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Place-Based Inquiry Teaching Approach: Effects on Grade 8 Students' Conceptual Understanding and Interest in Biology

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ABSTRACT

This study examined the effects of a Place-Based Inquiry Teaching Approach on Grade 8 students' conceptual understanding and interest in Biology at Senior High School. A mixed-method, quasi-experimental design was employed with 30 students assigned to control and experimental groups. Quantitative data were collected using a researcher-developed Biology Conceptual Understanding Test and an adapted Biology Interest Questionnaire, complemented by reflective journals and interviews. Results showed substantially greater gains in conceptual understanding for the experimental group than the control group, with statistically significant differences in post-test scores and mean gains. Although initial interest differed between groups, post-intervention analyses indicated comparable interest levels, suggesting that place-based inquiry helped sustain students' motivation. Thematic analysis revealed that students viewed place-based inquiry lessons as more meaningful, engaging, and connected to their daily lives and local community. These findings support place-based inquiry as a promising strategy for advancing Sustainable Development Goals on quality school science education.

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1. INTRODUCTION

The Place-based inquiry teaching approach is an innovative teaching approach that connects educational experiences to the students' local environment, culture, and community while fostering active learning and critical thinking. This approach is a blend of inquiry and place-based education, which encourages students to do educational activities and explorations outside the classroom through the process of inquiry learning. The idea of this approach is grounded that learning should extend beyond classroom walls and give importance to using local resources and socio-cultural context as an essential component of the learning process.

The approach of Place-based inquiry in teaching and learning maximized the students' involvement in constructing knowledge with practical experiences in the real world. Students take an active role as researchers, problem solvers, and critical thinkers, and explore real-world issues within the local community. Students in this setting are engaged in their community, work collaboratively with their peers and community members to investigate problems in society through inquiry skills, to prepare their understanding of the environment, and to work on solutions to the existing problems. Meanwhile, the teachers serve as facilitators and designers of learning experiences that encourage exploration and critical thinking rather than simply delivering the content. Teachers assist students in connecting what they learn to the local context and guide them to make a meaningful discovery.

In modern education, it often neglects to embrace the importance of the place where the study is situated, which results in abstract learning. Also, research has shown that despite the Philippine government's initiatives to localize the science curriculum, it still faces a persistent challenge. Many learners find it difficult to grasp complex biological concepts due to a lack of contextual relevance and limited opportunities for practical and real-world application (Montero & Geducos, 2023). Additionally, students encountering a wide range of biological concepts have difficulty conceptualizing, since most of these processes are not visible to the naked eye. Many students find it challenging to connect biological concepts to real-life situations, which makes the subject irrelevant to them. It indicates that when a student views Biology as unrelated to their daily experiences, their interest in lessons tends to decrease.

Moreover, science education in the Philippines is facing a dilemma, as shown in the low achievement scores of students in the recent results released by the Programme for International Students Assessment (PISA) 2023. Filipino students continuously exhibit low proficiency in math, science, and reading. According to the data, the Philippines ranked 79th out of 81 participating countries in science. The average science score for Filipino students was 356, which is significantly below the OECD average of 485. Engaging in more meaningful learning activities can improve students' knowledge acquisition (Saro *et al*., 2023). They demonstrated that localized and contextualized learning experiences play a significant role in improving the conceptual understanding of the students.

Despite the continuous efforts to improve science education, significant challenges remain in students' conceptual understanding of the subject. Hence, the researcher aimed to explore the use and benefits of the place-based inquiry approach as a potential solution to address the gap. The objective of this study is to investigate the effects of the Place-Based Inquiry Teaching Approach on the Grade 8 students of MSU – Tamparan Community High School, specifically in terms of their conceptual understanding and interest in Biology. This study aims to determine how Place-Based Inquiry Learning influences students' comprehension of biological concepts and their engagement with the subject. Specifically, it seeks to answer the following questions: (1) Is there a significant difference between the control and experimental groups in their Conceptual Understanding Test (CUT) mean scores before and after the

intervention, as well as in their mean gain in Biology? (2) Is there a significant difference between the control and experimental groups in their interest level in Biology before and after the intervention? and (3) What are the students' perceptions regarding the use of the Place-Based Inquiry Teaching Approach in learning Biology?

2. METHODS

The study employed a mixed-method design that integrates both quantitative and qualitative approaches. For the quantitative part, a quasi-experimental design with a matched pretest–posttest control group was utilized to determine whether there were significant differences in the conceptual understanding and interest in Biology of the students before and after the intervention. The qualitative aspect, on the other hand, focused on analyzing the students' perceptions of the Place-based Inquiry Teaching Approach, which were drawn from their reflective journals, interviews, and the researcher's field notes.

The research was conducted at Mindanao State University – Tamparan Community High School (MSU–TCHS), located in Linuk, Tamparan, Lanao del Sur. The school was chosen as the study locale because of its suitability for exploring innovative teaching strategies in a resource-limited environment. With its lack of laboratory facilities, unstable electricity, and poor internet connectivity, the school presented an appropriate setting to assess how place-based inquiry can serve as an alternative teaching approach to improve students' learning experiences. The participants of the study were Grade 8 students from two sections, which are the sections Rizal and Bonifacio, with a total of 59 students composed of 17 males and 42 females, aged 12 to 15. Using their first quarter grades in science as the basis, 15 matched pairs of students were formed and randomly assigned to experimental and control groups through coin tossing. The experimental group was taught using the Place-based Inquiry Teaching Approach, while the control group was instructed through conventional teaching methods.

To gather the necessary data, several instruments were used. The Biology Conceptual Understanding Test (CUT), developed by the researcher, consisted of 91 multiple-choice questions and two open-ended items per topic, validated by experts, pilot-tested, and found reliable with a Cronbach's alpha of 0.817. The Biology Interest Questionnaire (BIQ), a 12-item, six-point Likert scale instrument, was also employed and showed a high reliability of 0.930. In addition, students in the experimental group kept reflective journals to document their insights after each lesson, while the researcher-maintained field notes to track observations of students' engagement and behaviours. Furthermore, guided interview questions were used in one-on-one interviews with randomly selected students, and their responses were transcribed and thematically analyzed to support the quantitative findings.

The data-gathering procedure was carried out in three phases: pre-intervention, intervention, and post-intervention. The pre-intervention phase involved securing permissions, validating instruments, conducting pilot testing, and administering pre-tests to both groups. During the seven-week intervention, the experimental group was exposed to outdoor, inquiry-driven lessons connected to the local community, while the control group received a conventional teaching approach using the same topics. In the post-intervention phase, both groups were given post-tests, followed by interviews and the collection of reflective journals for qualitative analysis.

For data analysis, descriptive statistics such as mean, frequency, percentage, and standard deviation were used to describe the students' scores. Inferential statistics, particularly the t-test for independent samples, were applied to determine the significant differences between the pre-test and post-test mean scores of the control and experimental groups. Thematic

analysis was also conducted to interpret the qualitative data and provide deeper insights into students' perceptions of the teaching approaches.

Moreover, ethical considerations were observed throughout the study. Permission to conduct the research was sought from school authorities, and informed consent was obtained from the students and their parents or guardians. Participants were assured of the confidentiality and anonymity of their responses, and their participation was voluntary, with the freedom to withdraw at any stage of the study without any negative consequences. These measures ensured that the research was conducted responsibly, with respect for the rights and well-being of the participants.

3. RESULTS AND DISCUSSION

3.1 Control and Experimental Groups of Students' Conceptual Understanding Levels in Biology Before and After the Intervention

To determine whether the variances of the control and experimental groups were comparable in terms of their conceptual understanding of the topic domains in biology before and after intervention, variance is needed before a t-test because it helps calculate the test statistic and ensures the assumptions for comparing group means are met. A t-test independent sample, was utilized to find out if there was a significant difference between the control and experimental groups of students' conceptual understanding test mean scores before and after intervention, as well as their mean scores. **Table 1** shows the result of the statistical tests.

Table 1. Levene's Test, t-test, and Significant (p) Values on the comparison of Control and Experimental Groups of Students' Conceptual Understanding Mean Score in biology before and after the intervention, and the main gain score.

Period	Group (n=15)	Levene's Test for equality of variances		Mean Score	SD	t-value	p-value
Before Intervention	Control	0.14	0.71	20.40	4.15	-.48	.63 (ns)
	Experimental			21.20	4.90		
After Intervention	Control	0.56	0.46	28.27	5.89	-4.85	.00 (s)
	Experimental			30.20	6.45		
Mean Gain Score	Control			7.87	7.15	-4.18	.00 (s)
	Experimental			18.00			

Note. Significant at the .05 level of significance

Before the intervention, both the control and experimental groups showed no significant difference in their conceptual understanding, as indicated by non-significant Levene's and t-test results. Their low and nearly identical mean pre-test scores confirmed that they started with similar baseline knowledge.After the intervention, the groups remained comparable in variance, but the posttest t-test showed a highly significant difference, with the experimental group performing much better than the control group. The experimental group's higher mean posttest score and substantially larger mean gain (18.00 vs. 7.87) indicate that the Place-based Inquiry teaching approach had a strong positive effect on students' conceptual understanding in Biology. These findings are supported by previous studies (Soares, 2022; Dorji *et al*., 2021; Blonder *et al*., 2023), which also report improved academic performance through contextual, hands-on inquiry learning. The meaningful, real-life contexts provided by Place-based Inquiry helped deepen students' engagement, promote critical thinking, and make biological concepts more concrete and relatable.

The results align with literature (Taylor *et al*., 2023; Tan *et al*., 2020; McDaniel *et al*., 2022; Evans *et al*., 2024), emphasizing that linking inquiry activities to local environments enhances comprehension, supports cognitive growth, and fosters equitable, student-centered learning. Overall, the intervention proved more effective than traditional teaching methods in improving conceptual understanding. The study's findings were validated by the responses of students from the experimental group. They were asked whether they believed that the Place-based Inquiry teaching approach played a role in improving their understanding of the subject matter. Based on the responses, both agreed that the Place-based Inquiry Teaching Approach improved their understanding and retention of biological concepts. They shared that before experiencing this approach, she struggled with science, particularly in biology. However, through activities and real-life experiences, it became clearer and easier to remember. Similarly to the second student who expressed that biology was initially difficult for her, especially understanding technical terms. By engaging in explorations such as visiting rice fields they were able to discover and learn independently, leading to a deeper comprehension of the lesson.

Based on the response, the improvement in understanding and retention of biological concepts was attributed not only to the Place-based inquiry teaching approach itself but also significantly to the teacher's role in introducing and applying the approach effectively. Research indicates that even the most innovative and well-designed teaching methods depend heavily on the teacher's ability to facilitate learning. The teacher acts as a mediator who bridges the gap between the instructional approach and the students' engagement with the content. In the case of the first student, the guidance helped transform the approach from a theoretical method into a practical, relatable experience, making complex biological concepts clearer and easier to remember. Without such effective delivery, even a promising teaching approach may fail to yield the desired learning outcomes. This highlights that the success of Place-based Inquiry learning relies not only on the method itself but also on the teacher's capacity to implement it meaningfully.

Correspondingly, the positive response from the subject participant in conceptual understanding among students in the experimental group may also be explained through the lens of environmental and pedagogical factors highlighted by The students' perception that learning improved once the teacher introduced the Place-based inquiry approach aligns with the previous findings (Dorji *et al*., 2021), who emphasized that grounding education in local contexts significantly enhances student engagement and understanding. They observed that when learning is connected to students' immediate environment and experiences, it becomes more relevant and meaningful, encouraging active participation. This shift from traditional teaching to a place-based inquiry model allows students to explore concepts first-hand, fostering deeper cognitive connections and greater enthusiasm for learning. Therefore, the students' reported improvement reflects how place-based inquiry learning creates an enriched educational experience by making science more accessible and relatable. Also, real-world experiences are crucial in making biological concepts more accessible, meaningful, and easier to retain for learners (Aidoo *et al*., 2022).

3.2 Comparison of Control and Experimental Groups of Students' Interest in Biology before and after the Intervention

Table 2 presents the results of the Mann-Whitney U Test used to determine if there was a significant difference in the students' interest in biology between the control and experimental groups before and after the implementation of the intervention.

Table 2. Mann-Whitney U test and (p) Values on the Comparison of Control and Experimental Groups of Students' Interest in Biology before and after Intervention.

Test	Period	Group	Mean rank	Test	p-value	Remarks
Mann-Whitney U Test	Before Intervention	Control	19.43	53.50	0.01	Significant
		Experimental	11.57			
	After Intervention	Control	16.67	95.00	0.43	Not significant
		Experimental	14.33			

Note. U=Mann- Whitney, significant at 0.05 level of significance

Before the intervention, the control group had a higher mean score (19.43) compared to the experimental group (11.57). The computed Mann Whitney (U=53.50) test yielded a p-value of 0.01 less than 0.05 level of significance. This indicates a statistically significant difference in students' interest in biology between the between the control and experimental groups prior to the intervention. Therefore, it can be inferred that the control group had significantly greater interest in biology than the experimental group before the intervention.

After the intervention, the mean score of the control and experimental groups were 16.67 and 14.33, respectively. Mann Whitney (U=95.00) test yielded a p-value of 0.43 which is greater than the 0.05 level of significance. It suggests that there was no statistically significant difference in students' interest in biology between the two groups after the intervention. The lack of a significant difference might mean that the students in both groups had similar levels of interest in biology after the intervention.

This seeming discrepancy can be better explained by previous studies (https://www.academia.edu/48854498/Teachers_Pedagogical_Approaches_and_Students_Learning_Interest_in_Science_A_Correlational_Study), which examined how teachers' instructional methods influence students' interest in learning science. The study highlighted that student interest is essential in building scientific competence and emphasized the importance of a supportive and engaging learning environment. Notably, the study suggested that a blend of traditional and interactive methods may be most effective in fostering student interest. The findings of his study help explain why the place-based inquiry approach may not have produced statistically significant changes. The implementation of an approach alone, especially in a limited timeframe, might not be sufficient to override established habits, assessment expectations, or the effects of previous instructional styles. Correspondingly, while the method enhances engagement by connecting learning to real-life contexts, traditional teaching still effectively maintains student interest (Sudirman, 2022). Thus, both methods foster positive interest, and a longer or blended approach may be needed to show clearer differences. Lastly, interest plays a key role in sparking curiosity and motivation, but true learning success requires a balance where interest initiates engagement, and structured, goal-oriented instruction sustains motivation and leads to lasting understanding. This suggests that while both teaching methods foster interest, combining curiosity with guided learning is essential for deeper, measurable outcomes.

However, even though the results showed no statistically significant difference between the two groups after the intervention, students in the experimental group still reported positive insights and favorable experiences regarding the use of the place-based inquiry approach. Their feedback highlighted increased engagement, a deeper connection to real-world biological concepts, and an enhanced appreciation for the relevance of biology to their local environment. These qualitative responses suggest that, despite the lack of measurable

statistical difference, the place-based inquiry method may have had a meaningful impact on students' perceptions and attitudes toward learning biology.

The responses of selected students indicate that the Place-based Inquiry Teaching Approach increased student engagement by connecting biology lessons to real-life, familiar contexts. The student appreciated interacting with community members, learned from observing outdoor food chains, and gained insights from analyzing traditional foods, highlighting the cultural and practical relevance of biological concepts.

In contrast, control group students expressed interest in biology but noted challenges with memorization and understanding, suggesting that clarity and hands-on experiences influence engagement. While statistical significance was not observed, the experimental group showed an upward trend in interest after the intervention, indicating potential benefits.These findings are supported by studies showing that situating learning in authentic, local contexts enhances motivation, engagement, and personal relevance, allowing students to connect concepts to real-life experiences rather than relying solely on memorization. Hands-on, experiential activities were especially effective in fostering meaningful learning and sustained interest.

3.3 Experimental Group of Students' Perception on the Use of Place-Based Inquiry in Teaching and Learning Biology

To gain a comprehensive understanding, the data were collected through multiple methods: 1) student journal writing; 2) individual interviews; and 3) researcher observations in the classroom. Analysis of these data revealed that most students expressed positive feelings about the place-based inquiry approach. This was evident in their journal entries, where they discussed their experiences, as well as in the one-on-one interviews, where they directly shared their opinions. Additionally, the researcher's observations in the classroom provided further support for these positive perceptions, as students actively participated in discussions and demonstrated enthusiasm for the subject matter.

Through thematic analysis, the researcher explored the perception of the students regarding the approach. **Table 3** shows the key points, the recurring patterns, and the themes of the participants' responses. The data came from the researcher's field notes, the transcribed interview between the researcher and the students, and the students' journal entries. **Table 3** shows that students perceived the Place-Based Inquiry Teaching Approach very positively. Three main themes emerged: (i) it provides a new, engaging, and memorable learning experience that improves understanding and retention; (ii) it allows students to observe, engage with, and connect lessons to real-life contexts; and (iii) it encourages active participation, collaboration, and idea-sharing. These findings indicate that students are more motivated and interested when learning is enjoyable, interactive, and relevant to their daily lives. These results are supported by prior studies and Lutheran Education Queensland, which emphasize that grounding learning in local contexts, hands-on experiences, and real-world connections enhances engagement, conceptual understanding, and critical thinking. Overall, the Place-Based Inquiry Approach effectively fosters student interest, active participation, and deeper learning in Biology.

Research indicates that the Place-Based Inquiry Teaching Approach enhances student learning by situating lessons within familiar community contexts, allowing students to apply concepts to real-world situations and improving both academic achievement and personal engagement (Webber *et al*., 2021). Scholars (Tan *et al*., 2020; Vančugovienė *et al*., 2024) emphasize that meaningful learning goes beyond memorization, as traditional lecture methods often lead to superficial understanding and misconceptions, particularly in complex science topics. Incorporating local contexts and hands-on inquiry helps students grasp difficult concepts, correct misunderstandings, and develop critical thinking.

Table 3. Recurring Patterns, Key Points, and Themes of the Experimental Group of Students' Responses about the Use of the Place-Based Inquiry Approach

Perception of the Experimental Group of Students	Key Points	Recurring Patterns	Themes
Transcribed Interview	"…the approach helped me understand the lesson more effectively. It was a new experience for me, which made it even more interesting…" "…I understand most of the topics very well because of PBITA. I think I experienced the concept firsthand, it made them easier to understand." "…our activities in the real world help me retain the information much better." "One positive aspect of learning Biology using place-based learning is that we get to experience the concepts firsthand."	"It makes biology more relatable, fun, and memorable... "It let me relate biology to real life… "It made me realize at that moment how fun learning biology is…" "I found it engaging and interesting. We explored local areas to learn biology, making them more relatable and memorable." "It helps me connect the topics to real-world examples." "…it makes the lesson connected to the real world. For example, when we study plants and animals in their habitats."	Place-Based Inquiry Teaching Approach is a new experience that allows firsthand experience for better understanding and retention of information. It is relatable, fun, engaging, interesting, and memorable.
Journal Entries	"It helps me because I understand our topic clearly because we had the chance to interview people around school…." "Bing immersed us in our local area, like giving us a chance to observe the food in the stores and at the end of the lesson she gave us a task to present our investigation through presenting a meal plan using Meranao foods." "It helps me to relate the lesson to the real-life situation because now I understand how plants grow taller..." "It helps me understand the lesson better because we have applied the concept."	"My local environment and surroundings help me understand the lesson very well especially when I see a person who doesn't eat nutritious food." "The local environment helped me better understand the topic of mitosis because we utilized it to observe the phases of mitosis in the onion root tip." "It helped me understand better because we were able to apply our lesson to a real-life scenario…" "It helped me understand the lesson better because we applied our skills to use a Punnett square in a real-life scenario."	The Place-Based Inquiry Teaching Approach allows the students to observe, engage, and immerse themselves in their surroundings. It helps them connect their lessons to the real world as well as apply these concepts to their real life.

The approach aligns with Kolb's Experiential Learning Theory, which emphasizes learning through concrete experiences, reflection, conceptualization, and active experimentation, and Piaget's Constructivist Theory, which views knowledge as built through interaction with the environment. Place-based inquiry challenges students' existing understanding, encourages cognitive growth, and strengthens connections to their community and environment.

Additionally, students express positive views on the interactive nature of the teaching and learning approach, highlighting its promotion of engagement, critical thinking, and a deeper

understanding of Biology concepts. Students use the opportunity that the Place-based inquiry teaching approach gives to collaborate with their peers, participate in discussions, and apply their knowledge to the real world.

Table 3 (continue). Recurring Patterns, Key Points, and Themes of the Experimental Group of Students' Responses about the Use of the Place-Based Inquiry Approach

Perception of the Experimental Group of Students	Key Points	Recurring Patterns	Themes
Field Notes	The students were highly participative during the activity. Upon returning inside the class, each group member shared their thoughts and contributed to answering the activity worksheet. Listening to their presentation and reading their journal showed that students were engaged in interviewing the vendors and the people (including students) around the school and observing the food …the students show interest in investigating the problems introduced in the lesson/activity. They actively engage in discussions, ask thoughtful questions, and collaborate with their members to complete the activity.	…most of the groups are collaborating and sharing ideas about the lesson in the local context. They exchanged insights on how the topic relates to their surroundings. At the end of the activity, students shared their findings and how they relate to their local community. Almost all students actively collaborated with their groups, discussing their observations and assisting one another in preparing root tips and using the microscope. Most of the students were able to relate their personal experiences and local environment in their reflections. Students connected the concept of cell division to their daily lives. This realization was significant because many students typically view biology as an abstract subject rather than something directly applicable to their own experiences.	The students are highly participative, contributing, expressive, engaging, and collaborative. Most importantly, they showed interest, readily exchanged ideas and insights, and related the lessons to their personal and daily life. This shows that they find the Place-Based Inquiry approach enjoyable.

4. CONCLUSION

The study concluded that the Place-based Inquiry Teaching Approach significantly enhanced students' conceptual understanding and interest in Biology compared to conventional teaching methods. Students taught through this approach not only performed better in conceptual tests but also showed greater motivation and engagement in lessons. Their positive perceptions highlighted that learning became more meaningful, interactive, and connected to real-life experiences. In light of these findings, it is recommended that teachers adopt place-based inquiry strategies to make science instruction more engaging and relevant. School administrators are encouraged to provide training and resources that will support the integration of this approach, while curriculum developers may consider incorporating it into the science curriculum. Future researchers are also advised to explore its application across different grade levels, subjects, and contexts to further validate its effectiveness.

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6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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