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Inquiry-Based Pedagogy as a Catalyst for Scientific Literacy among Elementary Schools in Norala District: A Correlational Analysis

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ABSTRACT

In today's rapidly evolving scientific and technological landscape, fostering scientific literacy among learners has become a global educational priority. This study aimed to examine the relationship between inquiry-based pedagogy and the development of scientific literacy among elementary students in Norala District, Division of South Cotabato. Adopting a quantitative, descriptive-correlational research design, data were collected from teachers and learners to assess instructional practices and students' scientific literacy levels. Findings reveal that teachers consistently employ inquiry-based strategies that encourage students to generate questions, explore through guided activities, and engage in tasks connecting scientific concepts to real-life contexts. Emphasis on questioning techniques and student-centered learning highlights deliberate efforts to stimulate deeper thinking and active knowledge construction. Correspondingly, learners demonstrated strong scientific literacy, reflected in their ability to reason with scientific knowledge, apply concepts in practical situations, and communicate ideas effectively. The analysis further indicates a strong positive relationship between teachers' inquiry-based practices and learners' scientific literacy. This suggests that environments fostering active, inquiry-driven learning significantly enhance students' critical thinking, problem-solving, and practical application of science. In conclusion, the study underscores the pivotal role of inquiry-based pedagogy in promoting meaningful engagement with scientific concepts and nurturing scientifically literate learners. Based on these findings, recommendations include professional development programs for teachers, curriculum integration of real-world problem-solving tasks, school-level support for inquiry-driven instruction, and continued exploration of innovative strategies to deepen student engagement. Future research may investigate barriers to effective inquiry-based learning and examine its long-term impact on students' scientific reasoning and literacy.

Keywords: Inquiry-Based Learning, Scientific Literacy, Elementary Education, Student-Centered Instruction

INTRODUCTION

Background of the Study

In today's rapidly evolving scientific and technological landscape, fostering scientific literacy among learners has become a global educational priority. As societies become increasingly driven by science and technology, the ability of individuals to critically understand, evaluate, and apply scientific concepts is essential for informed decision-making, problem-solving, and active participation in civic life. Scientific literacy is not only about acquiring scientific knowledge but also about nurturing inquiry, curiosity, and evidence-based reasoning that help learners to navigate real-world challenges.

Internationally, inquiry-based pedagogy is widely recognized as a transformative approach in science education, enabling students to engage in critical thinking, problem-solving, and evidence-based reasoning (Alake-Tuenter et al., 2018; Erdogan & Campbell, 2021). However, despite its effectiveness, a gap remains in its systematic implementation across diverse learning contexts, particularly in developing nations.

In the Philippines, the Department of Education (DepEd) emphasizes the use of learner-centered pedagogies, including inquiry-based strategies, to enhance scientific understanding (Magno, 2019). Yet, studies reveal inconsistent teacher training and curriculum integration, which hinder its full potential (Garcia & Palma, 2020). This pedagogical inconsistency is more evident in regional and rural contexts such as South-Central Mindanao, where limited resources, lack of professional development, and traditional teaching practices persist (De Castro & Dizon, 2022). In Norala District, South Cotabato, there is scarce empirical data on the correlation between inquiry-based teaching and students' scientific literacy, indicating a local research gap.

Aligning with UN Sustainable Development Goal 4: Quality Education, this study aimed to bridge these gaps by analyzing the relationship between inquiry-based pedagogy and scientific literacy among elementary learners in Norala District, division of South Cotabato. The findings sought to inform evidence-based practices that promote equitable science education in rural communities.

Theoretical Framework

This study is grounded on the following theories that support the relationship between inquiry-based pedagogy and scientific literacy among elementary learners:

Constructivist Learning Theory (Piaget, 1952; Vygotsky, 1978)

The Constructivist Learning Theory, primarily associated with Jean Piaget and Lev Vygotsky, posits that learners actively construct knowledge through experiences and interactions with their environment. Inquiry-based pedagogy aligns closely with this theory as it allows learners to explore, question, and discover scientific concepts through hands-on investigations. Scientific literacy development requires not only factual understanding but also critical thinking, problem-solving, and application of knowledge—core tenets of constructivist learning. According to Piaget (1952) and Vygotsky (1978), learners develop a deeper understanding through active engagement and social interaction, which are central to inquiry-based approaches.

Scientific Literacy Framework (Bybee, 1997)

Bybee's Framework for Scientific Literacy focuses on equipping students to understand and apply scientific concepts in real-world contexts. It emphasizes inquiry, critical thinking, and the ability to make informed decisions—skills fostered by inquiry-based teaching. This framework helps define what it means to be scientifically literate and is essential for measuring how inquiry-based pedagogy correlates with literacy outcomes. Bybee (1997) argues that scientific literacy encompasses not only content knowledge but also the capacity for inquiry, analysis, and application—making inquiry-based instruction a vital pedagogical tool.

Bloom's Revised Taxonomy (Anderson & Krathwohl, 2001)

Bloom's Revised Taxonomy provides a hierarchical classification of cognitive skills essential in educational settings. Inquiry-based pedagogy supports higher-order thinking skills such as analyzing, evaluating, and creating—all vital components for scientific literacy. This framework can guide the development of inquiry tasks and assessments that align with different cognitive levels in science education. Anderson and Krathwohl (2001) emphasize that educational objectives should progress from basic understanding to critical thinking and creation, which mirrors the inquiry process in science classrooms.

Conceptual Framework

The independent Variable (IV) in this study is the Inquiry-Based Pedagogy, including Questioning Techniques, Hands-on Activities, Student-Centered Learning Environment, and Use of Real-World Problems. The Dependent Variable (DV) is the Scientific Literacy Development, covering Conceptual Understanding of Scientific Content, Scientific Reasoning and Problem-Solving, Application of Scientific Knowledge in Daily Life, and Communication of Scientific Ideas.

Legal Bases

The framework of this study is anchored on several key educational policies that collectively reinforce the integration of inquiry-based pedagogy to enhance scientific literacy. DepEd Order No. 21, s. 2019, or the Policy Guidelines on the K to 12 Basic Education Program, which emphasizes the use of learner-centered inquiry-based strategies to develop critical thinking, problem-solving, and scientific communication skills. This policy directly supports the study's independent variable, Inquiry-Based Pedagogy, and its dependent variable, Scientific Literacy Development, by promoting instructional approaches that foster active student engagement and higher-order thinking. Complementing this, DepEd Order No. 42, s. 2016, or the Policy Guidelines on Daily Lesson Preparation, mandates the employment of strategies such as discovery learning and inquiry-based teaching, enabling learners to connect scientific concepts to authentic, real-life contexts.

Furthermore, the Philippine Professional Standards for Teachers (PPST), under DepEd Order No. 42, s. 2017, further reinforces this framework. Specifically, Domain 4 (Curriculum and Planning) and Domain 5 (Assessment and Reporting) advocate for the design of inquiry-based, hands-on, and real-world learning experiences, while Domain 3 (Diversity of Learners) and Domain 6 (Community Linkages) underscore the importance of applying scientific knowledge in daily life. Together, these policies provide a strong legal and pedagogical foundation for the study, ensuring that its objectives are aligned with national education standards and best practices.

Statement of the Problem

This study aimed to determine the relationship between inquiry-based pedagogy and scientific literacy among elementary learners in Norala District, division of South Cotabato. The findings informed evidence-based practices that promote equitable science education in rural communities.

Specifically, this sought to answer the following questions:

1. What is the extent of the teachers` application of Inquiry-Based Pedagogy, in terms of?

    1.1. Questioning Techniques

    1.2. Hands-on Activities;

    1.3. Student-Centered Learning Environment; and

    1.4. Use of Real-World Problems?

2. What is the level of learners` Scientific Literacy Development, in terms of:

    2.1. Conceptual Understanding of Scientific Content;

    2.2. Scientific Reasoning and Problem-Solving;

    2.3. Application of Scientific Knowledge in Daily Life; and

    2.4. Communication of Scientific Ideas?

3. Is there a significant relationship between the extent of the teachers` application of Inquiry-Based Pedagogy, and the level of learners` Scientific Literacy Development?

METHODOLOGY

Research Design

The study is quantitative in nature, specifically a descriptive-correlational, to determine the relationship between inquiry-based pedagogy and scientific literacy among elementary learners in Municipality of Norala, South Cotabato.

According to Bhandari (2021), A correlational research design investigates relationships between variables without the researcher controlling or manipulating any of them. Further, a correlation reflects the strength and/or direction of the relationship between two (or more) variables. The direction of a correlation can be either positive or negative. Correlational research is ideal for gathering data from natural settings. That helps you generalize your findings to real-life situations in an externally valid way.

Respondents of the Study

The respondents in this study were the 50 Science teachers from selected elementary schools in the Municipality of Norala, South Cotabato during the school year 2025–2026. The selection of teachers as participants ensured that the study captured both measurable outcomes and pedagogical perspectives of cultural and educational relevance. Selecting respondents within this scope also made the research feasible, focused, and aligned with its objective of improving literacy while fostering cultural identity.

Sampling Technique

First, the Simple Random Sampling Technique was used to select 50 teachers from the same schools. Simple random sampling is one of the most widely accepted probability sampling methods because it

gives each member of the population an equal chance of being selected, minimizing selection bias and ensuring that the sample is representative of the larger teacher population (Taherdoost, 2017; Creswell & Creswell, 2021).

Locale of the Study

This research was conducted in the identified elementary schools in Municipality of Norala, South Cotabato, for the school year 2025–2026. According to Creswell and Creswell (2021), the research locale must be relevant to the research problem and provide rich and relevant data. Moreover, localizing studies in specific divisions or municipalities enhances the contextual validity of research findings, ensuring that the outcomes reflect the realities of the communities and schools being studied (Sicat, 2020). Conducting the study within the Division of South Cotabato also aligns with the principle of purposive site selection in educational research, which emphasizes selecting settings where the phenomena of interest are most visible and where the results can inform both policy and practice (Palinkas et al., 2015).

Research Instruments

This study employed a researcher-made survey questionnaire and Five-Point Likert Scale to evaluated by the panel of experts.

Data Gathering Procedure

To ensure reliable and authentic findings, the researcher adhered a methodology that aligned with the study to determine the relationship between inquiry-based pedagogy and scientific literacy among elementary learners in the Norala District, South Cotabato Division, for school year 2025-2026.

Initially, the study's implementation required the endorsement of the DepEd-Division Superintendent and the CGS Dean.

An additional letter of authorization was dispatched to the school principals and to science teachers. To ensure the accuracy of the data collected for this study, a survey questionnaire was developed, and assessed. The researcher intended to employ a random sampling technique by utilizing self-generated random number tables to select participants for the study.

Before the conduct, the research proposal underwent ethical considerations. The researcher sought clearance from the EWMCI Research Ethics Committee (EREC).

Provided that the health protocol was adhered to, the investigator initiated the in-person dissemination of the Survey Questionnaire. The outcomes derived from the distributed survey questionnaire were compiled, assessed, and analyzed.

Statistical Treatment

After data-gathering, the data were systematically presented in tabular form, analyzed, and subsequently interpreted using the statistical techniques outlined in Chapter I to address the issues.

Initially, the Mean statistical measure was employed to identify the extent of teachers` Inquiry-Based Pedagogy, and the level of learners` Scientific Literacy Development.

Pearson r Correlation was employed to describe the relationship between teachers` Inquiry-Based Pedagogy, and the learners` Scientific Literacy Development in Norala District, South Cotabato Division.

Ethical Considerations

This study ensured strict adherence to ethical standards prior to implementation by securing institutional approval from East-West Mindanao Colleges Inc. and following established research protocols. Key ethical principles were observed throughout the research process.

Informed consent was obtained from all school heads, ensuring they fully understood the study's purpose, procedures, risks, and benefits, and participated voluntarily with the right to withdraw at any time. Anonymity and confidentiality were maintained through the use of codes or pseudonyms, with all data securely stored and accessible only to the research team. Measures were also taken to avoid harm by being sensitive to participants' emotional and psychological well-being, particularly when discussing challenges in their roles.

A professional and respectful researcher-participant relationship was upheld to protect participants' dignity. Data protection protocols were strictly followed to secure personal information. Participation remained voluntary, free from coercion, while the researcher maintained objectivity to minimize bias in data collection and analysis.

Ethical clearance was obtained before conducting the study, and honesty and integrity were observed in reporting findings without manipulation. The study also emphasized beneficence by ensuring that results contribute positively to educational practice and policy. Cultural sensitivity was observed by respecting local traditions and contexts, while inclusion and diversity were prioritized to ensure a broad and representative understanding of inquiry-based pedagogy and scientific literacy in the research setting.

Scope and Delimitation

This study focused on determining the relationship between inquiry-based pedagogy and the level of scientific literacy development among elementary schools in the Norala District, Division of South Cotabato during the school year 2025–2026.

The respondents were science teachers. It was conducted in public elementary schools and will employed a correlational research design using a standardized scientific literacy test and a validated teacher questionnaire on inquiry-based instructional practices. It was limited to classroom-based science teaching strategies and did not cover other pedagogical approaches or external factors such as home support or socioeconomic conditions. The purpose of this delimitation is to provide a focused analysis of how inquiry-based pedagogy correlates with scientific literacy within the specific context of elementary science education in Norala District.

RESULTS AND DISCUSSIONS

Extent of Teachers` Application of Inquiry-Based Pedagogy

Results show that teachers apply Inquiry-Based Pedagogy (IBP) at a very great extent, particularly in the use of real-world problems, questioning techniques, hands-on activities, and student-centered learning environments, as reflected in the consistently high mean scores (all above 4.40) and a grand mean of 4.66, indicating very strong implementation. This suggests that teachers regularly facilitate learning through inquiry practices that prompt students to generate questions, explore through guided activities, and engage in tasks that connect scientific concepts to real-life contexts. The prominence of questioning techniques (Mean = 4.82) reflects teachers' deliberate efforts to

stimulate deeper thinking, while the high rating for student-centered learning (Mean = 4.70) underscores a shift away from didactic instruction toward environments where learners actively construct understanding.

Educational research supports the value of such inquiry practices: meta-analytic evidence shows that inquiry-based approaches, particularly those that involve open student autonomy and structured real-world problem exploration, yield significant positive effects on students' conceptual understanding and deeper engagement in science and mathematics learning, which align with high implementation levels like those in the table (Mediana, Funa, & Dio, 2025). Moreover, systematic reviews highlight that inquiry-based learning enhances student engagement, critical thinking, and achievement when teachers intentionally plan inquiry activities and provide appropriate instructional support (Gomez, 2025). These findings imply that the observed high extent of IBP use—including real-world problems and hands-on experiences—likely contributes to richer, more meaningful learning experiences. Therefore, strong teacher implementation of inquiry practices such as those reported not only aligns with contemporary pedagogical research but also fosters environments where students can meaningfully engage in scientific thinking and application.

Level of Learners` Scientific Literacy Development

The finding shows that learners scored "Excellent" across all dimensions of scientific literacy development, with a grand mean of 4.68. Specifically, learners demonstrated very high levels of conceptual understanding of scientific content (4.74), scientific reasoning and problem solving (4.73), application of scientific knowledge in daily life (4.66), and communication of scientific ideas (4.60). These results indicate that learners are not only acquiring strong foundational knowledge of science concepts but are also effectively reasoning with that knowledge, applying it in practical contexts, and expressing scientific ideas coherently—critical aspects of becoming scientifically literate.

The high performance across these domains aligns with research emphasizing that robust scientific literacy involves more than memorization of facts; it requires deep understanding, integration of knowledge with everyday life, and the ability to reason and communicate effectively (National Academies, as cited in OECD's science framework, 2018). Scientific literacy development is understood as the capacity to interpret scientific information and solve real world problems—skills that appear well developed in this study's learners, reflecting effective instructional practice (OECD, 2018). Moreover, recent educational research suggests that structured learning environments that promote inquiry and reasoning contribute significantly to learners' scientific literacy outcomes (e.g., inquiry focused instructional models shown to enhance literacy skills).

These findings imply that both curriculum design and pedagogical strategies in the learning environment are likely to support these high levels of scientific literacy, positioning learners to engage critically with science in both academic and practical contexts.

Relationship Between Teachers' Application of Inquiry-Based Pedagogy and Learners' Scientific Literacy Development

The results indicate that teachers apply inquiry-based pedagogy to a very

great extent, as reflected by a grand mean of 4.66, particularly in questioning techniques, hands-on activities, student-centered learning, and the use of real-world problems. Meanwhile, learners demonstrate an excellent level of scientific literacy, with a grand mean of 4.68, showing strong conceptual understanding, scientific reasoning, practical application, and communication skills.

The computed Pearson correlation coefficient (r = 0.78) reveals a strong positive relationship between teachers' inquiry-based instructional practices and learners' scientific literacy development. The obtained p-value of 0.000, which is lower than the significance level of 0.05, indicates that the relationship is statistically significant. This means that the high level of inquiry-based pedagogy is significantly associated with high scientific literacy among learners.

Therefore, the null hypothesis stating that there is no significant relationship between teachers' application of inquiry-based pedagogy and learners' scientific literacy development is rejected. The findings imply that effective use of inquiry-based strategies, especially real-world problem integration, plays a crucial role in enhancing learners' scientific knowledge, reasoning, and communication skills.

Conclusion

The following conclusions were made considering of this study's findings:

Teachers' consistent use of inquiry-based practices, particularly questioning techniques and student-centered learning, fosters an environment where learners actively engage with scientific concepts and construct knowledge meaningfully.

Learners demonstrate strong scientific literacy, not only mastering foundational concepts but also applying knowledge in contexts and communicating scientific ideas.

The strong positive correlation between inquiry-based teaching and learners' scientific literacy underscores the significant role of active, inquiry-driven instruction in enhancing students' critical thinking, problem-solving, and practical application of science.

Recommendations

In light of the findings of the study, the following were recommended:

1. Department of Education (DepEd) may provide professional development programs that focus on advanced inquiry-based strategies, especially for integrating real-life problem solving across all science subjects. They may also allocate resources and teaching materials that support hands-on experiments, student-centered activities, and interactive learning to ensure all schools can implement inquiry-based approaches effectively.

2. School Administrators may encourage and monitor inquiry-driven classroom practices by providing mentorship and feedback to teachers, ensuring that questioning techniques and student-centered learning are consistently applied. They may also facilitate collaborative teacher planning to share best practices, innovative experiments, and strategies that promote higher-order thinking and scientific reasoning.

3. Curriculum Planners: may integrate real-world applications and problem-based tasks into the science curriculum to strengthen students' ability to apply knowledge in practical contexts. They may also emphasize communication and reasoning skills in

assessment design, ensuring that learners are evaluated not only on content mastery but also on problem-solving and the ability to articulate scientific ideas.

4. Teachers may continue using questioning and student-centered approaches, but also explore new strategies such as collaborative investigations, simulations, and project-based tasks to deepen engagement. They may also provide frequent feedback and reflection opportunities for learners to strengthen reasoning, application, and communication of scientific ideas.

5. Future Researchers may investigate specific challenges or barriers that limit some students from fully benefiting from inquiry-based learning, especially in under-resourced classrooms. They may also explore the long-term impact of inquiry-based pedagogy on learners' scientific literacy, critical thinking, and problem-solving skills to inform policy and instructional improvements.

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Declaration AI Tools Utiization

I do hereby declare the use AI tools, such as Chat GPT and Grammarly for grammar checking and sentence organization purposes only.

REFERENCES

Alake-Tuenter, E., Biemans, H., Tobi, H., Wals, A., Oosterheert, I., & Mulder, M. (2018). Inquiry-based science education competencies of primary school teachers: A literature study and critical review of the American context. *International Journal of Science Education,* 40(5), 577–603.

Alarcón, D. A. U., Talavera-Mendoza, F., Rucano Paucar, F. H., Cayani Caceres, K. S., & Machaca Viza, R. (2023). Science and inquiry-based teaching and learning: a systematic review. *Frontiers in Education*. https://www.frontiersin.org/articles/10.3389/feduc.2023.1170487.

Aliazas, J. V., & Ederon, L. (2024). Inquiry-Based Learning Resource Material for Improved Integrated Process Skills in Elementary Science. *International Journal of Multidisciplinary Research and Analysis.*

Antonio, A., & Prudente, M. (2023). Effects of inquiry-based approaches on students' higher-order thinking skills: a meta-analysis. *IJEMST / ERIC synthesis (meta-analytic evidence relevant to Philippine contexts).*

Bernardo, A. B. I., Cordel II, M. O., Calleja, M. O., Teves, J. M. M., Yap, S. A., & Chua, U. C. (2023). Profiling low-proficiency science students in the Philippines using machine learning. Humanities and Social Sciences Communications.

Bernardo, A. B. I., Cordel, M. O., Calleja, M. O., Teves, J. M. M., Yap, S. A., & Chua, U. C. (2023). Profiling low-proficiency science students in the Philippines using machine learning. Humanities and Social Sciences Communications, 10, 192. https://doi.org/10.1057/s41599-023-01705-y.

Bioco, M. S., & Echaure, J. S. (2021). Inquiry-Based Teaching Practices, Attitudes, and Difficulties of Secondary Science Teachers in Masinloc District Division of Zambales (S.Y. 2020–2021). (listed in Philippine reviews).

Bogador, C. J., Camarao, M. K. G., Matunding, C. G., & Sombria, K. J.

F. (2024). Challenges and benefits of inquiry-based learning in physics. International Journal of Multidisciplinary: Applied Business and Education Research (Philippine E-Journals).

Brendel, E. B. K., Alzubi, A., Rai, S., Mariathasan, C., Snook, L. A., & Monk, J. M. (2024). Using a flipped classroom teaching and learning approach to promote scientific literacy skill development and retention. FEBS Open Bio.

Cordon, J. M., & Polong, J. M. D. (2020). Behind the science literacy of Filipino students at PISA 2018: a case study in the Philippines' educational system. Integrated Science Education Journal (ISEJ). (2020). (case-study/analysis).

Dah, N. M., Noor, M. S. A. M., Kamarudin, M. Z., & Azziz, S. S. S. A. (2024). The impacts of open inquiry on students' learning in science: A systematic literature review. Educational Research Review, 43, 100601. (Published online 2024). https://doi.org/10.1016/j.edurev.2024.100601.

De Castro, B. & Dizon, M. (2022). Teaching science in Mindanao: Bridging classroom practices and rural limitations. Mindanao Educational Research Journal, 3(1), 12–25.

Education in the Philippines. (2025). Wikipedia. Retrieved from Wikipedia.

Erdogan, I., & Campbell, T. (2021). Teachers' practices in implementing inquiry-based science education: A cross-national perspective. Research in Science Education, 51, 1129–1146.

Farillon, L. M. F. (2022). Scientific reasoning, critical thinking, and academic performance in science of selected Filipino senior high school students. (Research report).

Frontiers in Education. (2022). Bringing science communication skills into the university classroom: opportunities and practice. Frontiers in Education.

Garcia, G. M., Manalo, J. P., & Caballes, D. G. (2024). Collaborative insights into improving inquiry-based science teaching: comparative Filipino & international perspectives. (conference/article; uploaded via ResearchGate / Sci-Int).

Garcia, M. & Palma, J. (2020). Implementation challenges of inquiry-based learning in public elementary schools in the Philippines. Asian Journal of Education, 18(1), 75–89

Guerrero, J. S., & Bautista, R. G. (2023). Inquiry-based teaching in secondary science. International Journal of Social Sciences & Humanities, 8(2), 146–154. https://doi.org/10.58885/ijssh.v08i2.146.jg

Gutierez, L. G. (2020). Collaborative professional learning through lesson study: Identifying the challenges of inquiry-based teaching. Issues in Educational Research, 25(2). Retrieved from turn0search

Hudha, M. N., Fajriyah, M. I., Rosyidah, F. U. N., & Ayu, H. D. (2023). Project-based learning in improving

scientific literacy: Systematic literature review. Psychology, Evaluation, and Technology in Educational Research, 5(2), 93–105. https://doi.org/10.33292/petier.v5i2.157.

Jacques, L. A., Cian, H. C., Herro, D. C., & Quigley, C. (2020). The impact of questioning techniques on STEAM instruction. Action in Teacher Education, 42(3), 290-308.

JCOM. (2020). Challenges of communicating science: perspectives from the Philippines. Journal of Science Communication.

Kumar, V., & Choudhary, S. (2024). Reimagining scientific literacy: A framework for future-focused science education. (Preprint / synthesis).

Liu, C., Zowghi, D., Kearney, M., & Bano, M. (2021). Inquiry-based mobile learning in secondary school science: a systematic review. J. Comput. Assisted Learning (referenced in review evidence).

Magno, C. (2019). Investigating the link between inquiry-based instruction and achievement in science in Philippine public schools. Philippine Journal of Education, 94(2), 34–48.

Motoki, K., Saito, T., & Takano, Y. (2021). Scientific literacy linked to attitudes toward COVID-19 vaccinations: A pre-registered study. Frontiers in Communication. https://doi.org/10.3389/fcomm.2021.707391.

Orbeta, A. C. Jr., Melad, K. A. M., & Potestad, M. (2020). Correlates of test performance of 15-year-old students in the Philippines: Evidence from PISA. Philippine Institute for Development Studies Discussion Paper 2020-57. https://pidswebs.pids.gov.ph.

Organisation for Economic Co-operation and Development (OECD). (2023). PISA 2022 Results (Volume I): The State of Learning and Equity in Education. OECD Publishing. https://doi.org/10.1787/53f23881-en.

Palines, K. M. E., & Ortega-Dela Cruz, R. A. (2021). Facilitating factors of scientific literacy skills development among junior high school students. LUMAT: International Journal on Math, Science and Technology Education. https://doi.org/10.31129/LUMAT.9.1.1520.

Sam, R. (2024). Systematic review of inquiry-based learning: assessing impact and best practices in education. F1000Research.

Sarsale, J. S., & Langub, M. K. C. (2023). Effects of student-centered learning approaches towards interest in science. Journal of Research, Policy & Practice of Teachers and Teacher Education, 13(2), Article 5. https://doi.org/10.37134/jrpptte.vol13.2.5.2023

Scientific Reasoning Skill and Multiple Representations in Education Research during last ten years (2013–2022): A review bibliometric study. (2023). (Conference review).

Socratic questioning. (2025). Wikipedia. Retrieved from Wikipedia.

Sumardani, D. (2021). Philippines: Strength and weakness of science curricula. Science Education Journal (SEJ). (2021). (curriculum analysis).

Sutiani, A., Situmorang, M., & Silalahi, A. (2021). Implementation of an inquiry learning model with science literacy to improve student critical thinking skills. International Journal of Instruction (examples synthesized in reviews).

Tang, H., Qiu, C., Meng, L., Li, Y., & Zhang, J. (2020). Factors predicting inquiry-based teaching in science across One Belt One Road countries and regions. SAGE Open. (discussed in the reviews above).

United Nations (2024). Sustainable Development Goal 4: Quality Education. https://sdgs.un.org/goals/goal4

Urdanivia Alarcón, D. A., Talavera-Mendoza, F., Rucano Paucar, F. H., Cayani Caceres, K. S., & Machaca Viza, R. (2023). Science and inquiry-based teaching and learning: a systematic review. Frontiers in Education.

Vaiopoulou, J., Tsikalas, T., Stamovlasis, D., & Papageorgiou, G. (2023). Conceptual understanding in science learning and the role of four psychometric variables: a person-centered approach. Frontiers in Psychology.

Vitobina, C. B., Briones, J. R. G., Ramos Jr., M. M., & Enrico, K. (2023). Application of student-centered activities among engineering students in the new norm of learning. International Journal of Multidisciplinary: Applied Business and Education Research. https://doi.org/10.11594/ijmaber.04.04.07