

From Theory to Real Life: Elevating Biology Students' Performance in Ecology with Context-Based Learning

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Citation: Appiah-Adjei, A A, Agyei A. C, Gyamfi M (2025) From Theory to Real Life: Elevating Biology Students' Performance in Ecology with Context-Based Learning. American J Sci Edu Re: AJSER-248.

Received Date: 03 June, 2025; **Accepted Date:** 09 June, 2025; **Published Date:** 16 June, 2025

Abstract

This study investigated the effectiveness of context-based teaching and learning approach on the academic performance of senior high school biology 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 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 with the context-based approach performed better in ecology than those taught using the conventional approach. The study also explored students' views and found that the context-based 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, the study recommends that biology teachers enhance their skills in linking lessons to real-world experiences by using local, real-life objects as teaching aids. In-service training programs, seminars, and workshops should be organized to equip teachers with these strategies to improve student performance in ecology.

Keywords: Context-based, teaching approach, Ecology, Student achievement.

1. Introduction

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 student engagement, comprehension, and retention, thereby fostering a more profound educational

experience. Teaching methods can broadly be categorized into two types: teacher-centered methods and student-centered methods.

In teacher-centered methods, the teacher assumes the central position as 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-centered 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 (Bennett & Holman, 2002).

Conventional teaching methods, which are predominantly content-focused, continue to dominate classrooms in senior high schools (Duch et al., 2001). 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-centered 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). This approach aims to foster and maintain a sense of awe and inquisitiveness in young individuals toward the natural world (Stolk et al., 2009). 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. This has necessitated the need for this study.

2. Research Questions

The following research questions are set to guide the study:

- What is the difference in academic performance in ecology of students taught using context-based approach and those taught using the conventional approach?
- What are the views of students on context-based approach after their experience in the ecology classroom?

3. Literature Review

3.1. 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).

3.2. 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. 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 as "Ecology. The undoubted interest that youngsters have in living things is at once an 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 (WASSCE), 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.

3.3. 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.

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-centered 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).

4. Methodology

This study adopted 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).

Table 1: Results of Independent Samples T-Test on The Pre-Test Scores in Ecology of Students Taught 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 1 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 =

This study adopted a mixed-methods approach, which combines qualitative and quantitative methodologies to collect and analyse data (Creswell & Tashakkori, 2007).

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.

The study sample included 187 students, consisting of 127 males and 60 females from four purposively selected senior high schools.

5. Results

Difference in Academic Performance in Ecology between Students Taught Using Context-Based Approach and Those Taught Using the Conventional 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. There were no breaches in the preliminary assumption tests for normality, linearity, homogeneity of variance.

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 1 and 2.

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 2: Results of Independent Samples T-Test on The Post-Test Scores in Ecology of Students Taught 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 2 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) indicates a substantial impact of the context-based approach on student performance (Cohen, 2011). 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.

Views of Students on Features of the Context-based Teaching Approach in Ecology

The second objective explored the views of students on the use of context-based approach to teach them ecology. 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 an ecology class taught using a 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:

Student 1: "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."

Student 2: "Group projects and discussions are great. They allow us to share ideas and learn from each other, enhancing our understanding."

Student 3: "Interactive learning keeps me engaged and is a welcome change from conventional lecture-based teaching."

Student 4: "I found myself looking forward to each class because we were always discussing something that felt relevant to my life."

Student 5: "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"

Student 6: "The context-based approach makes learning more interactive as I enjoy the connections we make between ecology and other subjects."

Student 7: "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:

Student 8: "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."

Student 9: "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."

Student 10: "This approach makes the lessons relevant to our daily lives, which helps me see the importance of what we're

learning; case studies and real-world examples are engaging and show the practical side of what we're learning."

Student 11: "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."

Student 12: "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."

Student 13: "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."

Student 14: "Addressing current environmental issues in class helps me feel connected to global and local ecological concerns."

6. Discussion

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 2). The results in Table 2 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 & 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, favoring the experimental group. Bacay & 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 botany 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 Second research question explored the views of students on the context-based teaching approach after experiencing it through ecology lessons. 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.

Implication of the Study

First of all, the study demonstrated that the context-based teaching approach significantly improves students' academic performance in ecology. This finding suggests that educators should integrate real-world scenarios and hands-on experiences into their teaching strategies to facilitate better understanding and retention of concepts.

Moreover, the research highlights that student taught through the context-based approach exhibited higher engagement levels, participation, and enthusiasm. This suggests that active learning methods, such as discussions, group projects, and real-life applications, should be emphasized in teaching ecology and other science subjects.

Also, the study underscores the need for curriculum developers to incorporate context-based approaches in senior high school science curricula. The success of this approach in improving student performance supports the argument for revising traditional, lecture-based teaching methods in favor of more interactive, student-centered learning experiences.

Again, the study found that students exposed to the context-based approach developed a heightened interest in ecology and environmental issues. This implies that making science education more relevant to real-life environmental challenges can inspire students to pursue careers in ecology, conservation, and related fields.

Nonetheless, the findings suggest that integrating practical applications into ecology lessons can help students grasp abstract scientific concepts more effectively. This highlights the importance of experiential learning and field-based activities in science education.

Lastly, the study provides a foundation for further research into the application of context-based learning in other scientific disciplines. Future studies could explore how this approach affects students with different learning abilities, backgrounds, and interests

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Appendix I: 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**
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?
- mango tree
 - water-lily**
 - tadpole
 - orange tree
6. Which of the following is an example of food chain in an abandoned farmland
- Grass → bacteria → fish
 - Fish → tad pole → sand
 - Grass → Grasshopper → lizard → snake**
 - Weed → insect → snake → human
7. A low and wet land habitat representing a transition between aquatic and terrestrial habitat
- marsh land**
 - brackish
 - forest
 - desert
8. Which of the following animals cannot be found in river habitat?
- lizard**
 - tad pole
 - king fisher
 - fish.
9. Which of the following organisms cannot be found in both abandoned farm land and mountain habitats?
- rats
 - maize plants**
 - birds
 - insects
10. What is the name of an instrument for the measuring of transparency of water
- hydrometer**
 - Secchi disk
 - thermometer
 - rain gauge
11. Which of the following animals cannot be found in rivers habitat?
- Frogs
 - monkeys**
 - insects
 - king fisher
12. Which of the following living organism cannot be found in river habitat?
- Elephant grasses
 - toad
 - crabs
 - rodents**
13. The functional role of an organism in a given habitat is described as termed
- niche**
 - biomass
 - hydrosphere
 - atmosphere
14. Which of the following is not a characteristic of marsh habitat?
- Soil is soft making difficult for big animal to move
 - The vegetation is mostly dominated by grasses
 - It has little or no salt in them.
 - The contents of mineral salt are high**
15. Which of the following organisms cannot be found in ponds?
- scorpions**
 - spirogyra

- mosquitoes
 - water lettuce
16. What is the name of an instrument for measuring temperature?
- thermometer**
 - rain gauge
 - hygrometer
 - anemometer
17. The following are characteristics of hill habitat except
- the water is stagnant
 - it is a solid mass of intrusive igneous rock**
 - it is a natural flow of water that continues in a long line across
 - land to the sea/ocean,
18. What is the name of an instrument for measuring relative humidity?
- thermometer
 - rain gauge
 - hygrometer**
 - wind vane
19. Ponds, rivers, lake seas and ocean are grouped together as
- ecosystem
 - marine habitat
 - aquatic habitat**
 - terrestrial habitat
20. The instrument for measuring light intensity is called
- hygrometer
 - light meter**
 - wind vane
 - barometer

SECTION B (50 marks). Answer all questions

- What is a habitat? (2 marks)
 - Explain briefly energy flow in a freshwater habitat (8 marks)
- What is trophic level? (2 marks)
 - Explain briefly the relationship between three examples of symbiotic organisms (6 marks)
- Explain briefly three roles of a decomposer in an ecosystem (6 marks)
- Mention three roles of decomposers on a refuse dump (6 marks)
 - List three materials found in a refuse dump which would not be affected by the action of decomposers (3 marks)
- A pond at the back of a school hostel containing living organisms was abandoned for some time.
 - List two abiotic factors that would affect the organisms in the pond (2 marks)
 - Name the instrument that could be used to collect large animals found in the pond (1 mark)
 - State two benefits of the pond to the school and the environment (2 marks)
 - 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

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