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RESEARCH ARTICLE

Scientific Inquiry and Concept Mastery in Grade 10: Teaching Practices in Junior High School Science at Eastern Potia National High School

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Abstract

Scientific inquiry is a core component of effective science education, fostering learners' conceptual understanding, critical thinking, and problem-solving skills. In the Philippine K-12 curriculum, Junior High School Science emphasizes inquiry-based learning to support meaningful concept mastery. However, implementing inquiry-oriented instruction in rural public schools presents unique challenges. This study examined the teaching practices employed in Grade 10 Science at Eastern Potia National High School, with particular focus on how scientific inquiry supports learners' concept mastery. Using a qualitative case study design, data were collected through semi-structured teacher interviews, classroom observations, and document analysis. Thematic analysis revealed two major themes: learner-related challenges affecting inquiry and concept mastery, and inquiry-oriented teaching practices adopted by science teachers. Findings indicate that while learners face difficulties related to prior knowledge gaps, limited resources, and low confidence in scientific reasoning, teachers employ adaptive inquiry strategies such as guided experimentation, contextualized activities, and scaffolded questioning to promote conceptual understanding. The study underscores the importance of sustained instructional support, teacher professional development, and context-responsive inquiry approaches to strengthen science learning in rural Junior High School settings.

Keywords: scientific inquiry, concept mastery, science education, Grade 10, rural schools, Philippines

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INTRODUCTION

Science education plays a vital role in developing learners' understanding of natural phenomena and their capacity for scientific reasoning. Contemporary science curricula emphasize scientific inquiry as a means of engaging learners in constructing knowledge through observation, experimentation, and evidence-based explanation. In the Philippine K–12 curriculum, inquiry-based learning is central to Junior High School Science, particularly in Grade 10 where learners are expected to demonstrate higher levels of conceptual understanding and analytical thinking. Despite curricular emphasis, translating inquiry-based pedagogy into classroom practice remains challenging, especially in rural public schools. Learners often enter higher grade levels with fragmented prior knowledge, limited exposure to laboratory activities, and low confidence in engaging with scientific concepts. Teachers, in turn, must navigate constraints related to instructional time, class size, and availability of laboratory resources.

Previous studies suggest that effective inquiry-based instruction enhances concept mastery when supported by structured guidance and contextual relevance (Bybee, 2014; Minner et al., 2010). However, limited research has examined how inquiry-based practices are implemented in rural Junior High School Science classrooms in the Philippine context. Understanding teachers' instructional practices and experiences is crucial for improving science teaching and learning in such settings.

This study addresses this gap by examining scientific inquiry and concept mastery in Grade 10 Science at Eastern Potia National High School. It aims to document teaching practices that support inquiry-based learning and explore how these practices contribute to learners' conceptual understanding.

Objectives of the Study

This study aimed to:

1. Identify the challenges encountered by Grade 10 learners in engaging with scientific inquiry and mastering science concepts.
2. Examine the teaching practices employed by science teachers to support scientific inquiry and concept mastery.
3. Explore how contextual factors in a rural Junior High School influence inquiry-based science instruction.

Methodology

Research Design

A qualitative case study design was employed to gain an in-depth understanding of scientific inquiry practices and concept mastery in a specific rural school context. This approach allowed for rich descriptions of teaching practices and classroom dynamics in Grade 10 Science.

Research Site and Participants

The study was conducted at Eastern Potia National High School, a rural public secondary school offering Junior High School programs. Participants included five Grade 10 Science teachers selected through purposive sampling based on their teaching experience and involvement in inquiry-based science instruction.

Data Collection

Data were gathered through semi-structured interviews, classroom observations, and document analysis. Interviews focused on teachers' perceptions of learner challenges, inquiry-based strategies, and instructional decision-making. Classroom observations documented inquiry activities, teacher–learner interactions, and learner engagement. Instructional documents such as lesson plans, activity sheets, and assessment tools were analyzed to triangulate findings.

Data Analysis

Data were analyzed using thematic analysis following Braun and Clarke's (2006) framework. Transcripts and observation notes were coded and organized into themes that captured patterns related to inquiry practices and concept mastery. Triangulation across data sources enhanced the credibility of the findings.

Results and Findings

Analysis of the data yielded two major thematic domains: learner challenges in scientific inquiry and instructional practices supporting concept mastery.

Theme 1: Learner Challenges in Scientific Inquiry and Concept Mastery

Teachers reported that many Grade 10 learners struggled with applying prior scientific knowledge during inquiry activities. Gaps in foundational concepts limited learners' ability to formulate hypotheses, interpret data, and explain results.

"Kapag experiment na, nahihirapan silang ipaliwanag kung bakit ganoon ang resulta." (Teacher 2)

Learners also exhibited low confidence in scientific reasoning, often relying heavily on teacher guidance rather than independent inquiry. Limited access to laboratory equipment further constrained opportunities for hands-on experimentation. These challenges reflect findings from previous research indicating that inquiry-based learning requires strong conceptual foundations and learner confidence (Minner et al., 2010). In rural contexts, resource limitations and cumulative learning gaps may hinder effective inquiry engagement.

Theme 2: Inquiry-Based Teaching Practices Supporting Concept Mastery

Teachers employed guided inquiry approaches to support learners' understanding. Activities were structured to gradually lead learners through observation, data collection, and explanation.

"Hindi puwedeng pabayaang lang. Kailangan may guide questions para maintindihan nila ang concept." (Teacher 4)

Contextualized experiments using locally available materials were commonly observed. Teachers also used probing questions and group discussions to help learners articulate scientific explanations. Guided inquiry aligns with research suggesting that structured support enhances conceptual understanding, especially for learners with limited prior experience (Bybee, 2014). Contextualized inquiry activities make science concepts more accessible and meaningful, reinforcing concept mastery.

Discussion

The findings demonstrate that scientific inquiry in Grade 10 Science is strongly influenced by the interplay between learner readiness and instructional adaptability. Learners' ability to engage meaningfully in inquiry activities is shaped by their prior conceptual knowledge, confidence in scientific reasoning, and familiarity with inquiry processes. Many learners enter Grade 10 with fragmented understanding of key scientific concepts, which limits their capacity to formulate hypotheses, interpret experimental results, and construct evidence-based explanations. These challenges are further compounded by low self-confidence, often manifested through hesitation to participate in discussions and reliance on teacher guidance during inquiry tasks.

In response, teachers actively employ guided and contextualized inquiry strategies to bridge learning gaps and sustain learner engagement. Rather than relying solely on open-ended inquiry, teachers deliberately integrate explicit instruction, step-by-step guidance, and probing questions to support learners' sense-making processes. This balanced approach reflects the instructional continuum between inquiry and direct teaching, which research identifies as particularly effective in promoting deep conceptual understanding, especially for learners with limited prior knowledge (Kirschner et al., 2006). By scaffolding inquiry activities and grounding them in familiar contexts, teachers help learners gradually develop scientific reasoning skills while strengthening concept mastery.

The study also highlights the critical role of teacher agency in adapting inquiry-based instruction within constrained rural contexts. Faced with limited laboratory equipment, large class sizes, and

time constraints, teachers demonstrate pedagogical creativity by improvising materials, designing locally relevant experiments, and modifying inquiry tasks to suit available resources. These adaptive practices reflect teachers' professional commitment to ensuring meaningful science learning despite structural limitations. Consistent with existing literature, such teacher agency is central to the successful implementation of inquiry-based instruction in resource-limited settings, as it enables educators to align curricular goals with contextual realities while maintaining a focus on developing learners' scientific thinking and conceptual understanding.

Conclusion

Scientific inquiry plays a pivotal role in fostering concept mastery among Grade 10 Science learners, particularly in developing their ability to understand scientific principles, apply evidence-based reasoning, and engage in problem-solving processes. The findings of this study revealed that although rural learners at Eastern Potia National High School face several challenges in learning science—such as limited prior scientific knowledge, inadequate exposure to inquiry-based activities during their earlier years of schooling, and difficulties in formulating hypotheses, interpreting data, and drawing evidence-based conclusions—teachers have demonstrated resilience and innovation in addressing these barriers through adaptive inquiry-based instructional practices.

The study found that teachers consistently employed guided experimentation as a strategy to help learners gradually develop scientific process skills. Rather than allowing students to conduct investigations independently from the outset, teachers provided structured guidance, step-by-step procedures, and continuous feedback to ensure that learners could successfully engage in scientific investigations. This approach enabled students to gain confidence in conducting experiments while developing a deeper understanding of scientific concepts through firsthand experiences. Furthermore, contextualized learning activities emerged as an essential practice in making science instruction meaningful and relevant to learners' everyday lives. Teachers connected scientific concepts to local agricultural practices, environmental issues, community experiences, and familiar phenomena within the rural setting, thereby enhancing student engagement and facilitating knowledge retention.

Another significant finding was the use of scaffolded questioning techniques to stimulate critical thinking and conceptual understanding. Through carefully sequenced questions, teachers encouraged learners to observe, analyze, predict, explain, and reflect on scientific phenomena. This instructional strategy helped bridge gaps in learners' prior knowledge while promoting active participation in the learning process. The combination of guided experimentation, contextualization, and scaffolded questioning created a supportive learning environment where students could gradually construct scientific understanding and overcome challenges associated with inquiry-based learning.

The findings further suggest that inquiry-based science instruction contributes not only to improved concept mastery but also to the development of essential 21st-century skills such as critical thinking, collaboration, communication, and problem-solving. Learners became more actively involved in the learning process as they engaged in hands-on investigations, discussed scientific ideas with peers, and applied concepts to real-world situations. These experiences fostered a deeper appreciation of science as an active process of discovery rather than a mere collection of facts to be memorized.

Despite these positive outcomes, the study highlights the need for sustained support to strengthen inquiry-based science education in rural Junior High Schools. Teachers require continuous professional development opportunities focused on inquiry pedagogy, classroom facilitation techniques, and the effective integration of contextualized science instruction. Likewise, schools and educational stakeholders should provide adequate instructional materials, laboratory resources, and learning technologies that support experiential and inquiry-driven learning. Policy makers and educational leaders must also recognize the unique challenges faced by rural schools and develop context-responsive interventions that address resource limitations while promoting equitable access to quality science education.

Overall, the study underscores that effective inquiry-based science teaching can significantly enhance concept mastery among rural learners when instructional practices are carefully adapted

to the local context. By investing in teacher capacity building, strengthening resource support systems, and promoting learner-centered inquiry approaches, schools can create meaningful science learning experiences that empower students to become scientifically literate, critical thinkers, and lifelong learners capable of addressing the complex challenges of the modern world.

Implications

Schools should strengthen institutional support for inquiry-based science instruction by providing teachers with sustained professional development and instructional resources that are responsive to rural school contexts. Training programs should move beyond one-time workshops and instead focus on continuous capacity building that equips teachers with practical strategies for implementing guided inquiry, effective questioning techniques, and formative assessment methods that capture learners' conceptual understanding. Access to locally adaptable instructional materials, low-cost laboratory alternatives, and collaborative learning communities among science teachers can further enhance the quality of inquiry-based instruction in resource-constrained settings. At the same time, school leaders play a crucial role in fostering an environment that encourages instructional innovation, reflective practice, and teacher autonomy in adapting inquiry approaches to learners' needs. Future research is recommended to employ mixed-methods or longitudinal designs to examine the sustained effects of inquiry-based teaching on learners' science achievement, scientific reasoning, and attitudes toward science. Expanding such studies across diverse school settings would provide stronger empirical evidence to inform policy decisions and support the scaling of effective inquiry-based practices in junior high school science education.

References

- Andres, A. (2019). Achievement Goals and Mathematics Achievement of the Senior High School Students. *International Journal of English and Education*, 8 (2).
- Andres, A. (2023). Establishing Quality Instrument for the Summative Assessment of Pre-Service Elementary Teachers. *JETT*. 14 (3), 9-16).
- Andres, A.D. (2022). Metacognition and Performance in Mathematical Problem-Solving Among Bachelor of Elementary (BEED) Pre-service Teachers. *Central European Management Journal*, 30 (4). 86-95.
- Antonio, A. (2021). Syntactical Scrutiny: Inaccuracies in the Lesson Planning of Non- Language Pre Service Teachers. *International Journal of Arts, Sciences and Education*,
- Balog, P., & Gonzales, E. (2021). From Linguistic Landscapes to Teaching Resources: A Case of Some Rural Areas in the Province of Quezon. *International Journal of Arts, Sciences and Education*, 1(2), 23-44.
- Banares, A. J. (2022). Reinterpreting Sonnet 18 by William Shakespeare through Stylistic Analysis. *International Journal of Arts, Sciences and Education*, 3(July Special Issue), 189-204. <https://ijase.org/index.php/ijase/article/view/163>.
- Bangayan- Manera, A. (2020). Writing Without Permission: A Case study on Skinner's Analogy through Vandalism. *International Journal of Psychosocial Rehabilitation*. 24 (08), 571-578
- Bangayan, O., Navasca, M., Navasca, R., Abaquita-Espiritu, J., & Calaranan, M. (2025). Innovating Pedagogical Approaches in Industrial Technology and Livelihood Education: A Comparative Study of BTVTED and BTED Programs in Enhancing Technical Competency and Workforce Readiness in Philippine State Universities. *International Journal on Culture, History, and Religion*, 7(SI2), 676-692. <https://doi.org/10.63931/ijchr.v7iSI2.235>

- Bangayan-Manera, A, Vecaldo, R. & Saquing J. (2020). Cultural Structuring of Urok Practices: An Intercultural Communication of Bago Tribe in Kalinga, Philippines. *International Journal of Psychosocial Rehabilitation*.24 (6), 13193-13217
- Bangayan-Manera, A. (2019). Doodle: Towards A Hermeneutical Appreciation in Jacques Derrida's Deconstruction. *The Asian EFL Journal*. 24 (4.2), 291-204.
- Bangayan-Manera, A. (2019). Textual Analysis of School Graffiti. *The Asian EFL Journal*. 21 (2.3), 273-285.
- Batang, B., Villa, F., Natividad, A., Gonzales, A., Cabansag, J., & Bangayan, O. (2025). Culturally-Informed Leadership and Management Practices in Philippine State Universities and Colleges: Navigating Institutional Excellence through Localized Governance and Academic Culture. *International Journal on Culture, History, and Religion*, 7(SI2), 751–770. <https://doi.org/10.63931/ijchr.v7iSI2.243>
- Belarga, B., Guiquing-Clemente, B., Tulawie, A., Alih, C., Caban, R., & Manois, F. R. (2025). From Page to Praxis: The Role of Regional Literature in Shaping Culturally Grounded Teaching Methods in HEIs. *International Journal on Culture, History, and Religion*, 7(SI2), 356–371. <https://doi.org/10.63931/ijchr.v7iSI2.206>
- Bonoan, K. C., Bunagan, K. A., Calangi, A. D., Chan, E. P., Corpuz, L. P., Deseo, J. M., Suarez, R. H., Sumulong, B. I., & Flores, A. R. (2021). A Comparative Study on the Knowledge, Attitude, and Practices (KAP) on the Preventive Measures Against Covid-19 of the Residents in Rural (Lobo, Batangas) and Urban (Taguig City, Metro Manila) Areas in the Philippines. *International Journal of Arts, Sciences and Education*, 1(3), 77–123. Retrieved from <https://ijase.org/index.php/ijase/article/view/35>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101.
- Buncag, R. (2022). Parent-Assisted Modular Reading Program: Its Effect on Reading Performance During the Covid-19 Pandemic of Grade 5 Pupils of Biwag Elementary School, Tallag Cabagan Isabela. *International Journal of Arts, Sciences and Education*, 3(July Special Issue), 39–50. <https://ijase.org/index.php/ijase/article/view/154>
- Bybee, R. W. (2014). *The BSCS 5E instructional model: Personal reflections and contemporary implications*. BSCS.
- Caliboso, J., Bagalay, B., Santiago, M., Bayan, R., Aguinaldo, I., & Belo, J. (2025). Literary Texts as Cultural Tools: A Study on Contextualized Learning Strategies in Philippine Higher Education. *International Journal on Culture, History, and Religion*, 7(SI2), 340–355. <https://doi.org/10.63931/ijchr.v7iSI2.205>
- Decena, A. J. (2021). A Survey on the Reading Difficulties Of K-12 Learners In Selected Tagalog-Speaking Provinces: Basis for Intervention. *International Journal of Arts, Sciences and Education*, 1(2), 219–226. Retrieved from <https://ijase.org/index.php/ijase/article/view/61>
- Dela Cruz, L., Aguinaldo, I., Alzate, L. J., Camero, C., Abiado, K. R., & Gumpal, B. (2025). Fostering Intercultural Competence through Culturally Responsive Pedagogy: Practices and Perspectives in Philippine Higher Education Institutions. *International Journal on Culture, History, and Religion*, 7(SI2), 36–50. <https://doi.org/10.63931/ijchr.v7iSI2.187>
- Dela Cruz, L., Manera, A., Ramirez, E., Macato, D., Catbagan, R. J. I., & Tulawie, A. (2025). Bridging Cultures in the Classroom: Analyzing Pedagogical Approaches that Promote Intercultural

- Competence in Multicultural Higher Education Settings. *International Journal on Culture, History, and Religion*, 7(SI2), 242–261. <https://doi.org/10.63931/ijchr.v7iSI2.202>
- Domingo- Alejo, J. (2022). Delving The Perceived Administrator’s Personality in Basic Education Unit. *CEMJ*. 30 (4), 2052-2060.
- Domingo- Alejo, J. (2023). Exploring the Level of Morale of Teachers in Public Basic Education Unit. *Rivista Italiana di Filosofia Analitica Junior*. 14 (1), 482-496.
- Domingo-Alejo, J. (2024). AI Integrated Administration tool design with ML Technology for Smart Education System. 2024 4th International Conference on Advance Computing and Innovative Technologies in Engineering (ICACITE). 1423-1428.
- Edobane, R. (2025). Culturally Rooted Pedagogy in Technology and Livelihood Education: Assessing Curriculum Implementation in Western Visayas State Universities. *International Journal on Culture, History, and Religion*, 7(SI2), 568–586. <https://doi.org/10.63931/ijchr.v7iSI2.226>
- Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work. *Educational Psychologist*, 41(2), 75–86.
- Minner, D. D., Levy, A. J., & Century, J. (2010). Inquiry-based science instruction—What is it and does it matter? *Journal of Research in Science Teaching*, 47(4), 474–496.
- OECD. (2019). *Education in rural areas: Issues and solutions*. OECD Publishing.