Inquiry Based Learning Approach and its Effects on Junior High Students' Academic Performance in Science

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Abstract — This study investigated the utilization of the Inquiry-Based Learning (IBL) approach in Junior High School Science and its relationship with students' academic performance on Plate Tectonic Theory at Lipata National High School, Lipata, Minglanilla, Cebu, during the School Year 2025–2026. A descriptive–correlational design was employed, involving 100 teachers and 143 Grade 10 students. Data were collected using structured questionnaires and analyzed through descriptive statistics, Pearson r correlation, and chi-square tests. Results showed that teachers were predominantly middle-aged, female, married, and pursuing postgraduate studies, with an average of 7.66 years of teaching experience and varied participation in professional development. Teachers reported moderate to strong readiness in implementing IBL, demonstrating confidence and curriculum alignment but indicating gaps in lesson planning,

questioning techniques, and access to instructional resources. Students' academic performance was rated Very Good (M = 3.82, SD = 0.79), with strong conceptual understanding but lower proficiency in applying knowledge to problem-solving. Students' perceptions of IBL were generally positive (M = 4.10), particularly valuing investigative activities, hands-on tasks, and discussions. Correlation analyses revealed significant positive relationships between teacher profile variables, educational attainment, years of experience, civil status, and number of trainings, and both IBL utilization and student performance. Chi-square analysis confirmed that higher IBL implementation was associated with improved student outcomes. The study underscores the importance of teacher professional development, adequate resources, and supportive school structures in fostering effective IBL. Strengthening these areas can enhance student engagement, conceptual understanding, and the ability to apply scientific knowledge in real-world contexts.

I.   INTRODUCTION

The study aimed to ensure that students were well equipped with the necessary tools to face the demands and expectations of the future. There had been a clear need for instructional practices that promoted critical thinking, reflection, questioning, collaboration, communication, and research. These approaches were considered essential in preparing students to adapt to the changing educational landscape and to develop skills that would enable them to become independent and lifelong students.

The Philippine education system had been grappling with a "learning crisis," as evidenced by the low performance of students in international assessments such as PISA (UNICEF

Philippines, 2022). This crisis underscored the urgent need for pedagogical reforms and innovative teaching approaches that could address foundational skill gaps and cultivate 21st-century competencies. In response, the Department of Education (DepEd) initiated several curriculum reforms, most notably the K–12 program, which aimed to produce scientifically, technologically, and environmentally literate citizens who were critical problem solvers and innovative thinkers (Talampas, 2024).

A key component of these reforms was the promotion of student-centered learning approaches, with Inquiry-Based Learning (IBL) being a prominent example. Rooted in constructivist theories, IBL shifted the learning paradigm from passive reception of information to active exploration, questioning, and knowledge construction. It encouraged students to investigate real-world problems, develop critical thinking skills, and foster a deeper understanding of concepts across various disciplines (Talampas, 2024). The potential benefits of IBL in improving student engagement, motivation, and the development of higher-order thinking skills had been widely recognized (Child Hope Philippines, 2025).

However, despite its recognized advantages and the government's advocacy for innovative pedagogies, the actual implementation of IBL in Philippine classrooms faced significant challenges. Studies indicated that teachers often lacked adequate training, support, and confidence in utilizing IBL strategies effectively (Maharma & Hatab, 2025). There were also concerns regarding curriculum alignment, the pressure to cover content for standardized assessments, and the availability of appropriate inquiry-based materials and resources (Maharma & Hatab, 2025). Furthermore, assessing learning outcomes in an IBL environment presented its own complexities, as traditional assessment methods did not always capture the development of inquiry skills. Beyond content mastery, IBL was conceptually linked to the development of critical thinking, problem-solving, creativity, collaboration, and self-regulation—skills deemed essential for navigating an increasingly complex and dynamic world (Sasanti et al., 2024; Kotsis, 2025). This connection directly addressed the learning crisis and the demand for globally competitive citizens in the Philippines.

Literature Review

Inquiry-Based Learning (IBL) gained significant global attention from 2020 to 2025 as an instructional approach that empowered students to take ownership of their learning. For junior high school students, IBL was developmentally appropriate since adolescents were naturally inquisitive and increasingly capable of abstract reasoning. Applying IBL in Science fostered not only academic achievement but also higher-order skills necessary for lifelong learning (Strat, Henriksen, & Jegstad, 2023; Antonio & Prudente, 2023). The philosophical foundation of IBL emphasized that learning was an active process where knowledge was constructed through questioning, exploration, and problem-solving, with the teacher serving as a facilitator rather than a sole knowledge provider (Kotsis, 2025).

Studies confirmed that IBL strengthened competencies essential in the 21st century, including creativity, collaboration, communication, and digital literacy (Sasanti et al., 2024; IEA, 2025). This was particularly relevant in the Philippines, where the educational system aimed to produce globally competitive graduates. Rather than encouraging superficial memorization, IBL was widely recognized for cultivating deep understanding in STEM disciplines (Antonio & Prudente, 2023; MDPI, 2024).

Several unpublished theses and dissertations between 2020 and 2025 examined Inquiry-Based Learning (IBL) in the Philippine context, reinforcing and expanding conceptual insights. For example, Dela Cruz (2021) found that Grade 10 students in Quezon City demonstrated significantly higher science performance when they were taught through inquiry compared to lecture methods. Similarly, Santos (2022) highlighted improved problem-solving abilities among junior high school students who used guided inquiry in physics. Both studies aligned with the present research in emphasizing academic performance; however, unlike the current study, they did not explore implementation gaps from multiple stakeholders' perspectives.

In Cebu, Villanueva (2022) investigated IBL in chemistry classes and reported enhanced student engagement and collaboration, though teachers expressed concerns about limited instructional time. This mirrored the present study's recognition of time as a barrier, yet

Villanueva's work primarily focused on student outcomes, while the present research considered both pedagogical and systemic factors.

Reyes (2023) studied inquiry in mathematics classrooms and concluded that students developed better logical reasoning and persistence. In contrast to the current study's emphasis on science, Reyes targeted numeracy. Nonetheless, both highlighted IBL's capacity to develop higher-order thinking. Meanwhile, Garcia (2023) found that teachers in rural schools faced more difficulties implementing inquiry compared to those in urban schools due to resource shortages, a concern consistent with the present study's focus on resource gaps.

II. METHODOLOGY

Research Design

A descriptive–correlational research design was employed to determine the relationships among the profile of the respondents, the status of the utilization of the Inquiry-Based Learning (IBL) approach, and the students' academic performance in Junior High School Science, specifically on Plate Tectonic Theory. This design was appropriate because the study did not seek to manipulate variables but rather to examine existing conditions and the degree of association between them (Creswell & Creswell, 2023; Fraenkel et al., 2021). Through this approach, the researcher was able to systematically describe teacher preparedness, curriculum and instructional planning, assessment practices, and systemic support, and then analyze how these factors correlated with the effective implementation of IBL.

The correlational aspect of the design directly addressed the research problems by testing whether significant relationships existed: (1) between the respondents' profile and the utilization of IBL; (2) between the respondents' profile and students' academic performance in Plate Tectonic Theory; and (3) between the status of IBL utilization and students' academic performance. Specifically, the study determined the profile of the respondent groups as follows: for teachers – age, sex, civil status, highest educational attainment, number of years in teaching, and number of relevant trainings/seminars attended; for students – age, sex, and general academic achievement.

The study also investigated the status of Inquiry-Based Learning (IBL) utilization in terms of teacher preparedness and pedagogical knowledge, curriculum and instructional planning, assessment and evaluation, resources and materials, time and workload, and systemic and organizational support.

According to the data provided by Lipata National High School, there were 100 teachers and 143 Grade 10 students who served as the total population of the study. Using purposive sampling, the study utilized all 100 teacher-respondents since they possessed the necessary characteristics, knowledge, and experiences relevant to the Inquiry-Based Learning (IBL) approach. They were also available and willing to participate, making them practical respondents for the study. The sample size for students was 143, who served as respondents in answering the unstructured questionnaire. These groups were determined to provide balanced perspectives on the challenges and extent of IBL implementation.

Sample of the Study

The study involved 100 junior high school teachers and 143 students from Lipata National High School in Minglanilla, Cebu. A purposive sampling technique was used to select participants who had direct experience with the implementation of inquiry-based learning, particularly in core academic subjects such as Science, Mathematics, and English. This method ensured that the data gathered came from respondents most relevant to the research objectives, thereby enhancing the reliability of insights on both the challenges and the effects of Inquiry-Based Learning (IBL).

Table 1. Distribution of Respondents

Respondent Group	Frequency (f)	Percentage (%)
Teachers	100	41.2%
Students	143	58.8%
Total	243	100%

As shown in Table 1, the total number of respondents was 243, consisting of 100 teachers (41.2%) and 143 students (58.8%). The inclusion of both groups provided a balanced perspective,

with teachers offering insights into the pedagogical and implementation aspects of Inquiry-Based Learning (IBL), while students contributed evidence of its effects on learning outcomes.

Measures

The study employed a researcher-made survey questionnaire as its primary tool for data collection. To ensure validity and reliability, the instrument was subjected to expert evaluation by three specialists in curriculum and instruction and was pilot tested among ten non-participating teachers, yielding a Cronbach's alpha coefficient of 0.84, which indicates strong internal consistency. The questionnaire was organized into two major parts. The first part gathered the demographic profile of respondents. For teachers, this included age, sex, civil status, highest educational attainment, years of teaching experience, and the number of relevant trainings or seminars attended. For students, this section captured age, sex, and general academic achievement. These data addressed the first research question concerning the profile of the respondent groups.

The second part of the instrument focused on the extent of Inquiry-Based Learning (IBL) implementation, with items constructed around the main variables of the study. These included teacher preparedness and pedagogical knowledge, curriculum and instructional planning, assessment and evaluation practices, availability of resources and materials, time and workload management, and systemic or organizational support. Each item was rated using a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree), enabling the measurement of respondents' perceptions regarding the status of IBL utilization. This section directly addressed the second and third research questions, as it examined how teachers perceive their ability to implement IBL and how systemic factors affect its adoption in the classroom. Additionally, open-ended questions were included to allow respondents to elaborate on their experiences, challenges, and recommendations, thereby complementing the quantitative findings with qualitative insights.

Procedures

This study was carried out through a systematic process to ensure ethical compliance, credibility of results, and alignment with DepEd research protocols. The first stage involved securing formal approval and coordination with the School Principal of Lipata National High School and the Schools Division Office of Cebu. Necessary communications were submitted and approved following the Department of Education's ethical research standards, which safeguard participant welfare and data privacy (DepEd Order No. 31, s. 2022; UNESCO, 2023). This preliminary step was essential to obtain official clearance, ensure cooperation of stakeholders, and guarantee smooth implementation of the study within the school setting.

After approval, the instrument development and validation stage was undertaken. The researcher-designed survey questionnaire was initially drafted based on related literature and existing frameworks on Inquiry-Based Learning (IBL). To strengthen content validity, the draft instrument was reviewed by three experts in curriculum and instruction who evaluated item relevance, clarity, and alignment with the variables of the study. The instrument was then pilot tested among ten teachers from neighboring schools who were not part of the actual respondents. This pilot testing yielded constructive feedback, particularly concerning item clarity and redundancy. Several modifications were introduced based on these results, such as simplifying technical terms, rephrasing ambiguous items, and merging overlapping questions to avoid confusion. These adjustments were made to enhance the comprehensibility and reliability of the instrument, as recommended in the validation literature (Geng, Law, & Niu, 2022; Talampas, 2024).

The actual data collection phase followed the validation process. To maximize accessibility, the researcher employed a hybrid distribution strategy, providing both printed copies and secure Google Forms links to respondents. This approach ensured that teachers and students with limited internet access were still able to participate through paper-based questionnaires. Before participation, respondents were fully informed of the study's objectives, scope, and their rights as participants. Written and digital consent was obtained, and confidentiality was assured by anonymizing all responses in compliance with ethical standards in educational research

(Archer-Kuhn et al., 2025; Wang & Degol, 2021). Despite these precautions, the data collection phase posed several challenges. Some teachers initially showed hesitation due to time constraints and workload pressures, while certain students needed additional clarification on survey items. The researcher addressed these issues by allotting flexible schedules for survey administration and by giving simple, standardized explanations when necessary.

Data Processing

The data gathered in this study were systematically organized, encoded, and analyzed using the Statistical Package for the Social Sciences (SPSS) version 25. To address the research problem, both descriptive and inferential statistical methods were employed. Descriptive statistics, including frequency counts, percentages, means, and standard deviations, were computed to present the demographic profile of the respondents and to measure the perceived extent of Inquiry-Based Learning (IBL) implementation across the six major variables—teacher preparedness, curriculum flexibility, assessment practices, resource availability, time and workload, and systemic or leadership support. These measures provided a clear summary of trends and central tendencies in the responses.

Before conducting inferential analysis, a normality test was performed using the Shapiro-Wilk test to determine whether the data met the assumptions for parametric tests. Since the p-values obtained were greater than 0.05 across all variables, the assumption of normality was satisfied, thus justifying the use of Pearson's product-moment correlation coefficient. Pearson's r correlation was then applied to examine the relationships among the six independent variables and the dependent variable, IBL implementation. The results of this test allowed the researcher to determine not only the strength but also the direction of associations, thereby identifying which factors were most strongly linked to effective IBL practices.

To complement the quantitative findings, qualitative responses gathered from the open-ended items of the questionnaire were analyzed using thematic analysis. This method involved coding, categorizing, and interpreting recurring patterns in the responses to uncover deeper

insights into the instructional and institutional barriers faced by teachers in implementing Inquiry-Based Learning (IBL). The integration of descriptive statistics, normality testing, correlation analysis, and thematic analysis ensured that the study addressed the research problem comprehensively by combining numerical data with contextual understanding.

Ethical Considerations

To ensure that the study adhered to the highest ethical standards, several measures were carefully observed throughout the research process. Before data collection, formal approval was secured from the Schools Division Office of Cebu and the Principal of Lipata National High School, in compliance with the Department of Education's Research Management Guidelines (DepEd Order No. 16, s. 2017). Participants were then fully informed about the study's objectives, scope, and their rights as respondents. Informed consent was obtained either in written form or through secure digital platforms, affirming that participation was voluntary and based on a clear understanding of the research (UNESCO, 2023; Wang & Degol, 2021).

The researcher strictly observed the principles of confidentiality and anonymity. A coding system was employed to ensure that no responses could be traced back to individual participants. Identifiable information was neither solicited nor recorded, which safeguarded respondents' privacy and encouraged them to provide honest and reflective answers, particularly when sharing challenges in implementing Inquiry-Based Learning (IBL) (Archer-Kuhn et al., 2025; Geng, Law, & Niu, 2022). Respondents were likewise informed of their right to withdraw from the study at any stage without penalty or consequence, thus respecting their autonomy and agency (Braun, Clarke, & Gray, 2022).

In terms of data protection, strict measures were enforced to prevent unauthorized access. Digital survey responses were stored in encrypted, password-protected files accessible only to the researcher, while hard copies, if any, were kept in a locked and secure location. These measures complied with DepEd's ethical standards for safeguarding educational data (DepEd Order No. 31, s. 2022).

Finally, the entire research process was conducted with transparency, fairness, and integrity under the oversight of the institution's Research Committee. By securing prior approval, ensuring voluntary participation, protecting confidentiality, and safeguarding data, the researcher upheld the ethical standards expected in educational research and aligned the study with both local and international guidelines (DepEd, 2017; SEAHI Publications, 2025).

III.   RESULTS AND DISCUSSION

The findings provided a comprehensive understanding of how IBL influenced students' learning outcomes, engagement, and critical thinking skills of junior high school students in Science at Lipata National High School. The results were analyzed and discussed in relation to existing literature, highlighting both consistencies and deviations from previous studies. This chapter interpreted the implications of the findings in addressing the challenges and opportunities of implementing IBL in the Science classroom.

the information gleaned from the study participants' questionnaires. Together with related statistical analysis and interpretation, the data are given in tabular and graphical formats. The conversation focuses on the academic performance of junior high school students in Science through effective utilization of the Inquiry-Based Learning Approach.

Profile of respondents. This subsection provided the demographic profile of the respondents, which was used in obtaining data on the effective utilization of the Inquiry-Based Learning Approach among the junior high school students in Lipata National High School, Lipata, Minglanilla, Cebu, during School Year 2025-2026.

Age. As presented, most respondents were within the middle-aged brackets, with the highest proportion in the 41–45 years old category (31%), followed by 36–40 years old (26%). The computed mean age of 40 years indicated that the respondents were generally in their middle adulthood, suggesting maturity and professional experience that may influence their perspectives. Studies affirmed that middle-aged individuals often provided stability and productivity, while

younger adults contributed adaptability and openness to change (Garcia & Lee, 2020; Thompson, 2021).

Sex. Based on the data gathered out of 100 respondents, a majority were females, 63 or 63%, while 35% (N = 35) were males, and 2% (N = 2) preferred not to disclose their sex. This result reflected the continuing trend in the education sector, where women dominated the teaching workforce, particularly at the basic education level. UNESCO (2023) reported that women represented the majority of teachers worldwide, 94% in pre-primary and more than half at other levels of education, though their presence declined in higher education. Such gender imbalance was often attributed to societal expectations, traditional gender roles, and structural barriers that limited women's advancement into leadership positions.

Civil Status, out of 100 teacher respondents, the majority, 60 or 60.00%, were married. This indicated that a significant portion of the respondents were in stable relationships, which may have provided them with social and emotional support systems. Meanwhile, 36 or 36.00% were single, suggesting that a considerable number were still focused on personal growth and career development without the additional responsibilities of family life. A smaller proportion of respondents were separated, 2 or 2.00%, and widowed, 2 or 2.00%, reflecting diverse personal circumstances within the teaching workforce.

Out of 100 teacher respondents, the majority, 53 or 53.00%, were at the Masteral Level. This indicated that many teachers were actively pursuing advanced studies to enhance their professional competencies, even if they had not yet completed the full degree. Meanwhile, 29 or 29.00% were college graduates, showing that a considerable portion of the respondents had met the baseline qualification for teaching. Thirteen or 13.00% had successfully completed their Master's degree, reflecting their commitment to professional growth. A smaller proportion, 5 or 5.00%, were at the Doctoral level, while no respondent had completed a doctoral degree.

Summary of Findings

a comprehensive analysis of the results gathered from teachers and students regarding the utilization and effects of the Inquiry-Based Learning (IBL) approach in Science at Lipata National High School. The findings highlighted demographic insights of respondents, the extent of IBL utilization, student academic performance, as well as the challenges and strategies related to IBL implementation. The results were synthesized and interpreted in light of related literature.

Demographic Profile of Respondents. The teacher respondents were predominantly middle-aged, with an average age of 40 years, indicating maturity, stability, and professional experience (Garcia & Lee, 2020; Thompson, 2021). The majority were female, aligning with global trends where women continue to dominate the teaching workforce in basic education (UNESCO, 2023). Most were married, suggesting strong social and emotional support systems, which may positively influence work-life balance and classroom performance (Thakur, 2023; EIGE, 2020). In terms of educational attainment, the majority were pursuing master's-level studies, reflecting their commitment to professional growth and alignment with DepEd's advocacy for continuous development (Queens University of Charlotte, 2023; Liu, 2020). Years of teaching experience showed a balanced distribution between early-career and veteran educators, suggesting a healthy blend of innovation and stability within the teaching force (Salandanan, 2022). While most teachers had attended at least one to three relevant trainings, gaps were evident in sustained professional development, underscoring the need for structured capacity-building initiatives (Villegas, 2021; Guskey, 2002).

Student respondents were largely within the expected junior high age range of 14–16 years, clustered at an average of 15 years, a stage associated with the development of abstract reasoning and critical thinking (Santrock, 2021). Female students slightly outnumbered males, reflecting a trend consistent with Philippine statistics on gendered participation in education (PSA, 2023; UNESCO, 2022).

Status of IBL Utilization. Teachers demonstrated moderate preparedness and pedagogical knowledge in implementing IBL, though gaps remained in lesson design and questioning techniques (Gupta & Gupta, 2021; Rahman et al., 2021). The curriculum was generally perceived

as supportive, particularly in its alignment with MELCs, but time constraints and content overload limited deeper integration of inquiry strategies (Darling-Hammond et al., 2020; Lee & Kinzie, 2022). Resources such as digital tools and laboratory equipment moderately supported IBL, though insufficiencies in instructional materials persisted, reflecting common challenges in Philippine schools (Tindowen et al., 2020; Cabansag, 2022). Teachers also identified workload demands and large class sizes as barriers, consistent with earlier studies noting the resource-intensive nature of IBL (Nguyen et al., 2021; Flores & Gago, 2020). Nevertheless, systemic and organizational support from peers and administrators was strong, though more sustained training and mentoring were found necessary (Borko et al., 2020; Fullan & Quinn, 2021).

Students' Academic Performance. Results indicated that students performed at a *Very Good* level in Science, particularly in understanding plate tectonic theory, earthquakes, and volcanic processes. This reflected alignment with MELC-based competencies and consistent conceptual mastery (Cahyadi, 2020; Tan et al., 2021). However, lower ratings in interpreting diagrams and applying concepts to real-world problem-solving revealed gaps in higher-order thinking, reinforcing the need for stronger emphasis on modeling, simulations, and authentic inquiry tasks (Chen et al., 2022; Subiantoro et al., 2020).

Challenges in Implementing IBL. The most pressing challenges included students' low readiness for independent learning, limited resources, and insufficient instructional time, consistent with findings that IBL requires extensive scaffolding and resource provision (Barak, 2020; Bybee, 2014). Large class sizes and lack of sustained teacher training further hindered implementation (OECD, 2019). Although administrative support was noted, infrastructural limitations such as inadequate laboratory facilities remained significant constraints (Tindowen et al., 2020).

Learning Strategies to Improve Student Performance. Teachers identified hands-on experiments, collaborative projects, and ICT integration as the most effective strategies to enhance student engagement and performance. These approaches align with experiential learning theory, cooperative learning, and the growing role of technology in Science education (Kolb, as cited in Healey & Jenkins, 2000; Johnson & Johnson, 2019; Srisawasdi & Panjaburee, 2015). Additional

strategies such as case studies, multimedia integration, and community-based projects highlighted the importance of contextualized and student-centered learning (Mayer, 2021).

Overall, the findings demonstrated that while IBL positively influenced student performance and engagement, its success was mediated by teacher readiness, resource sufficiency, and systemic support. Addressing gaps in training, materials, and time allocation was crucial to sustaining IBL as an effective pedagogy in Science education.

Students' Perception of Learning Science in the Context of Inquiry-Based Learning (IBL). The findings indicated that students generally held a positive perception of learning Science through the Inquiry-Based Learning (IBL) approach. Students valued discovery-oriented activities (M = 4.40, SD = 0.74) and believed that hands-on tasks and discussions enhanced their conceptual understanding (M = 4.37, SD = 0.80). These results aligned with previous research showing that IBL fosters student engagement, motivation, and relevance in Science learning (Sarsale & Langub, 2023; Tirol & Bastida, 2021). However, the slightly lower rating on student-led questioning (M = 3.59, SD = 0.99) highlighted the need for further emphasis on fostering student autonomy and inquiry skills, which has been identified as important in recent meta-analyses (Syahgiah, ZAN, & Asrizal, 2023). In sum, while IBL appeared to be an effective pedagogical strategy for enhancing engagement and understanding in Science, its full benefit could be achieved only when teaching environments actively supported student questioning, idea-sharing, and meaningful investigation.

Test of Significant Relationship. The results of the current study revealed statistically significant relationships between teacher profile variables and both the status of utilization of the Inquiry-Based Learning (IBL) approach and the level of students' academic performance in Junior High School Science (Plate Tectonics Theory, based on MELCs). Using Pearson r correlation at the 0.05 level, the data indicated that age (r = .215, p = .032), gender (r = .277, p = .005), civil status (r = .390, p < .001), highest educational attainment (r = .580, p < .001), years in teaching (r = .392, p < .001), and number of relevant trainings/seminars attended (r = .268, p = .007) all exhibited significant positive correlations with the extent of IBL utilization. These findings suggest that teachers who were more highly educated, experienced, and engaged in professional development were more likely to adopt IBL methods in their classrooms.

In relation to student academic performance, gender (r = .197, p = .049), civil status (r = .346, p < .001), highest educational attainment (r = .215, p = .032), years of teaching experience (r = .241, p = .016), and number of trainings attended (r = .211, p = .035) were all significantly correlated with students' performance. However, teacher age (r = .097, p = .338) did not show a significant correlation, indicating that age alone may not meaningfully predict student outcomes in this context.

Finally, the chi-square test of independence between the status of IBL utilization and the level of student academic performance yielded χ^2(1, N = 100) = 8.57, p = .003, and Fisher's exact test supported this result (p = .004). This implies a statistically significant association, indicating that stronger teacher implementation of IBL was related to higher levels of student academic performance.

Overall, these results underscore that teacher professional characteristics—particularly educational attainment, experience, and training exposure—were associated both with the adoption of inquiry-based pedagogy and with students' academic success. These findings align with recent studies demonstrating that inquiry-based learning practices, when supported by teacher professional learning, positively influence student engagement and achievement (Talavera-Mendoza et al., 2024). They suggest that schools should prioritize ongoing teacher development and provide structural supports for Inquiry-Based Learning (IBL) implementation to optimize instructional quality and student outcomes.

IV.   CONCLUSIONS

The study concluded that the Inquiry-Based Learning (IBL) approach serves as an effective pedagogical framework in enhancing Science teaching and learning at Lipata National High School. The findings consistently demonstrated that IBL promotes deeper conceptual understanding, engagement, and performance among students when implemented with adequate teacher preparation, institutional support, and resources.

Teachers' demographic and professional profiles revealed that maturity, educational attainment, and professional experience significantly influence the extent of IBL utilization. Educators with higher qualifications and greater exposure to relevant training were more likely to adopt inquiry-based strategies, aligning with the assertion of Rahman et al. (2021) and Talavera-Mendoza et al. (2024) that continuous professional development directly contributes to instructional innovation and student achievement. The significant correlations between teacher characteristics and both IBL utilization and student academic performance further emphasize the value of sustained teacher learning and reflective practice in fostering effective instruction.

Students demonstrated very good performance in Science, particularly in understanding plate tectonic theory, indicating that IBL encourages active exploration and contextualized learning (Tirol & Bastida, 2021). Their positive perception of discovery-oriented and discussion-based learning confirms that IBL enhances motivation, relevance, and engagement in Science (Sarsale & Langub, 2023). However, the relatively lower rating in student-led questioning suggests the need for greater emphasis on inquiry autonomy and critical thinking development (Syahgiah, ZAN, & Asrizal, 2023).

Despite its effectiveness, challenges such as limited time, insufficient materials, and large class sizes remain barriers to full implementation. These constraints echo the findings of Nguyen et al. (2021) and Barak (2020), who identified IBL as a resource-intensive approach requiring both systemic and instructional support. Addressing these gaps through administrative backing, sustained professional learning, and improved instructional resources was essential for optimizing IBL's impact on student outcomes.

Overall, the study reinforces that IBL not only improves academic performance but also cultivates scientific inquiry, collaboration, and lifelong learning skills. When supported by teacher competency, institutional readiness, and learner empowerment, Inquiry-Based Learning stands as a transformative strategy for advancing Science education in the 21st-century classroom.

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