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Teachers' Pedagogical and Laboratory Practices in Biological Science: A Qualitative Study at Dinadiawan National High School

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Abstract

This qualitative study examined teachers' pedagogical and laboratory practices in the teaching of Biological Science at Dinadiawan National High School, focusing on how these practices influence the teaching-learning process. Anchored on the objectives of describing instructional strategies, examining laboratory integration, exploring learners' experiences, and identifying implementation challenges, the study employed a qualitative descriptive research design. Data were gathered through semi-structured interviews with Biological Science teachers and focus group discussions with learners selected through purposive sampling. Verbatim transcripts were analyzed using thematic analysis.

The findings revealed four major themes: learner-centered and inquiry-based pedagogical practices, laboratory-based instruction enhancing conceptual understanding, teacher facilitation and laboratory management supporting learning, and challenges in implementing effective pedagogical and laboratory practices. Teachers' use of questioning, discussions, and guided inquiry promoted active learner engagement, while laboratory activities such as experiments and specimen observation strengthened conceptual understanding by linking theory to practice. Teacher facilitation, including guidance, feedback, and safety supervision, was essential in scaffolding learners' cognitive and procedural skills. However, limited laboratory resources, time constraints, and large class sizes constrained the consistent implementation of hands-on laboratory activities. The study concludes that integrating learner-centered pedagogy with laboratory-based instruction enhances engagement and understanding in Biological Science. Sustained implementation requires institutional support to address contextual challenges in public secondary schools.

Keywords: *biological science education; pedagogical practices; laboratory instruction; inquiry-based learning; qualitative study*

Introduction

Biological Science education plays a crucial role in developing learners' scientific literacy, critical thinking, and understanding of life processes essential to personal, social, and environmental decision-making. At the secondary level, effective biology instruction requires not only sound pedagogical strategies but also meaningful laboratory experiences that allow learners to explore scientific concepts through observation, experimentation, and inquiry. The integration of classroom instruction and laboratory practice is therefore central to quality science education. Contemporary science education frameworks emphasize inquiry-based, learner-centered, and laboratory-supported instruction as essential for promoting conceptual understanding and engagement (National Research Council [NRC], 2012). Laboratory activities provide learners with opportunities to test hypotheses, manipulate variables, and connect theoretical knowledge to real-world biological phenomena. Teachers' pedagogical and laboratory practices significantly influence how learners experience biology as a discipline and how effectively they construct scientific understanding.

Despite these ideals, many public secondary schools face challenges in implementing effective laboratory-based biology instruction due to limited resources, time constraints, and varying levels of teacher preparation. In rural school contexts, these challenges are often intensified, affecting the consistency and quality of laboratory integration in classroom teaching. While several studies have examined science pedagogy broadly, fewer have focused specifically on how teachers enact pedagogical and laboratory practices in Biological Science within rural secondary schools.

This study was conducted to examine teachers' pedagogical and laboratory practices in Biological Science at Dinadiawan National High School. By exploring teachers' instructional approaches and learners' experiences, the study seeks to provide empirical insights into how pedagogy and laboratory work shape the teaching-learning process in biology and to identify challenges that affect effective implementation.

Research Objectives

This study aimed to examine teachers' pedagogical and laboratory practices in the teaching of Biological Science at Dinadiawan National High School. Specifically, it sought to:

1. Describe the pedagogical strategies employed by teachers in Biological Science instruction;
2. Examine how laboratory practices are integrated into biology teaching;
3. Explore learners' experiences of classroom and laboratory-based instruction; and
4. Identify challenges affecting the effective implementation of pedagogical and laboratory practices in Biological Science.

Methodology

The study employed a qualitative descriptive research design to capture in-depth perspectives on pedagogical and laboratory practices in Biological Science. This design was appropriate for examining participants' lived experiences and interpretations of instructional practices within their natural school context.

The participants included Biological Science teachers and junior high school learners at Dinadiawan National High School, Dipaculao, Aurora. Teachers were selected based on their direct involvement in teaching biology and managing laboratory activities, while learners were chosen from classes where laboratory instruction was regularly implemented. Purposive sampling was used to ensure that participants could provide relevant and rich information related to the study objectives.

Data were collected through semi-structured interviews with teachers and focus group discussions (FGDs) with learners. Interview and discussion guides focused on instructional strategies, laboratory activities, classroom-laboratory integration, learner participation, and perceived challenges. All interviews and FGDs were conducted with informed consent, audio-recorded, and transcribed verbatim.

Thematic analysis was used to analyze the data, following the procedures of familiarization, coding, theme development, and interpretation. Trustworthiness was ensured through triangulation of data sources, member checking to validate interpretations, and peer debriefing to enhance credibility and rigor.

Results/Findings

Analysis of the data yielded four major themes that describe teachers' pedagogical and laboratory practices in Biological Science and their influence on the teaching-learning process.

Theme 1: Learner-Centered and Inquiry-Based Pedagogical Practices

Teachers reported employing learner-centered strategies such as questioning, group discussions, and guided inquiry to encourage active participation in biology lessons. Learners described classroom instruction as interactive, particularly when teachers prompted them to ask questions and explain biological processes in their own words.

One teacher shared, *"Mas naiintindihan ng mga bata ang biology kapag sila mismo ang nagtatanong at nagpapaliwanag."* A learner remarked, *"Mas nagiging interesting ang lesson kapag may discussion at hindi lang lecture."*

These responses indicate that learner-centered and inquiry-based pedagogy enhances engagement and conceptual understanding in Biological Science. By positioning learners as active participants in meaning-making, teachers foster deeper cognitive processing and curiosity, which are essential to scientific learning.

Theme 2: Laboratory-Based Instruction Enhancing Conceptual Understanding

Participants emphasized the importance of laboratory activities such as microscopy, specimen observation, and simple experiments in reinforcing classroom lessons. Teachers explained that laboratory work helped learners visualize abstract biological concepts, while learners reported that experiments made lessons easier to understand. A teacher noted, *"Kapag may laboratory, mas malinaw sa kanila ang lesson kasi nakikita at nagagawa nila."* A learner stated, *"Mas natatandaan ko ang topic kapag may experiment."*

These findings suggest that laboratory-based instruction strengthens conceptual understanding by allowing learners to connect theory with practice. Hands-on experiences make abstract biological processes tangible, supporting meaningful learning and retention.

Theme 3: Teacher Facilitation and Laboratory Management Supporting Learning

Teachers highlighted their dual roles as instructors and facilitators of laboratory learning. They described providing step-by-step guidance, safety reminders, and feedback during laboratory activities. Learners expressed appreciation for teacher guidance, noting that it helped them perform tasks correctly and understand results.

One learner shared, *"Mahalaga ang guide ng teacher sa lab kasi minsan nalilito kami."* A teacher explained, *"Kailangan talagang bantayan at i-guide ang students para safe at tama ang ginagawa nila."*

Explanation

and

Interpretation:

This theme underscores the importance of teacher facilitation and effective laboratory management in supporting learning. Guided supervision and feedback scaffold learners' skills and understanding while ensuring safety and accuracy during laboratory work.

Theme 4: Challenges in Implementing Effective Pedagogical and Laboratory Practices

Despite positive practices, participants identified challenges such as limited laboratory equipment, insufficient time, and large class sizes. Teachers expressed difficulty in providing hands-on experiences to all learners due to resource constraints.

One teacher stated, *"Hindi lahat ng students ay nakakapag-hands-on dahil kulang ang kagamitan."* Learners also noted, *"Minsan group na lang kami kasi kulang ang materials."*

These challenges highlight how contextual and institutional constraints affect the consistent implementation of effective pedagogy and laboratory instruction. While teachers demonstrate commitment to quality teaching, adequate resources and structural support are necessary to sustain effective practices.

Discussions

The findings demonstrate that learner-centered pedagogy and laboratory-based instruction significantly enhance the teaching-learning process in Biological Science. Inquiry-oriented strategies and hands-on laboratory activities promote engagement, understanding, and scientific thinking, consistent with constructivist and inquiry-based science education frameworks (NRC, 2012; Bybee, 2013).

Teacher facilitation emerged as a critical factor in translating pedagogical and laboratory practices into meaningful learning experiences. Guided instruction, feedback, and effective laboratory management support learners' cognitive development and skill acquisition, aligning with studies emphasizing the teacher's role as a facilitator of inquiry (Hmelo-Silver et al., 2007).

However, the challenges identified reflect systemic issues commonly reported in public secondary schools, particularly in rural contexts. Limited resources and time constraints restrict the frequency and depth of laboratory experiences. Previous research underscores that sustained improvement in science instruction requires

institutional support, adequate resources, and curriculum flexibility (OECD, 2016).

Conclusions

This study concludes that teachers' pedagogical and laboratory practices play a vital role in shaping the teaching-learning process in Biological Science at Dinadiawan National High School. Learner-centered pedagogy, inquiry-based instruction, and laboratory integration enhance engagement and conceptual understanding. Addressing contextual challenges through institutional support is essential to sustaining effective biology education.

Implications of the Study

Pedagogical Implications:

Teachers are encouraged to sustain inquiry-based and learner-centered strategies while maximizing available laboratory resources.

School Leadership Implications:

School leaders may strengthen biology instruction by prioritizing laboratory resource provision and supportive scheduling.

Policy and Curriculum Implications:

Education policymakers and curriculum developers may emphasize laboratory integration as a core component of secondary biology education.

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