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Learning Biology Beyond the Classroom: The Role of Farms, Wetlands, and Markets in Senior High Schools in the Effutu Municipality

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Abstract: The aim of teaching the subject of biology is to enable students to perceive the living systems in their day-to-day socioeconomic environments. Nonetheless, the teaching in most high schools is still mostly classroom and textbook-based and does not offer students the opportunity to relate the abstract concepts of biology with the real world. This paper explored the importance of farms, wetlands, and local markets as natural learning classrooms in the development of biological concepts among senior high school students in the Effutu Municipality, Ghana. The study was based on Experiential Learning Theory, Constructivism, and Place-Based Education; its design was a convergent parallel mixed-methods approach. A structured questionnaire was used to gather quantitative data about the 100 biology students based on their exposure to outdoor learning environments and their conceptual knowledge, and a semi-structured interview was used to generate qualitative data on 16 biology teachers. The quantitative data were analysed through descriptive statistics, and the qualitative data were analysed in the form of a theme. The results have shown that the students indicated improvement in their knowledge regarding plant development, animal rearing, environmental interactions, and human environment relationships when learning activities were done in farms, wetlands and marketplaces. Teachers also saw these environments as having pedagogical value in enhancing student engagement, motivation and understanding of concepts. Nevertheless, the size of the classes and the insufficient time for instruction, safety, and institutional support limited the regular integration of outdoor learning. There was no significant barrier to the willingness of the community to host school visits. The paper concludes that the underutilised but valuable pedagogical resources include farms, wetlands, and markets and suggests specific institutional support, flexibility of the curriculum, and professional growth of teachers to maintain place-based experiential learning of biology.

Keywords: Field learning, experiential biology learning, farm learning, wetlands learning and contextual learning.

1. Introduction and background

The goal of education in biology is to provide learners with a way to make sense of the living world they experience in everyday life, that is, food systems and farms, wetlands and waterways, and marketplaces where ecological and agricultural processes intersect with human livelihoods. However, in most settings, school biology remains highly confined to classrooms and textbooks, presented in an abstract form rather than learning about actual locations, activities, and issues. This disconnection does not allow students to view biology as perceptually relevant to their personal lives and to pressing socio-ecological issues, and causes disengagement and attrition in science, especially in students with underrepresented backgrounds (Beltran et al., 2020; Estrada et al., 2018; Kay et al., 2022).

Reform in biology and Life Sciences education internationally has focused on active, experiential, and situational learning that views students as agents instead of people taking in information (Byars-Winston et al., 2020; Lorenzetti et al., 2020). An increasing range of literature has shown that extracurricular learning (in the form of field courses, place-based learning, and community-engaged learning) can enhance conceptual knowledge, improve scientific proficiency, and promote motivation and perseverance in biology (Beltran et al., 2020; Fleischner et al., 2017; Jeronen et al., 2017). When linked to local problems, cultural traditions, and the sense of place of students themselves, outdoor and non-school settings in particular are especially potent (Sukhontapatipak & Srikosamatara, 2012; Williamson et al., 2023a). The same can be applied to experimental learning studies in the field of Life Sciences, where it was found that generic skills and the ability to understand concepts better are improved when learners are allowed to connect their classroom theory with the experience they acquire in a setting beyond the classroom (McAlexander et al., 2024).

Field courses and outdoor elements are time-bound, resource-limited, and institution-focused, and opportunities to engage the community in any formal biology programs are still uncommon (Fleischner et al., 2017; Kay et al., 2022). A documented shift in teacher education has been to abstract, molecular notions of life, and thus, the future teacher is left without much experience of local environments as the place of inquiry and exploration (Entress, 2023). Researchers thus suggest that the understanding of the field of biology education should be consciously extended to encompass not just relatively undisturbed environments but also human-made landscapes and community spaces like farms, markets, and urban green spaces (Fleischner et al., 2017; Kay et al., 2022; Kervinen et al., 2020). This is in line with the systems-thinking methodologies that theorize biology as the study of nested interacting human and nonhuman systems, and wider goals of science education to equip students as knowledgeable, self-reflective agents of socio-ecological transformation (Momsen et al., 2022; Williamson et al., 2023a).

These international issues are combined with critical local environmental and educational issues within Africa and Ghana. Livelihoods, food security, and culture revolve around agriculture, wetlands, and coastal environments; however, most of these systems are experiencing stress due to unsustainable land use, pollution, and climate change (Tsurkan & Unguryan, 2025). When the teaching process is based on local landscapes and community experiences, place-based and transgressive pedagogies in Ghana have been demonstrated to change students' attitudes to environmental stewardship and climate action (Tsurkan & Unguryan, 2025). Simultaneously, experiential and environmental education research in the context of African schools demonstrates that, despite the importance of contextual and environment-based education, teachers have difficulty with limited time, resources, training, and institutional support (Kramer-Simpson, 2018). It is therefore understood that there is a necessity to shift towards more contextual and

experiential education that builds upon local culture, settings, and sustenance, in contrast to the mostly text-based and classroom-based education (Shlieina & Zimonova, 2025).
These tensions are illustrated in the Effutu Municipality of the Central Region of Ghana. The municipality has fertile agricultural lands, local markets, and ecologically important wetlands like the Muni-Pomadze area, which sustains the biodiversity, fisheries, agriculture, and the cultural practices. However, such ecosystems are affected by practices like intensive farming, harvesting of fuel wood, bush fires, and uncontrolled exploitation of resources, and people are not aware of ecological processes, biodiversity conservation, and sustainability (Sukhontapatipak & Srikosamatara, 2012), used here as an analogy of wetland-based livelihoods. Senior high school students in Effutu live in direct proximity to farms, wetlands, and markets, but official biology instruction in most Ghanaian schools is still based largely on textbook-based and examination-driven models, which fail to systematically exploit these local settings as instructional resources.

This scenario creates a distinct issue, which requires an empirical study. The biological concepts that are in the focus of the senior high school curriculum of biology, which include plant growth and reproduction, soil and nutrient cycle, animal husbandry, food chains and webs, and ecological interactions, can be directly observed in the farms, wetlands, and markets surrounding Effutu students. But these are the mundane settings that are yet to be pedagogically exploited, and very little information is available concerning the way and the magnitude to which they are being employed to facilitate learning of biology in the municipality. What is more, very little is known regarding the perception of farms, wetlands, and markets as educational resources by teachers, as well as regarding the challenges encountered by teachers in utilizing them in the teaching process. In the absence of it, the chances to make biology more topical and involving, to empower students' knowledge on those concepts crucial in the subject, and the promotion of the values of environmental stewardship and socio-ecological responsibility can be overlooked in a community where the local natural resources are directly relied upon.
It is on this global-local background that the current study, which is entitled Learning Biology Beyond the Classroom: The Role of Farms, Wetlands, and Markets in Senior High Schools in the Effutu Municipality, explores the possibility of the three interrelated situations described as authentic learning environments in the teaching of biology. The research paper is devoted to the degree to which the farm-, wetland-, and local-market-based learning activities are useful in promoting knowledge of the biological concepts among the students and the realities which teachers face in trying to utilize those environments. In particular, the following objectives guide the study: (1) To determine how effective farm-based learning activities, wetlands, and local markets are in terms of enhancing the knowledge of the students on some biological concepts, including plant growth, animal husbandry, and ecological interactions. (2) To determine the views of teachers about the farms, wetlands, and markets in biology instruction and the challenges they face.

2. Literature

2.1 Farm-based learning and understanding of biological concepts

The farm setting has become a significant learning laboratory in biology, especially with regard to plant development, animal rearing, and the operation of agroecosystems. In a pilot study that compared lessons on biology taught on a farm and taught in school, the levels of subject-matter knowledge remained similar in both education settings over time, meaning that there was no negative impact of farm-based teaching on cognitive outcomes, and the method has other socio-emotional and motivational advantages (Malariková et al., 2023). Interviews and subsequent analyses indicate that veritable situations can enable

learners to develop more substantial and lasting knowledge when activities are placed in actual agricultural activities like animal husbandry and crop farming (Malariková et al., 2023).

It is demonstrated that place-based experiential learning in campus farms can transform the sense of place and pro-environmentalism, and incorporates biological knowledge with food systems and sustainability themes (Williamson et al., 2023a). Likewise, participatory organic farming on campus improves the understanding of sustainable agriculture among students, critical thinking, and environmental management, which attests to the importance of farm-based learning as a pedagogical approach to learning about plant development and agroecosystem well-being (Yenti & Fitri, 2022). These results are directly related to the primary objective of the research work, as they suggest that farm-based activities can be effective in promoting conceptual knowledge and provide an additional affective and ethical layer.

2.2 Wetland-Based Learning and Ecological Understanding

Wetlands provide especially fruitful instructional possibilities on the ecological interactions, ecosystem services, and conservation biology. Undergraduate students' Action research involving campus wetlands has demonstrated that the intensive field training enhances general knowledge about ecological concepts like food webs, habitat functions, and human-environment interactions, and also forms values/ attitudes towards local wetlands (Sukhontapatipak & Srikosamatara, 2012). Through the direct investigation of wetland biota and processes by involving students in the exercise, cognitive learning is combined with an affective and ethical aspect of environmental responsibility.

Recent studies in the Huaper wetland show how experiential environmental education based on constructivist principles can help cultivate ecological knowledge and support sustainable behaviours by students and members of the community (Cardenas Morales et al., 2025). The immersive activities to evaluate the biophysical conditions, analyze anthropogenic stresses, as well as community partnerships, contribute to the whole learning process regarding the ecological relationships and ecosystem services. There is complementary evidence of on-site instruction being more beneficial in terms of cognitive outcomes and enabling emotional attachment to the environments than classroom instruction, although it might be limited by the logistical conditions of time and weather (Jeronen et al., 2017). All of this literature makes the recommendation that wetlands are potent environments for meeting the first research objective, and in particular, regarding ecological interactions and conservation.

2.3 Markets, Agrobiodiversity, and Everyday Biology Learning

Local markets are being recognized as key places where the intersection of biodiversity, agriculture, and human livelihoods occurs, and thus as a possible context in which to learn biology. The local market studies of agro biodiversity-rich areas indicate that they serve as sources of diversity of plants and access to seeds and propagules, and thus help in conserving food plant resources in situ and offer a hands-on experience of plant variation, domestication, and propagation (Akpınarlı & Akaydın, 2024). The use of ethno-botanical studies in community markets shows that local vegetables are economically, culturally, and medically important, and the diversity of local vegetables can be utilised to explain the concepts of biodiversity, adaptation, and sustainable horticultural practices concepts (Malariková et al., 2023).

The results of the findings are in line with a wider set of recommendations to incorporate local wisdom and community practices in the learning of biology as a way of rendering the content more contextual and supportive of Education for Sustainable Development (Hidayat et al., 2024). By using the resources that are found locally in ways that incorporate food systems and the market, students will be able to connect concepts in

biology with those of plants, diets, and livelihoods that students already know about, and a better comprehension of plant growth, plant diversity, and the interactions between humans and their environment can be gained.

3. Theoretical framework

The paper is based on the Experiential Learning Theory, Constructivism, and Place-Based Education. The combination of Experiential Learning Theory, Constructivism, and Place-Based Education is explained by the fact that outdoor biology learning is multidimensional, i.e. it involves experience, cognition and context at the same time. Experiential Learning Theory is a process theory that gives an explanation of how students can convert the concrete experience with biological phenomena into abstract knowledge. Constructivism adds to this by explaining how learners make sense of these experiences based on prior knowledge, social interaction, and cultural sense-making. Place-Based Education also elaborates this structure by locating learning in the context of known local spaces, which connects biological knowledge with the realities of the students and the ecosystems of the communities. When applied together, these theories can provide a consistent analytical frame explaining not only the mechanism of learning but also the rationale and location of why outdoor environments can be considered effective pedagogical spaces in teaching biology.

Experiential Learning Theory, as described by Kolb, is based on the idea that knowledge is formed in the process of transformation of experience through the cycles of concrete experience, reflective observation, abstract conceptualization, and active experimentation. Constructivist approaches underline the fact that learners actively make meaning by tying new experiences to previous knowledge against social and cultural backgrounds. Environmental education based on wetlands and community engagement directly involves constructivist principles, where practical exploration, discussion, and cooperative inquiry facilitate the building of ecological knowledge and the development of sustainable behaviour (Cardenas Morales et al., 2025; Sukhontapatipak & Srikosamatara, 2012).

Place-based education offers a complementary prism, which emphasizes the pedagogical importance of local settings and local practices as the context of education. Students are engaged in farms, wetlands, and markets as interrelated socio-ecological systems where they get to learn about the biological concepts and create a sense of place, responsibility, and agency (Villalobos-Chávez & Niño-Gutiérrez, 2025; Williamson et al., 2023a).

4. Research design and methods

4.1 Research approach and design

This research used a convergent parallel mixed-methods design in which quantitative and qualitative data were gathered simultaneously, analysed independently, and later integrated during interpretation. This design was considered appropriate because it enabled the complementary examination of students' learning outcomes and teachers' perceptions within a single temporal framework (McCrudden et al., 2019).

4.2 Population and Sampling

The target population included all the biology teachers and students in four senior high schools in the Effutu Municipality: Uncle Rich Senior High School, Zion Girls Senior High School, Winneba Senior High School, and Pearl College. The total number of biology teachers was 16, with the distributions of 2, 1, 12, and 1, respectively, and the total number of biology students was 100, with the distributions of 36, 10, 50, and 4, respectively.

Since the teacher population was small and accessible, the quantitative teacher component was sampled by census, meaning that all 16 biology teachers were selected, fully covering perspectives and eliminating sampling error at the teacher level. There were 100 biology students across all four schools; hence, all 100 (36, 10, 50, and 4 students from the respective schools) were included in the study.

In the qualitative strand, purposeful sampling was used to recruit teacher participants who had plenty of information to be explored in depth to understand perceptions and challenges. Of these 16 biology teachers, all participated in the interviews, with a purposive emphasis on those with varied teaching experience and prior exposure to outdoor learning contexts. The criteria of selection were that there should be diversification in the teaching experience, type of school, and previous (or non) use of farms, wetlands or markets in instruction.

Two principal instruments were used to collect data in accordance with the two strands. In the case of the quantitative student component, a structured questionnaire was created which included the section of demographic information, the exposure to the learning activities related to farms, wetlands, and local markets and the measures of the knowledge on the main biological concepts. Items were statements of a Likert scale on the perceived contribution of these environments to learning, and objective items measuring conceptual understanding. In the case of the teacher component, a semi-structured interview guide was created to provide an idea of the perceived educational value of such non-classroom contexts, concrete instances of their application or non-application, and the perceived logistical, curricular or institutional barriers.

4.3 Research Instruments

The quality of instruments was considered with the help of validation and reliability testing in line with the principles of mixed methods, which underline the need to focus on quantitative reliability, as well as on qualitative reliability and trustworthiness (McCrudden et al., 2019; Warfa, 2016). The content validity of the questionnaire and interview guide was achieved through expert review by two university lecturers in the field of biology, and one seasoned senior high school biology teacher, who reviewed the instruments to ensure that they are appropriate to the research objective and that the research question is clear and understandable in the context of Ghana. Feedback from the reviewers informed minor revisions to item wording and alignment with the study objectives before final administration. The pilot data were analysed to calculate internal consistency with the help of Cronbach's alpha; the reliability coefficient derived was 0.79.

The methods of quantitative data collection were the administration of the validated questionnaire to all 100 students who study biology at regular class hours, with the same schedule to minimise the administrative bias. Qualitative data were collected through the use of individual semi-structured interviews with all 16 biology teachers. The interviews were carried out in the quiet corners of the schools, the tapes were audio-taped with consent, and the interviews were complemented by some field notes where the observations in the context could be made. The simultaneous data collection of quantitative and qualitative types is in line with the convergent parallel designs logic, which attempts to compare both strands of data collection as snapshots of the identical phenomenon (Adhikari & Timsina, 2024; Gierus et al., 2025).

4.4 Data analysis

The student questionnaires were coded and entered into a statistical Package for the Social Sciences (SPSS version 24) for quantitative analysis. Students' exposure to farm-, wetland-, and market-based learning activities, along with their conceptual levels of understanding, were summarized using descriptive statistics (frequencies, percentages, means, and standard deviations) given the exploratory focus of the study.

Teacher interviews were transcribed verbatim and thematically analysed. Initially, the open coding was employed to establish frequent concepts associated with the perceived value of education, direct practices, opportunities, and challenges in utilizing the farms, wetlands and markets. Groups of codes were then formed, and some larger themes were created that reflected trends across schools, including the institutional constraints, alignment of curriculum, safety issues, and perceived benefit to students. Theme development was refined through iterative comparison across transcripts to ensure consistency and coherence. The convergence and divergence between teachers were also considered, which is consistent with the recommendations that qualitative strands in a mixed methods study should be analysed systematically and transparently (McCrudden et al., 2019; Zhou et al., 2024).

At the interpretation phase, quantitative and qualitative results were integrated, in accordance with the principles of the convergent parallel design and established mixed-methods integration procedures (Fetters, Curry and Creswell, 2013, Adhikari & Timsina, 2024; Zhou et al., 2024). The quantitative patterns of the reported non-classroom environment and the level of understanding among students were compared with the qualitative themes of practices and challenges of teachers. The convergence areas (eg, strong student support of farm-based learning) and divergence areas (ex, students reported little exposure even when teachers indicated that they valued such situations) were also imposed to produce more refined meta-inferences. This integrative procedure is representative of the logic of triangulation of mixed methods research, since the joint application of approaches is likely to result in a deeper understanding that can be acquired through both strands separately (McCrudden et al., 2019; Turner et al., 2017; Warfa, 2016).

4.5 Ethical Considerations

Ethical principles were met in accordance with the general recommendations of mixed methods and educational research. Ethical approval of data collection was obtained before data collection, and consent was granted by the concerned institutional ethics committee, the Ghana Education Service and the school authorities. Written informed consent was obtained from all the teacher participants. In the case of students, parents or guardians consent was obtained, and student assent was secured, as the participants were minors. The involvement was voluntary, and the participants were made to understand they had the right to pull out at any time without a penalty. Anonymity and confidentiality were guaranteed using codes to identify schools, teachers and students and keeping the data secure. Results were presented in aggregate or anonymized form, and pains were made to ensure that individuals and schools were not identified. Another objective of the study was to avoid as much disruption to the teaching and learning process as possible, so the data was collected at times that were agreed upon by the school authorities and teachers. Such processes will be aligned with ethical and quality requirements of mixed methods research in education, which focuses on respecting participants, being transparent and avoiding harm (Warfa, 2016).

5. Findings

5.1 Research Question 1: To what extent do farm-based learning activities, wetlands, and local markets enhance students' understanding of biological concepts such as plant growth, animal husbandry, and ecological interactions? To address this research question, a questionnaire was administered to teachers in selected schools, and the results were analysed in Table 1and 2

Table 1: Students' responses on how wetlands, farms, and markets enhance understanding of biological concepts

Statement	1	2	3	4	5
Visiting farms has helped me understand plant growth better.	5(5%)	12(12%)	18(18%)	40(40%)	25(25%)
Activities in wetlands have improved my understanding of ecological interactions.	6(6%)	16(16%)	23(23%)	32(32%)	23(23%)
Going to local markets helps me see how animal and plant products relate to biology lessons.	4(6%)	14(14%)	22(22%)	30(30%)	30(30%)
Learning outside the classroom (farms, wetlands, markets) makes biology concepts easier to remember.	3(3%)	10(10%)	27(27%)	36(36%)	26(26%)
After farm or market visits, I can explain biological concepts better to my classmates.	6(6%)	15(15%)	25(25%)	32(32%)	23(23%)
Wetland visits have helped me understand human impacts on ecosystems.	7(7%)	18(18%)	20(20%)	30(30%)	26(26%)
I feel more interested in biology when we learn in farms, wetlands or markets.	4(4%)	11(11%)	20(20%)	33(33%)	32(32%)
Field activities (farms, wetlands, markets) help me connect biology to real life.	3(3%)	9(9%)	18(18%)	34(34%)	36(36%)

Source: Field data, 2025 **1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree*

The results provided in Table 1 indicate that overall, students have a positive disposition toward using farms, wetlands, and local markets as a setting to learn the biological concepts. In each item, the pattern of responses depicts a definite concentration in the higher category of the Likert scale, which implies that a high percentage of the students felt that an out-of-classroom learning setting was useful to their learning of biology.

In the case of farm-based learning, an apparent majority of students said that learning about plant growth was reinforced by attending farms. Although a comparatively low percentage of the respondents showed disagreement or uncertainty, almost two out of every three of the students showed agreement or strong agreement. This distribution indicates that first-hand exposure to agricultural practices was highly viewed as increasing the understanding of the process of plant growth. The same can be said about the wetland activities, where over 50% of the respondents said that they learned more about ecological interactions through such activities, even though there is a moderate percentage of neutral answers. The general trend is that of a favourable tendency to wetlands as a good field to study ecology-related concepts.

The answers to the questions about the visits to local markets by students also support this positive tendency. A large proportion of the people noted that market experiences assisted them in associating animal and plant products with biology classes, with a very small number of students showing differences. This indicates that markets were constructive spaces where biological knowledge could be connected with the common economic and social activities. The statistics also show that there are positive attitudes concerning the capacity of students to explain the biological concepts after visits to the farm and market.

More than half of the respondents responded with agreement or strong agreement, and it is possible to suppose that field-based experiences can contribute to the development of confidence and clarity in expressing biological ideas among students. On the same note, the students rated the learning of human effects on the ecosystems positively, and most of them credited the visits to the wetlands with their awareness of the environmental interaction. Even though the neutrality and disagreement were also expressed by some students, the general distribution is still biased towards agreement.

Lastly, students indicated that they had a great interest and felt it was relevant when they learned biology in farms, wetlands and markets. An apparent majority reported heightened interest in biology within such a state of learning, and the greatest positive response pattern was reported relating biology to real life. The fact that the majority of responses were concentrated in the agreement and strong agreement categories means that the field activities were highly viewed as effective in the aspect of aligning theoretical biological concepts with real-life contexts.

Table 2: Teachers' responses on how wetlands, farms, and markets enhance students' understanding of biological concepts

Statement	1	2	3	4	5
Farm-based activities enhance students' understanding of plant growth and physiology.	1(6.3%)	1(6.3%)	3(18.8%)	6(37.6%)	5(31.3%)
Wetland visits are effective for teaching ecological interactions and environmental change.	1(6.3%)	2(12.6%)	3(18.8%)	5(31.3%)	5(31.3%)
Local markets provide useful examples for animal husbandry and food chains.	1(6.3%)	2(12.5%)	3(18.8%)	5(31.3%)	5(31.3%)
Students retain biology concepts longer when taught through farms, wetlands, or markets.	1(6.3%)	2(12.5%)	4(25.0%)	5(31.3%)	4(25.0%)
Learning in real environments increases students' engagement and motivation in biology.	0(0%)	1(6.3%)	2(12.5%)	6(37.5%)	7(43.8%)

Source: Field Data, 2025 **1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree*

Table 2 data show that teachers had rather positive views concerning the effectiveness of farms, wetlands, and local markets in improving the knowledge of biological concepts in students. In all the items, the responses are mainly in the agreement and strong agreement options, which shows a general professional understanding of the pedagogical merit of real-life learning settings.

Teachers strongly agreed that learning in real environments enhances student engagement and motivation.

The qualitative data were aggregated based on open-ended feedback made by students and teachers to share the results of the quantitative data. Three themes were obtained in a systematic coding and thematic analysis. These themes reflect collectives of experiences and insights into how learning activities based in a farm, visits to wetlands, and exposure to local markets contribute to the students' understanding of biological concepts, including

plant growth, animal husbandry and ecological interactions. When describing these findings, clear connections are drawn between the narratives and the excerpts of the participants, which effectively point to how the voices of the students and teachers form a convergent way of describing the observed results.

Theme 1: Direct experience with Plants and Animal Farming.
The interpretation of the qualitative data indicates that the direct experience in farms and local markets helped the students to abandon rote learning and get a more tangible grasp of plant growth and animal husbandry. As scholars, we noted that subjects always associated the visual, tactile and contact with biological materials with a clearer idea. Students reported that the experience of seeing crops at various stages of growth and livestock management practices helped them to contextualize classroom teaching. Teachers enhanced this perception by arguing that these environments gave real-life examples that helped them understand some complicated biological processes.

One student related how growing up on a farm changed their perception of the growth of plants, saying, when we visited the farm, I was able to observe how the crops were planted, watered and weeded at various stages. This enabled me to comprehend what our teacher explained about the growth of plants. I am now able to visualize it during the classes.

Equally, one student pointed out the usefulness of farm learning by stating that the process of observing animals being fed and reproduced in the farm assisted me in grasping feeding and reproduction. It simplified the process of studying those topics in comparison to the textbook. Teachers also supported these student experiences. One teacher explained, Farm learning enables students to learn directly about the growth of plants and how to take care of animals. This real-life experience renders the concepts of biology more understandable when compared to the classroom explanations.

Theme 2: Intensified Ecological Interaction Familiarity with wetland experiences.

The results also reveal that the wetland visits were very effective in improving the knowledge of the students on ecological interactions and ecosystem dynamics. On the part of the researchers, wetlands acted as natural laboratories where the students could find interdependence between organisms, environmental conditions and human actions. The students always associated these observations with their better comprehension of food chains, ecosystems, and environmental change. On the same note, teachers also pointed out that wetlands offered tangible ecology teaching contexts.

One of the students was able to comment on this experience and said,
There were plants, insects, birds, and water interacting at the wetland. This made me realize the dependence of organisms on one another. The ecosystems were brought to a place of ease of understanding. I observed contaminated water and organisms which were struggling. It made the lesson real for me." The third student said, the ecology study at the wetland made me understand food chains more since I was able to see real-life examples. It was not as difficult as simply letting diagrams in a classroom.

5.2 Research Question 2: What are teachers' perceptions and challenges in integrating farms, wetlands, and markets into biology teaching? To address this research question, a questionnaire was administered to teachers in selected schools, and the results were analysed in Table 3

Table 3: Teachers' perceptions and challenges in integrating farms, wetlands, and markets into biology teaching

Statement	1	2	3	4	5
I feel confident planning lessons that use farms, wetlands, or markets.	1(6.3%)	3(18.8%)	4(25.0%)	5(3136%)	3(18.8%)
Large class sizes make it difficult to effectively use outdoor learning environments.	0(0%)	1(6.3%)	3(18.8%)	5(31.3%)	7(43.8%)
Our school has adequate resources and support for field-based biology learning.	4(25.0%)	5(31.5%)	3(18.8%)	3(18.8%)	1(6.3%)
I am concerned about student safety and liability during visits to farms or wetlands	0(0%)	2(12.5%)	3(16.8%)	6(37.5%)	5(31.3%)
Time constraints make it difficult to organize farm, wetland, or market visits.	0(0%)	1(6.3%)	2(12.5%)	7(43.8%)	6(37.5%)
Integrating farms, wetlands, and markets aligns well with the biology curriculum	1(6.3%)	3(18.8%)	4(25.0%)	5(31.3%)	3(18.8%)
Farmers and market women are not ready to receive our students	6(37.5%)	5(31.3%)	2(12.5%)	2(12.5%)	1(6.3%)
Managing students' safety during outdoor learning activities is challenging.	1(6.3%)	2(12.5%)	4(25.0%)	6(37.5%)	3(18.8%)
Local markets provide relevant real-life examples for teaching biology topics	1(6.3%)	1(6.3%)	3(18.8%)	5(31.5%)	6(37.5%)
Despite the challenges, I believe outdoor learning should be regularly integrated into biology teaching.	0(0%)	1(6.3%)	2(12.5%)	6(37.5%)	7(43.8%)

Source: Field Data, 2025 **1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree*

Teachers' responses regarding class size indicated a strong sense of the challenge. The vast proportion of respondents expressed their agreement or strong agreement on the fact that in large classes, outdoor learning environments prove challenging to utilize, citing 75.1% of the answers.

In terms of institutional resources and support, there was a negative response. The majority of teachers (56.5%) did not agree or strongly disagreed that their schools had sufficient resources and support to learn field-based biology. Conversely, the proportion of those who agreed or strongly agreed is only 25.1 with 18.8% of those who were neutral. In a cumulative result, 68.8 percent of teachers said that they were concerned with safety and liability issues and primarily agreed or strongly agreed, whilst a smaller number said that they were neutral or disagreed. This means that safety concerns are a significant attribute contributing to the likelihood of teachers planning outdoor learning activities.

Time limitations were also highly felt as an integration inhibitor. A large proportion of teachers (81.3) concurred that they were visited to farms, wetlands or markets, but due to a lack of time, this proved hard to arrange. The number of those who did not agree or were neutral was very few, which also demonstrates the omnipresence of time-related issues in the school setting.

The responses to curriculum alignment had a more balanced distribution of responses from teachers. Two out of every five respondents (50.1% said yes, or yes strongly), agreed that integrating farms, wetlands, and markets is compatible with the biology curriculum, but every fourth (25) of the respondents said that the curriculum is neutral on the subject, and a quarter (25.1%) of the respondents said that the curriculum should not be changed. This implies an average level of acknowledgement of the compatibility of the curricula, with a certain degree of doubt among the teachers.

The answers to the question of whether farmers and market women are willing to accept students were mostly negative. The percentage of the teachers who disagreed or strongly disagreed with the statement is 68.8%, which shows that a majority of the teachers did not consider the community stakeholders to be uncooperative. It was only a minor percentage that was in agreement with 12.5% being neutral, implying that the readiness of the stakeholders may not be a significant limitation to the majority of the respondents.

Student safety management in outdoor learning activities was also found to be a challenge, as 56.3% of the teachers agreed or strongly agreed that it is hard to manage. Every fourth of the respondents was neutral, and proportionately fewer did not agree that safety management was an issue of concern to many teachers, but not everyone considered it to be problematic.

The instructional relation of teachers to local markets was very favorable. Most of the respondents (69.0%) agreed or strongly agreed that local markets are pertinent real-life examples in teaching biology subjects.

Last but not least, there were positive feelings expressed by teachers towards outdoor learning in spite of the identified range of challenges. Most of the respondents (81.3) responded by agreeing and strongly agreeing that outdoor learning should be incorporated into teaching biology regularly. The opinions of very few teachers were not favourable and neutral, which can be seen as the fact that the methods of experiential learning are highly professionally supported in teaching biology.

6. Discussion of findings

The findings of the current study extend beyond presenting the perceptions of the participants through analytical illustrations on how farm, wetlands and local market learning serve as an important process of enhancing the knowledge of the students on the biological matters. The accumulating quantitative and qualitative evidences show that these place-based learning settings not only promote content knowledge but are also active in promoting conceptual integration, contextual reasoning, and long-term retention of the biological ideas. Notably, the research has shown that various structural and pedagogical issues that teachers mention, including the lack of institutional support, inflexible curriculum, and pressure on assessment, are not accidental issues but rather significant determinants of the sustainability and stability of the experiential biology instruction. The observable learning outcomes allow for connecting the professional perceptions of teachers to the results, which makes the findings align with the literature on experimental and place-based science education by empirically illustrating the role of contextual learning spaces in mediating the relationship between pedagogy and student cognition. Therefore, the given study contributes to the existing knowledge by explaining why the experiences and the limitations of the teachers are relevant: they directly affect the depth, quality, and continuity of the real-world biological learning of students.

Across the student data, the consistently high levels of agreement recorded with reference to farm-based, wetland, and market learning suggest that these settings are very important in converting abstract biological concepts into concrete, meaningful knowledge. This trend is supportive of constructivist and experiential approaches to learning, which suggest a deeper set of knowledge developed through the prism of real-life experience and placed in practical contexts (Sukhontapatipak & Srikosamatara, 2012; Turner et al., 2017). The reported gains in the understanding of plant growth, animal husbandry, and ecological interactions by the students are indicators that the exposure of students to real biological processes can help them change their concept because of the ability to bridge the gap between theoretical teaching and the phenomena that are observed. This outcome can also be seen in recent studies on biology education that show that outdoor and community-based learning experiences can be used to increase conceptual clarity and decrease misconceptions in life sciences (Mapulanga & Bwalya, 2024).

The reactions of teachers greatly support the views of students, especially in how well experiential learning is instructional in improving understanding, engagement, and motivation. The fact that farm-based activities, wetland visits, and market-based examples are significantly endorsed by teachers is a sign that, as professionals, they recognize these environments as effective pedagogical practices. The alignment of student and teacher views is what makes the findings valid and consistent with the recent international findings that suggest that teachers are increasingly supportive of inquiry-based and outdoor science learning (Susanto et al., 2023). The high consensus among educators that real environment learning enhances engagement is a clear indication of the motivational advantages experienced by students, and therefore, it can be argued that there is a common perception of the pedagogical value of such strategies.

Nevertheless, the results also show a crucial conflict between the positive norms of teachers and the real challenges that teachers encounter in practice in implementing experiential learning. Although they acknowledged the importance of outdoor learning, most of the teachers cited time and large classes, as well as limited resources and the safety and liability issues. Such difficulties are thoroughly known in the literature and are systematic challenges to the ubiquity of field-based science education (Saensouk et al., 2025). The dominance of time and the large size of classes in the results indicates a possibility that the aspects of the school system structure could limit the ability of teachers to turn pedagogic beliefs into practice, although professional commitment is strong.

Interestingly, the data indicate that the readiness of the community, in this regard, the willingness of farmers and market women to accept students, was not seen as a significant obstacle. This discovery contradicts expectations that local communities are hard to engage with schools and instead highlights the underutilized opportunities in the school-community partnerships in the area of biology education. The findings of recent place-based education studies demonstrate the significance of capitalizing on the community assets and local knowledge to enhance the process of learning science, especially in settings in which official access to laboratory resources is scarce (Dwindahari & I Gede Astawan, 2025; Sukhontapatipak & Srikosamatara, 2012). The perceived transparency of stakeholders in the community in the current research work indicates that the institutional and logistical constraints of schools could be a more limiting factor than the external community variables.

Although these issues were found, the teachers were very much in support of the frequent incorporation of outdoor learning in teaching biology. With this commitment comes a definite adherence to Experiential Learning Theory, since teachers consider direct interaction with natural environments an essential part of worthwhile biological knowledge. Based on the Constructivist viewpoint, outdoor learning was viewed as a way through which learners could construct knowledge actively by observing, asking, and reflecting on it as opposed to passively receiving it. Also, the focus on learning in local

contexts is consistent with the Place-Based Education approach, which strengthens the contextually relevant and responsive biology education. The results put experiential outdoor learning in the centre stage, rather than a peripheral practice targeting the core of the biology instruction and the modern objectives of sustainability education and environmental literacy (Dwindahari & I Gede Astawan, 2025)

7. Conclusion

The study aimed to investigate how much farm-based learning activities, wetlands, and local markets benefit the knowledge of students in biological concepts and also assess teachers' views and issues in incorporating these settings in the teaching of biology. Based on the quantitative and qualitative data, the results indicate that learning outside the classroom contributes greatly to the overall learning process of biology, as the abstract theory is identified in real-life situations.

The findings suggest that students see the outdoor and community-based learning settings as potent means of comprehending plant growth, ecological interactions, animal production, and human-environment interrelations. The field visit to farms allowed students to see the plant and animal systems at first hand, thus reinforcing the idea of conceptual learning and memory. Wetlands were also used to offer real-world settings in which to study ecological relationships, biodiversity and anthropogenic effects on the ecosystem and local markets to enable students relate biological knowledge to food systems, livelihood and daily activities. In these settings, learners reported being more interested, better able to explain these ideas to their colleagues, and having a stronger biological-real-life linkage.

On the teachers' side, the research found strong professional support for outdoor learning as a biology learning methodology. To a significant extent, teachers agreed that real-life settings do improve the interest of students, their motivation, and the long-term memorization of the material. Notably, educators also identified the correspondence between farm-, wetland-, and market-based learning and the biology curriculum, indicating that these strategies are not peripheral to the formal curriculum, but rather the sound approach to the pedagogical process.

Notwithstanding these positive perceptions, the research has revealed that there have been ongoing issues that limit successful implementation. The large size of the classes, lack of sufficient time to instruct, the issue of safety and liability, and the lack of resources in the institutions were some of the key inhibitors. Although the majority of the teachers did not believe that community stakeholders, including farmers and market women, were pleased with the concept of learning activities, the logistical issues of organizing and supervising students' extracurricular to the classroom were still a factor of concern. These issues reflect the apparent disconnect between the pedagogical belief and the realities of the situation in which biology is taught by teachers.

Finally, the research confirms that extracurricular learning of biology can have significant opportunities to enrich the background knowledge, increase the value and relevance of the biological concepts and foster a valuable interaction with the subject. The effectiveness and sustainability of such approaches, however, lie in response to systemic, institutional and professional constraints. The incorporation

of farms, wetlands, and markets into biology education will probably not become part of the routine without specific encouragement.

8. Recommendations

Based on the findings of the study, the following recommendations were made.
Education authorities and the school administrations should offer systematic assistance in assimilating farms, wetlands as well as regional markets into the instruction of biology. This involves the incorporation of time in the school timetable to do field-based, provision of simple logistical backup and the creation of unmistakable guidelines to accommodate safe and productive outdoor education.
Biology teachers should be arranged in targeted professional development programs to enhance their ability to plan, manage, and assess outdoor and community-based learning activities. These programs must target the design of lessons, alignment of curriculum, risk management, and proper utilisation of local environments as the instruments of instruction.
The schools are advised to enhance partnership with the local farmers, wetland managers and market stakeholders to enable them have easy and systematic access to these learning landscapes. The formation of organised school-community alliances will make experiential biology learning more sustainable and facilitate contextualization of biological learning.

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