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Pedagogical Practices in the Teaching–Learning of Science: A Qualitative Study at Calabuanan National High School

¹ Edgar Allan R. Nortez

Northeastern College

Calabuanan National High School

Correspondence: edgarallan.nortez@deped.gov.ph

Abstract

Effective science instruction is central to the development of learners' scientific literacy, critical thinking, and problem-solving skills (Bybee, 2013). Pedagogical practices employed by teachers play a crucial role in shaping learners' engagement, conceptual understanding, and attitudes toward science (Hmelo-Silver et al., 2007). This qualitative study examined the pedagogical practices used in the teaching–learning of Science at Calabuanan National High School and explored how these practices influence learners' classroom engagement and learning experiences. Using a qualitative descriptive research design, data were gathered through semi-structured interviews with science teachers and focus group discussions with junior high school learners. Thematic analysis revealed four major themes: learner-centered and inquiry-based practices, contextualization and real-world connections, assessment practices supporting learning, and challenges in implementing innovative pedagogy. Findings indicate that participatory and inquiry-oriented strategies enhance learner engagement and conceptual understanding, while contextualized instruction supports meaningful learning (Prince & Felder, 2006). However, constraints such as time limitations, large class sizes, and limited resources affect consistent implementation. The study concludes that science teaching is most effective when inquiry-based and contextually grounded approaches are supported by institutional resources and professional development.

Keywords: *science education, pedagogical practices, inquiry-based learning, qualitative study, secondary education*



Introduction

Science education plays a vital role in preparing learners to understand the natural world, make informed decisions, and participate meaningfully in a scientifically driven society (National Research Council [NRC], 2012). At the secondary level, science instruction is expected to move beyond factual recall toward the development of inquiry skills, critical thinking, and scientific reasoning (Bybee, 2013). Pedagogical practices adopted by teachers significantly influence how learners engage with scientific concepts and how they construct understanding during the learning process (Furtak et al., 2012).

Contemporary science education emphasizes learner-centered and inquiry-based approaches, where students actively engage in investigations, discussions, and evidence-based reasoning (Hmelo-Silver et al., 2007). These approaches are grounded in constructivist learning theory, which views learning as an active process shaped by learners' prior knowledge and experiences (Vygotsky, 1978). Despite curricular reforms advocating inquiry-oriented pedagogy, studies indicate that many classrooms continue to rely on teacher-centered instruction due to contextual constraints (OECD, 2016).

Public secondary schools often face challenges related to class size, instructional time, and availability of laboratory resources, which affect the implementation of effective science pedagogy (Banilower et al., 2018). Understanding how teachers navigate these constraints and how learners experience science instruction is essential for improving teaching–learning processes. This study examined pedagogical practices in the teaching–learning of Science at Calabuanan National High School to contribute empirical insights into classroom-level science instruction.

Objectives of the Study

This study aimed to examine the pedagogical practices employed in the teaching–learning of Science at Calabuanan National High School. Specifically, it sought to describe the dominant instructional strategies used by science teachers, explore learners' experiences and perceptions of these practices, examine how pedagogical approaches influence learner engagement and understanding, and identify challenges encountered in implementing effective science teaching practices. These objectives align with research emphasizing the importance of classroom-level inquiry into science pedagogy and learner engagement (Furtak et al., 2012; NRC, 2012).

Methodology

The study employed a qualitative descriptive research design to capture in-depth perspectives on science teaching and learning practices. This approach was appropriate for exploring participants' experiences and interpretations within their natural classroom context (Creswell & Poth, 2018). Participants included science teachers and junior high school learners at Calabuanan National High School. Teachers were selected based on their active involvement in science instruction, while learners were chosen from classes that regularly engaged in experiments, discussions, and collaborative activities. Purposive sampling ensured that participants had direct experience with the phenomenon under investigation (Patton, 2015).

Data were collected through semi-structured interviews with science teachers and focus group discussions with learners. Interview guides focused on instructional strategies, classroom engagement, assessment practices, and challenges in science teaching. All sessions were conducted with informed consent, audio-recorded, and transcribed verbatim. Data analysis followed thematic analysis procedures involving coding, categorization, and synthesis of recurring patterns (Braun &



Clarke, 2006). Trustworthiness was ensured through triangulation, member checking, and peer debriefing, consistent with qualitative research standards (Lincoln & Guba, 1985)

Results/Findings

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

Teachers reported regularly employing learner-centered and inquiry-based strategies such as hands-on experiments, guided investigations, and probing questions to actively engage students in the learning process. These practices encouraged learners to explore scientific concepts, formulate explanations, and participate meaningfully in classroom discussions. Learners noted that inquiry-based activities made lessons more engaging and helped them understand concepts more clearly compared to purely lecture-based instruction.

Participant responses :

“Mas naiintindihan namin ang lesson kapag kami mismo ang gumagawa ng experiment.” P16

“Hindi agad binibigay ng teacher ang sagot, pinapaisip muna kami.” P18

“Mas active ang klase kapag may investigation o activity.” P3

These responses indicate that learner-centered and inquiry-based pedagogical practices promote active engagement by positioning learners as active participants in knowledge construction rather than passive recipients of information. Through experimentation and guided inquiry, learners are given opportunities to ask questions, test ideas, and draw conclusions based on evidence. This process supports deeper conceptual understanding and the development of scientific reasoning skills. The findings are consistent with inquiry-oriented science instruction, which emphasizes exploration, questioning, and sense-making as central to effective science learning (Hmelo-Silver et al., 2007; National Research Council [NRC], 2012). By allowing learners to construct knowledge through experience and reflection, inquiry-based practices foster meaningful and enduring learning.

Theme 2: Contextualization and Real-World Connections

Participants emphasized the use of real-life examples, local situations, and everyday experiences to explain scientific concepts. Teachers described relating lessons to familiar phenomena such as household processes, environmental issues, and community-based observations. Learners expressed that these connections helped them see the relevance of science in their daily lives.

Participant responses included:

“Inuugnay ng teacher ang science sa mga nangyayari sa paligid namin.” P7

“Mas madaling maintindihan kapag may example sa totoong buhay.” P11

“Nakikita namin na may silbi ang science sa araw-araw.” P16

These responses suggest that contextualized instruction enhances comprehension by making abstract scientific concepts more concrete and relatable. When learners can connect new information to their lived experiences, they are better able to understand, remember, and apply scientific ideas. Contextualization also increases learner interest and motivation by demonstrating the practical value of science beyond the classroom. This finding supports situated learning principles, which posit that knowledge is more effectively acquired when learning occurs within meaningful and authentic



contexts (Furtak et al., 2012). By situating science instruction within real-world contexts, teachers facilitate deeper understanding and sustained engagement.

Theme 3: Assessment Practices Supporting Learning

Teachers described using formative assessment practices such as performance tasks, group outputs, short quizzes, and ongoing feedback to monitor learners' understanding and guide instruction. Learners reported that these assessments helped them identify areas of strength and aspects that needed improvement, rather than simply measuring performance for grading purposes.

Participant responses :

“Hindi lang exam ang basis, may activities at outputs.” P9

“Malaki ang tulong ng feedback ng teacher.” P5

“Mas naiintindihan namin kung saan kami nagkamali.” P1

These responses indicate that formative assessment practices support learning by providing learners with timely and constructive feedback. Rather than focusing solely on summative outcomes, these assessment strategies encourage continuous improvement and reflection. Feedback allows learners to recognize misconceptions and refine their understanding, thereby supporting conceptual development. These findings align with formative assessment literature, which emphasizes the role of feedback in enhancing learning, motivation, and self-regulation (Black & Wiliam, 2009). When assessment is integrated into instruction, it becomes a tool for learning rather than merely an evaluation of learning.

Theme 4: Challenges in Implementing Effective Science Pedagogy

Despite the use of effective pedagogical practices, participants identified several challenges that affect the consistent implementation of inquiry-based science teaching. Teachers cited limited instructional time, large class sizes, and insufficient laboratory materials as major constraints. Learners also noted that limited resources sometimes restricted opportunities for hands-on activities.

Participant responses :

“Minsan kulang ang oras para sa experiment.” P2

“Mahirap mag-monitor kapag marami ang estudyante.” P7

“Hindi sapat ang gamit sa laboratory para sa lahat.” P10

These responses reflect systemic and institutional factors that influence science pedagogy. Time constraints and large class sizes limit opportunities for individualized instruction and in-depth inquiry, while inadequate resources restrict the frequency and quality of hands-on activities. These challenges highlight the need for institutional support, including adequate facilities, manageable class sizes, and sufficient instructional time, to sustain effective science teaching. Consistent with international findings, such constraints can hinder the full implementation of inquiry-based pedagogy, even when teachers are willing and capable of using innovative strategies (OECD, 2016).

Discussions



The findings demonstrate that learner-centered, inquiry-based, and contextualized pedagogical practices significantly enhance science learning by actively engaging students in the construction of knowledge and deepening their conceptual understanding. When learners are encouraged to ask questions, conduct investigations, analyze data, and discuss findings, they become more intellectually involved in the learning process. Such active engagement allows learners to develop scientific reasoning skills, connect prior knowledge with new concepts, and gain a clearer understanding of abstract scientific ideas. Contextualized instruction further strengthens this process by linking scientific concepts to real-life situations and everyday experiences, making learning more relevant, meaningful, and easier to comprehend.

These pedagogical practices align closely with established science education frameworks that emphasize active learning, inquiry, and learner participation as core principles of effective science instruction (Bybee, 2013; National Research Council [NRC], 2012). Inquiry-based approaches position learners as active investigators, while learner-centered strategies recognize students' experiences and perspectives as valuable resources for learning. However, despite their proven effectiveness, the findings also reveal persistent challenges that influence the consistent implementation of these practices. Contextual and institutional factors such as limited instructional time, large class sizes, and insufficient instructional resources often constrain teachers' ability to sustain inquiry-based and contextualized teaching. These challenges underscore the need for systemic support, including adequate resources, professional development, and supportive school policies, to ensure that effective science pedagogical practices can be consistently implemented and maintained.

Conclusions

This study concludes that science teaching at Calabuanan National High School is largely characterized by inquiry-based and learner-centered pedagogical practices that promote meaningful and active learning among students. Through strategies such as experiments, guided investigations, questioning, and collaborative activities, learners are provided opportunities to explore scientific concepts, construct understanding, and engage in higher-order thinking processes. These practices encourage learners to become active participants in the learning process rather than passive recipients of information, thereby strengthening their conceptual understanding and interest in science.

Furthermore, the use of contextualized instruction and formative assessment was found to play a significant role in enhancing learner engagement and comprehension. By relating scientific concepts to real-life situations and providing timely feedback through varied assessment strategies, teachers were able to make learning more relevant and responsive to learners' needs. However, the study also highlights the importance of addressing persistent challenges such as limited instructional time, large class sizes, and inadequate resources. Without adequate institutional support and resource provision, the sustainability and consistency of effective science pedagogy may be compromised. Addressing these challenges is therefore essential to strengthening inquiry-based teaching practices and ensuring high-quality science education.

Implications of the Study

The findings suggest that sustained and coordinated support for inquiry-based instruction is essential in strengthening the quality of science teaching and learning. While teachers demonstrate the use of learner-centered and inquiry-oriented strategies, the consistent and effective implementation of these practices requires ongoing institutional backing. This includes providing



adequate instructional time, reducing class sizes where possible, and ensuring access to appropriate laboratory facilities and learning materials. When teachers are supported with sufficient resources and conducive teaching conditions, they are better able to design meaningful inquiry activities that engage learners and deepen conceptual understanding.

In addition, continuous professional development for teachers is necessary to enhance pedagogical competence and confidence in implementing inquiry-based and contextualized science instruction. Professional learning opportunities such as workshops, mentoring, and collaborative lesson planning can help teachers refine their instructional strategies, integrate formative assessment effectively, and address challenges encountered in the classroom. Curriculum planners also play a critical role in strengthening science education by ensuring that science standards and learning competencies are closely aligned with actual classroom practices. Aligning curriculum goals with inquiry-based pedagogy and assessment practices supports quality instruction by providing teachers with clear guidance and flexibility to implement innovative teaching approaches that foster scientific literacy and meaningful learning experiences.

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Conflicts of Interests

The author declares no conflict of interest.

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