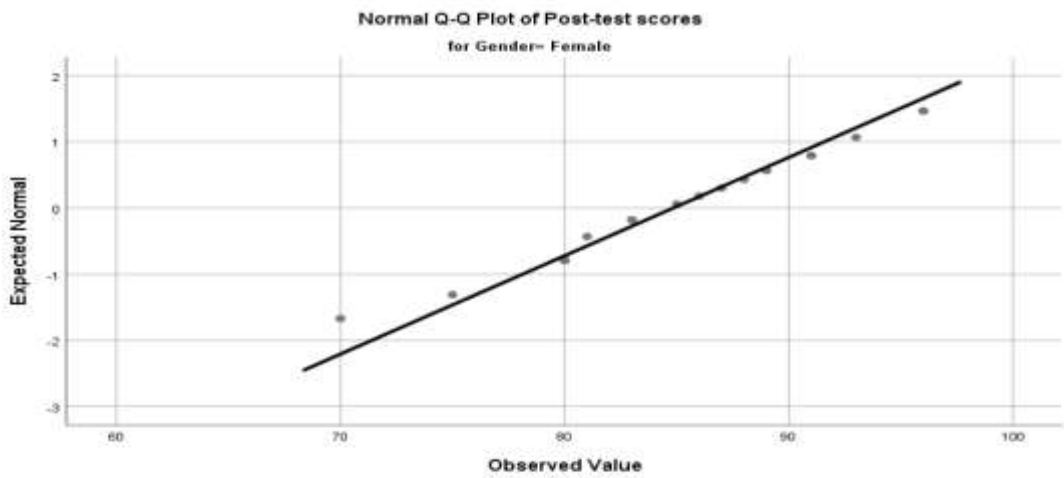


Histogram of post-test scores for experimental (context-based) female students

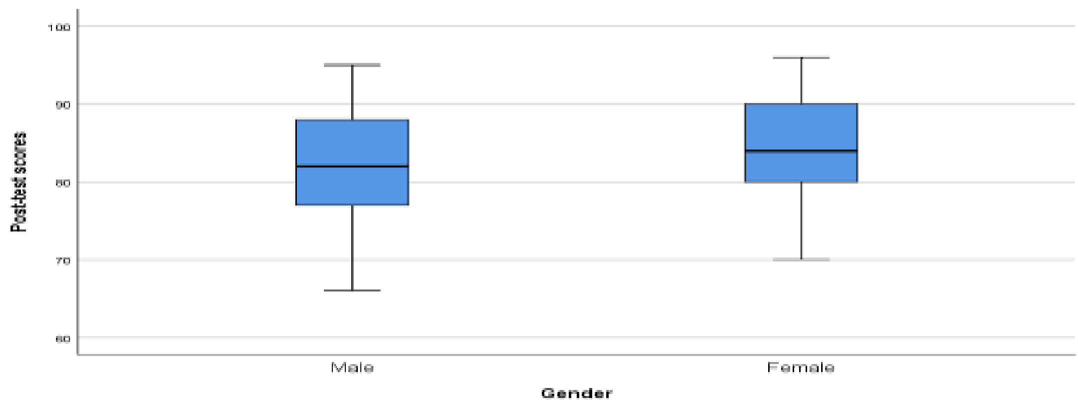
Normal Q-Q Plots of Post-Test for Gender in Context-Based Approach Students



Normal Q-Q plot of post-test for experimental (context-based) male students



Normal Q-Q plot of post-test for experimental (context-based) female students



Box Plot of Post-Test for Experimental (Context-based) Male and Female Students

T-Test

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Pre-test scores	Male	74	33.03	7.236	.841
	Female	20	36.35	6.691	1.496
Post-test scores	Male	74	82.23	7.460	.867
	Female	20	84.85	6.730	1.505

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Diff.	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	Lower	Upper
Pre-test scores	Equal variances assumed	1.364	.246	-1.850	92	.067	-3.323	1.796	-6.890	.244
	Equal variances not assumed			-1.936	32.076	.062	-3.323	1.716	-6.819	.173
Post-test scores	Equal variances assumed	.713	.401	-1.421	92	.159	-2.620	1.844	-6.282	1.041
	Equal variances not assumed			-1.509	32.776	.141	-2.620	1.737	-6.155	.914

Appendix III: Calculation of Eta squared

Eta squared =

$$\frac{t^2}{t^2 + (N1 + N2 - 2)}$$

$$\frac{29.804^2}{29.804^2 + (94 + 93 - 2)}$$

$$\frac{888.278416}{1073.278416}$$

= 0.8276309323

= 0.8

Appendix IV: Ecology Performance Test (EPT)

The purpose of this test is to find out your understanding of Ecology in Biology. You are assured that your participation is confidential and voluntary. You can withdraw from participation.

Instructions:

1. Answer all questions
2. Read questions carefully before answering

School ………………………… Class No. …………… Sign …………...

SECTION A (40 marks)

1. Mountain, abandoned farmland, rock are grouped together as

   a. ecosystem
   b. marine habitat
   c. aquatic habitat
   d. terrestrial habitat

2. Which of these is a food chain in the ponds?

   a. seed → mouse → snake
   b. grass → grasshopper → toad → snake
   c. water lettuce → tadpole → fish
   d. cactus → woodrat → wasp → hedgehog

3. Mountain organisms are characterized by

   a. webbed feet, arms, legs
   b. air filed, parts, legs, arms
   c. limbs, legs, arms, and feet
   d. limbs, webbed feet, air filed parts

4. All these are ecological factors affecting all habitat except

a. rainfall

b. temperature

c. humidity

d. none of the above

5. Which of the following plants can be found in ponds habitat?

a. mango tree

b. water-lily

c. tadpole

d. orange tree

6. Which of the following is an example of food chain in an abandoned farmland

a. grass → bacteria → fish

b. fish → tad pole → sand

c. grass → grasshopper → lizard → snake

d. weed → insect → snake → human

7. A low and wet land habitat representing a transition between aquatic and terrestrial habitat

a. marsh land

b. brackish

c. forest

d. desert

8. Which of the following animals cannot be found in river habitat?

a. lizard

b. tad pole

c. king fisher

d. fish

9. Which of the following organisms cannot be found in both abandoned farm land and mountain habitats?

a. rats

b. maize plants

a. birds

b. insects

10. What is the name of an instrument for the measuring of transparency of water

a. hydrometer

b. secchi disk

c. thermometer

d. rain gauge

11. Which of the following animals cannot be found in rivers habitat?

a. frogs

b. monkeys

c. insects

d. king fisher

12. Which of the following living organism cannot be found in river habitat?

a. elephant grasses

b. toad

c. crabs

d. rodents

13. The functional role of an organism in a given habitat is described as termed

a. niche

b. biomass

c. hydrosphere

d. atmosphere

14. Which of the following is not a characteristic of marsh habitat?

a. soil is soft making difficult for big animal to move

b. the vegetation is mostly dominated by grasses

c. it has little or no salt in them

d. the contents of mineral salt are high

15. Which of the following organisms cannot be found in ponds?

a. scorpions

b. spirogyra

c. mosquitoes

d. water lettuce

16. What is the name of an instrument for measuring temperature?

a. thermometer

b. rain gauge

c. hygrometer

d. anemometer

17. The following are characteristics of hill habitat except

a. the water is stagnant

b. it is a solid mass of intrusive igneous rock

c. it is a natural flow of water that continues in a long line across

d. land to the sea/ocean

18. What is the name of an instrument for measuring relative humidity?

a. thermometer

b. rain gauge

c. hygrometer

d. wind vane

19. Ponds, rivers, lake seas and ocean are grouped together as

a. ecosystem

b. marine habitat

c. aquatic habitat

d. terrestrial habitat

20. The instrument for measuring light intensity is called

a. hygrometer

b. light meter

c. wind vane

d. barometer

<u>SECTION B (60 marks)</u>

1. a. What is a habitat? (2 marks)

   b. Explain briefly energy flow in a freshwater habitat (8 marks)

2. a. What is trophic level? (2 marks)

   b. Explain briefly the relationship between three examples of symbiotic organisms (8 marks)

3. a. Explain briefly three roles of a decomposer in an ecosystem (6 marks)

   b. Name four products of decomposition (4 marks)

4. a. Mention three roles of decomposers on a refuse dump (6 marks)

   b. List four materials found in a refuse dump which would not be affected by the action of decomposers (4 marks)

5. A pond at the back of a school hostel containing living organisms was abandoned for some time.

a. Name two producers and consumers that could be found in the pond (2 marks)

b. List three abiotic factors that would affect the organisms in the pond (3 marks)

c. Name the instrument that could be used to collect large animals found in the pond (1 mark)

d. State two benefits of the pond to the school and the environment (2 marks)

e. State two disadvantages of the pond to the school and the environment (2 marks)

6. Complete the table by placing each of the organisms under the appropriate heading.

Algae, Bacteria, Dog, Water lettuce, Tadpole, Human, Lemna, Waterleaf, Rhizopus, Mushroom (10 marks)

Decomposer	Producer	Consumer

ANSWERS

SECTION A (40 marks)

1. D	6. C	11. C	16. A
2. C	7. B	12. B	17. B
3. C	8. D	13. A	18. C
4. B	9. A	14. C	19. C
5. C	10. A	15. B	20. B

SECTION B (60 marks)

1. a. Habitat is the natural dwelling place of an organism (2 marks)

b. In a fresh water habitat, aquatic plants use energy from the sun to photosynthesize or produce food; this food is eaten by primary consumers or small aquatic animals which would in turn be eaten by bigger aquatic animals or secondary consumers. In the process of feeding energy flows from one trophic level to another and decrease progressively; dead animals or plants also decompose leading to energy loss (8 marks)

2. a. Trophic level is the position occupied by an organism with energy transfer in a food chain / food web in an ecosystem (2 marks)

b. Sea anemone attaching itself to the shell of hermit crab; thereby enjoying pieces of leftover therein; the hermit crab in turn enjoys protection against predators or the sea anemone's stings prevent the predators from harming the hermit crab (8 marks)

OR

Algae and fungi in a lichen; lichen is made up of a fungus and unicellular alga living together; the green alga produces food/photosynthesis for the association; the fungus protects the alga/absorbs water from the surrounding for the use of the alga (8 marks)

3. a. Decomposers are organisms which bring about decay of dead parts/whole of plants and animals to produce manure/humus; by this they release nutrients into soil which are absorbed by the roots of plants and are used to build up a new plant tissue. They thus help in nutrient recycling and at the same time releasing offensive gases/odour which pollute the air (6 marks)

b. Name of products of decomposition include (4 marks):

- Carbon (IV) oxide
- Ammonia
- Water/ Water vapour
- Heat/energy
- Humus
- Plant nutrient/ Mineral salt

4. a. The roles of decomposers on a refuse dump include: (6 marks)

- They feed on dead/decaying organisms
- They form a link in a food chain
- They form a link between biotic and abiotic factors in an ecosystem
- They release inorganic components from organic materials
- They facilitate the recycling of nutrients in the ecosystem
- They reduce the bulky nature of debris/dump

b. Materials in a refuse dump which would not be affected by the action of decomposers include: (4 marks)

- Plastics
- Metals/iron/tin/zinc
- Glass/bottle

- Nylon/polythene
- Rubber/tyres
- Stones
- Ceramics

5. a. Producers and consumers that could be found in the pond (2 marks)

Producers	**Consumers**
Euglena	Water snails
Water lettuce	Tadpoles, Mosquito larvae
Water fern	Water scorpion
Water lily	Mudfish/Catfish/ Tilapia
Algae/Spirogyra	Zooplankton

b. Abiotic factors that would affect the organisms in the pond (3 marks)

- Temperature
- pH
- Density
- Pressure
- Oxygen
- Rainfall
- Sunlight
- Carbon (IV) oxide/ Carbon dioxide

c. Instrument that could be used to collect large animals in the pond (1 mark)

- Sieve
- Sweep net
- Basket net/fish net/ butterfly net

- Plankton net/Drag net

d. Benefits of the pond to the school and the environment (2 marks)

- For collection of samples
- Balances water cycling in nature
- Habitat for some organisms/ biodiversity
- Breeding ground/niche for some organisms
- For oxygen/ carbon dioxide balance in nature
- Balances food chain/food web

e. Disadvantages of the pond to the school and the environment (2 marks)

- Breeding spots for toads/frogs
- Breeding ground for mosquito
- Could be a death trap
- Could cause air/water pollution from decomposing organisms
- Health hazard for the environment/school

6. Complete the table by placing each of the organisms under the appropriate heading (10 marks)

Decomposer	**Producer**	**Consumer**
Bacteria	Algae	Dog
Rhizopus	Water lettuce	Tadpole
Mushroom	Lemna	Human
	Waterleaf	

Appendix V: Interview Guide for Focus Group Discussion

Interview Guide to Explore the Views of Senior High School Students on the Use of Context-based Approach in Ecology Classroom

1. How would you describe the context-based teaching approach used in your Ecology lessons?
2. How did this approach influence your level of engagement and participation in class activities?
3. Can you provide examples of how you applied the ecological concepts learned in real-life?
4. How did the teaching approach help you in solving ecological problems or understanding environmental challenges?
5. What opportunities did the context-based approach provide for critical thinking and decision-making in environmental issues?
6. How did this approach encourage collaboration and communication among you and your classmates?
7. How relevant were the lessons to your daily life and the ecological challenges in your community?
8. Do you feel this approach helped you understand ecological concepts better? Why or why not?
9. What specific strategies used by your teacher in this approach did you find most effective or enjoyable?
10. Would you recommend the context-based teaching approach for other subjects? Why or why not?

Appendix VI: The Weekly Lesson Plan

<u>THE PLAN (6 WEEKS)</u>

Breakdown of 6 weeks plan in detail

Week 1 – Introduction and pre-test

Weeks 2 – 5: Lessons delivery

Weekly Learning Planner

<table>
<tr><td colspan="2">Subject: Biology</td><td colspan="2">Week: 2</td><td>Duration: 60 minutes</td><td>Form: Year 2</td></tr>
<tr><td>Strand</td><td>Interactions in Nature</td><td colspan="2">Sub-Strand</td><td colspan="2">Basic Concepts in Ecology
Study of Specific Habitats</td></tr>
<tr><td>Content Standard</td><td colspan="5">Demonstrate understanding of basic concepts in Ecology and general characteristics of aquatic and terrestrial habitat</td></tr>
<tr><td>Learning Indicators</td><td colspan="5">2.1.1 Discuss basic concepts in Ecology
2.2.1 Outline the general characteristics of aquatic and terrestrial habitats</td></tr>
<tr><td>Performance Indicators</td><td colspan="5">By the end of this lesson, students will be able to:
1. Identify key concepts in Ecology within the context of local ecosystems.
2. Describe and compare the general characteristics of aquatic and terrestrial habitats.
3. Recognize the interdependence of organisms and their environment.</td></tr>
<tr><td>Core Competencies</td><td colspan="5">Critical Thinking, Communication and Collaboration, Personal Development and Leadership</td></tr>
</table>

Materials	1. Local maps or diagrams depicting nearby aquatic and terrestrial habitats 2. Field notebooks or digital devices for note-taking 3. Camera or smartphone for capturing observations (optional)	
Starter **(10 minutes)**	**Main Activities** **(40 minutes)**	**Conclusions** **(10 minutes)**
Start with a brief discussion on the importance of studying local ecosystems. Ask students to share their experiences or observations of nearby habitats such as ponds, parks, forests, or urban areas. Introduce the	**Exploration (25 minutes):** 1. **Field Trip or Virtual Exploration (15 minutes):** a. Take students on a guided tour of a nearby aquatic and terrestrial habitat, if possible or use virtual tools or local maps to explore these habitats remotely. b. Encourage students to observe and record the features, organisms, and environmental factors present in each habitat. c. Guide students to ask questions about the interactions they observe between living and non-living components of the ecosystems. 2. **Note-taking and Observation (10 minutes):** a. Provide students with field notebooks to record their observations. b. Encourage them to take notes on the physical characteristics (e.g., water quality,	Summarize the key concepts discussed during the exploration and analysis. Emphasize the interconnectedness of organisms and their environment, highlighting the importance of studying local ecosystems. Encourage students to continue exploring and observing their

concept of Ecology as the study of interactions between living organisms and their environment.	soil type, vegetation) and biological components (e.g., plants, animals, microorganisms) of both habitats. c. Facilitate discussions and answer questions as students make their observations. **Analysis and Discussion (15 minutes):** **Comparative Analysis:** a. Guide students to compare and contrast the characteristics of the aquatic and terrestrial habitats they observed. b. Discuss how factors such as availability of water, sunlight, temperature, and nutrients influence the distribution of organisms in each habitat. c. Explore the concepts of habitat specialization and adaptation based on observed features. **Assessment:** • Explain the concept of Ecology? • Describe habitat of an organism • Mention the major types of habitats • Outline the general characteristics of aquatic and terrestrial habitats	surroundings to deepen their understanding of Ecology. **Homework:** Students can be assigned a project to research and create presentations on specific aquatic or terrestrial habitats, focusing on their characteristics, biodiversity, and ecological significance. They can also explore human impacts on these habitats and propose conservation measures

Weekly Learning Planner

<table>
<tr><td colspan="2">Subject: Biology</td><td colspan="2">Week: 3</td><td>Duration: 60 minutes</td><td>Form: Year 2</td></tr>
<tr><td>Strand</td><td colspan="2">Interactions in Nature</td><td>Sub-Strand</td><td colspan="2">Study of Specific Habitats</td></tr>
<tr><td>Content Standard</td><td colspan="5">Demonstrate understanding of biotic and abiotic factors, adaptations of organisms in the aquatic and terrestrial habitats</td></tr>
<tr><td>Learning Indicators</td><td colspan="5">2.2.2 The students will be able to explain the effects of abiotic and biotic factors on life in aquatic and terrestrial habitats
2.2.3 Explain how organisms in aquatic and terrestrial habitats are adapted to their habitats</td></tr>
<tr><td>Performance Indicators</td><td colspan="5">By the end of this lesson, students will be able to:
1. Define and differentiate between biotic and abiotic factors.
2. Identify examples of biotic and abiotic factors in terrestrial and aquatic habitats.
3. Explain how organisms adapt to their environment in response to biotic and abiotic factors.</td></tr>
<tr><td>Core Competencies</td><td colspan="5">Critical Thinking, Communication and Collaboration, Personal Development and Leadership</td></tr>
<tr><td>Materials</td><td colspan="5">1. PowerPoint presentation or whiteboard
2. Images or diagrams of terrestrial and aquatic habitats
3. Worksheets for note-taking and activities
4. Examples of adaptations in organisms (optional)</td></tr>
<tr><td>Starter (10 minutes)</td><td colspan="4">Main Activities (40 minutes)</td><td>Conclusion (10 minutes)</td></tr>
<tr><td>Begin with a</td><td colspan="4">Main Content (30 minutes):</td><td>Summarize the key</td></tr>
</table>

brief discussion on the components of ecosystems. Introduce the concepts of biotic and abiotic factors: Biotic factors: Living components of an ecosystem, including plants, animals, fungi, and microorganisms. Abiotic factors: Non-living	• **Examples of Biotic and Abiotic Factors (10 minutes):** a. Present examples of biotic factors in terrestrial habitats (e.g., plants, animals, decomposers) and aquatic habitats (e.g., fish, algae, plankton). b. Show examples of abiotic factors in both terrestrial habitats (e.g., temperature, precipitation, soil type) and aquatic habitats (e.g., water temperature, dissolved oxygen, pH level). c. Discuss how these factors interact with each other and influence the distribution and abundance of organisms. • **Adaptations of Organisms (20 minutes):** a. Explain the concept of adaptation as traits or behaviours that help organisms survive and reproduce in their environment. b. Provide examples of adaptations in terrestrial organisms (e.g., camouflage, hibernation, drought tolerance) and aquatic organisms (e.g., gills for oxygen exchange, streamlined bodies for swimming).	points covered in the lesson, emphasizing the interdependence between biotic and abiotic factors and organismal adaptations. Encourage students to reflect on how these concepts apply to real-world ecosystems and the importance of conservation efforts in preserving biodiversity. Invite students to ask questions or share insights they gained from the lesson. **Homework:** Students can be assigned a homework task to

components of an ecosystem, such as temperature, water, sunlight, soil, and air.	c. Facilitate a discussion on how these adaptations are related to specific biotic and abiotic factors present in their habitats. **Activity (10 minutes):** • Divide students into small groups. • Provide each group with a worksheet containing scenarios or case studies of organisms in terrestrial and aquatic habitats. • Instruct students to identify the biotic and abiotic factors influencing each organism and discuss possible adaptations that enable its survival. • Allow groups to present their findings to the class, fostering discussions and comparisons between different habitats and organisms. **Assessment:** • Define biotic and abiotic factors. • Differentiate between biotic and abiotic factors. • Identify examples of biotic and abiotic factors in terrestrial and aquatic habitats.	research specific adaptations of organisms in terrestrial or aquatic habitats. They can create posters, presentations, or written reports detailing the adaptations observed, their ecological significance, and potential implications for conservation and management of natural resources. Additionally, students can explore virtual simulations or conduct field observations to further investigate adaptations in different ecosystems.

	• Explain how organisms adapt to their environment in response to biotic and abiotic factors.	

Weekly Learning Planner

Subject: Biology		**Week:** 4	**Duration:** 60 minutes	**Form:** Year 2
Strand	Interactions in Nature	**Sub-Strand**	Study of Specific Habitats	
Content Standard	Demonstrate understanding of food chains, food webs and pyramids of numbers, biomass and energy, and Methods of determining food chains and webs			
Learning Indicators	2.2.4 The students will be able to identify the components of a food chain, food web, and ecological pyramids 2.2.5 Explain how food chains and food webs can be determined			
Performance Indicators	By the end of this lesson, students will be able to: 1. Define food chains, food webs, and ecological pyramids and differentiate between them. 2. Understand the flow of energy and matter through ecosystems. 3. Apply methods to determine food chains and food webs in local ecosystems.			
Core Competencies	Critical Thinking, Communication and Collaboration, Personal Development and Leadership			
Materials	1. Pictures or diagrams of food chains, food webs, and			

	ecological pyramids 2. Worksheets or handouts for note-taking and activities 3. Samples of local organisms or ecosystem models 4. Field notebooks or digital devices for outdoor exploration (optional)	
Starter **(10 minutes)**	**Main Activities** **(40 minutes)**	**Conclusion** **(10 minutes)**
Introduce the concepts of food chains, food webs, and ecological pyramids: Food chain: Sequential transfer of energy and nutrients from one organism to another in a linear pathway. Food web:	**Main Content (30 minutes):** • **Understanding Food Chains and Food Webs (15 minutes):** a. Present examples of food chains in different ecosystems, emphasizing the roles of producers, consumers, and decomposers. b. Introduce the concept of a food web as a more realistic representation of feeding relationships in ecosystems. c. Use visuals to illustrate the complexity and interconnectedness of organisms in food webs. • **Exploring Ecological Pyramids (15 minutes):** a. Explain the three types of ecological pyramids: numbers, biomass, and energy.	Summarize the key points covered in the lesson, emphasizing the importance of food chains, food webs, and ecological pyramids in understanding ecosystem dynamics. Discuss the relevance of these concepts to real-world issues such as biodiversity conservation and ecosystem management. Encourage students to apply their knowledge to

Complex network of interconnected food chains within an ecosystem. Ecological pyramid: Graphical representation of the trophic structure and energy flow in an ecosystem.	b. Discuss how each type of pyramid is constructed and what it represents about the trophic structure of an ecosystem. c. Provide examples of ecological pyramids and guide students in interpreting the patterns of energy transfer and trophic levels. **Activity (10 minutes):** • Divide students into small groups. • Provide each group with a worksheet containing scenarios or case studies of local ecosystems. • Instruct students to identify and construct food chains and webs based on the given scenarios, and to create ecological pyramids (numbers, biomass, and energy) for each ecosystem. • Encourage groups to discuss their findings and present their analyses to the class. **Assessment:** • Define food chains, food webs	analyse and interpret ecosystem data in future lessons or outdoor explorations. **Homework:** Students can be assigned a homework task to research a specific ecosystem and create a detailed food web and ecological pyramid for that ecosystem. They can also explore case studies or articles on human disturbances to ecosystems and analyse the resulting impacts on food chains, food webs, and ecological pyramids. Additionally, students can conduct field observations or

	• Differentiate between food chains and food webs. • Explain the flow of energy and matter through ecosystems. • Apply methods to determine food chains and food webs in your local ecosystem.	experiments to collect data on local ecosystems and apply their knowledge of ecological concepts to interpret their findings.

Weekly Learning Planner

Subject: Biology		**Week:** 5		**Duration:** 60 minutes	**Form:** Year 2
Strand	Interactions in Nature		**Sub-Strand**	Biological Associations	
Content Standard	Demonstrate understanding of concept of symbiosis: Symbiotic relationships: Mutualism, Parasitism, Saprophytism, and Epiphytism				
Learning Indicators	2.3.1 The students will be able to explain the concept of symbiosis 2.3.2 Identify the different symbiotic relationships				
Performance Indicators	By the end of this lesson, students will be able to: 1. Define symbiosis and identify different types of symbiotic relationships. 2. Describe examples of mutualism, parasitism, saprophytism, and epiphytism found in various ecosystems. 3. Analyse the ecological significance of symbiotic relationships in maintaining ecosystem balance.				
Core Competencies	Critical Thinking, Communication and Collaboration, Personal Development and Leadership				

Materials	1. Pictures or diagrams illustrating symbiotic relationships 2. Worksheets or handouts for note-taking and activities 3. Examples of organisms involved in symbiotic relationships 4. Video clips or interactive simulations (optional)	
Starter **(10 minutes)**	**Main Activities** **(40 minutes)**	**Conclusion** **(10 minutes)**
Engage students with a short video clip or image of a symbiotic relationship in nature. Initiate a class discussion by asking students to share what they know about symbiosis and its importance in ecosystems.	**Main Content (30 minutes):** • **Understanding Symbiotic Relationships (15 minutes):** a. Define symbiosis as a close and long-term interaction between different species living together. b. Explain the four main types of symbiotic relationships: - Mutualism: Both species benefit from the interaction. - Parasitism: One species benefits at the expense of the other. - Saprophytism: One species feed on dead or decaying matter. - Epiphytism: One species lives on the surface of another without harming it. c. Provide examples and illustrations to help students understand each type of relationship. • **Exploring Examples of Symbiosis (15 minutes):**	Summarize the key points covered in the lesson, emphasizing the diversity and importance of symbiotic relationships in ecosystems. Discuss how symbiotic interactions contribute to ecosystem stability and biodiversity. Encourage students to continue exploring examples of symbiosis in their environment and to

Introduce the objectives of the lesson and explain that they will explore different types of symbiotic relationships.	a. Present case studies or examples of symbiotic relationships found in different ecosystems, such as coral reefs, rainforests, or grasslands. b. Divide students into small groups and assign each group a specific type of symbiotic relationship to research. c. Instruct students to identify examples of their assigned type of symbiosis and describe the interactions between the organisms involved. d. Encourage groups to present their findings to the class, discussing the ecological roles and significance of each type of symbiotic relationship. **Activity (10 minutes):** • Distribute worksheets or handouts containing scenarios or case studies of symbiotic relationships. • Instruct students to analyse each scenario and determine the type of symbiotic relationship depicted. • Encourage students to explain their reasoning and discuss their answers with	consider the implications of human activities on these relationships. **Homework:** Students can be assigned a homework task to research specific examples of symbiotic relationships in their local environment. They can create presentations, posters, or written reports detailing the ecological significance of these relationships and their role in ecosystem dynamics. Additionally, students

	their peers. **Assessment:** • Define symbiosis • Identify different types of symbiotic relationships. • Describe examples of mutualism, parasitism, saprophytism, and epiphytism found in various ecosystems. • Elaborate the ecological significance of symbiotic relationships in maintaining ecosystem balance.	can explore how changes in environmental conditions or human activities may impact symbiotic interactions and propose strategies for promoting symbiosis in conservation efforts.

Week 6

Post test administration and conclusions

Reference: Elective Biology syllabus page 18 – 19 (MOE, 2010)

Unit 1 – basic concepts in Ecology

Unit 2 – study of specific habitats (aquatic and terrestrial, biotic and abiotic factors, food chains and food webs, ecological pyramids)

Unit 3 – biological associations (symbiosis, mutualism, parasitism, epiphytism)

Appendix VII: Ethical Approval

Kwame Nkrumah University of Science and Technology, Kumasi

College of Health Sciences
SCHOOL OF MEDICINE AND DENTISTRY

COMMITTEE ON HUMAN RESEARCH, PUBLICATION AND ETHICS

Our Ref: CHRPE/AP/077/25

31st January, 2025

Miss Anita Asantewaa Appiah-Adjei
Akenten Appiah-Menka University of
Skills, Training, and Entrepreneurial
Development.

Dear Madam,

LETTER OF APPROVAL

Protocol Title:	***"Effect of Context-Based Approach on Students' Academic Performance in Ecology in Senior High Schools."***
Proposed Site:	***Senior High Schools in Atwima Nwabiagya Municipality (Nkawie, Toase, Barekese).***
Sponsor:	***Self-Sponsored.***
Student:	Miss Anita Asantewaa Appiah-Adjei ***Supervisor:*** Dr. Charles Amoah Agyei

Your submission to the Committee on Human Research, Publications, and Ethics on the above-named protocol refer.

The Committee reviewed the following documents:

- A notification letter of 10th January, 2025 from the Ghana Education Service, Atwima Nwabiagya (study site) indicating approval for the conduct of the study at the Schools.
- A Completed CHRPE Application Form.
- Participant Information Leaflet and Consent Form.
- Research Protocol.
- Questionnaire and Interview guide.

The Committee has considered the ethical merit of your submission and approved the protocol. The approval is for one year, renewable after that, from **31st January 2025 to 30th January 2026**. The Committee may, however, suspend or withdraw ethical approval at any time if your study is found to contravene the approved protocol.

Data gathered for the study should be used for the approved purposes only. Permission should be sought from the Committee if any amendment to the protocol or use, other than submitted, is made of your research data.

The Committee should be notified of the actual start date of the project and would expect a report on your study, annually or at the close of the project, whichever one comes first. It should also be informed of any publication arising from the study.

Thank you for your application.

Yours faithfully,

Rev. Prof. John Appiah-Poku.
Honorary Secretary
FOR: CHAIRMAN

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