

Inquiry-Based Teaching Approach and the Student's Academic Performance in Science 9

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Abstract

This study aimed to evaluate the effectiveness of the inquiry-based approach in teaching science at Lucsuhin National High School. A descriptive research design was used, with data collected from 102 Grade 9 students through a structured questionnaire. The data were analyzed using weighted mean, t-test, and Pearson's correlation coefficient to assess the impact of inquiry-based strategies on student learning outcomes. The findings indicated that inquiry-based teaching methods are highly effective in enhancing students' prior knowledge of scientific concepts, increasing their engagement in lessons, and promoting a student-centered learning environment. This approach was shown to encourage critical thinking and active participation, leading to a deeper understanding of science content. Furthermore, the study found that demographic factors such as age and gender did not significantly influence the effectiveness of inquiry-based teaching strategies. However,

students' academic performance, particularly their grades, was positively correlated with the use of inquiry-based methods, suggesting that these strategies contribute to improved learning outcomes. Moreover, inquiry-based strategies are valuable in promoting deeper learning but highlight the importance of considering individual student factors such as grade performance when implementing such approaches. Based on these findings, the study proposed an action plan to further integrate and strengthen the application of inquiry-based strategies in science education. This action plan aims to provide teachers with professional development opportunities, enhance instructional resources, and foster a more interactive and engaging classroom environment, aiming to boost student performance in science. This study provides valuable insights for educators to improve teaching practices and enhance student achievement.

Keywords: *Grade performance, Inquiry-based teaching, Scientific inquiry, Student engagement, Student-centered learning*

INTRODUCTION

Background and Rationale

In the Philippines, science performance has remained poor for years. According to the 2022 Program for International Student Assessment (PISA), student performance in science has shown minimal improvement. Between 2018 and 2022, the country recorded a 2.2-percentage-point increase in mathematics proficiency, a 6.9-percent-point rise in reading proficiency, but a slight 0.8-percent-point

decline in science proficiency. This persistent underperformance poses challenges for teachers, who must improve their strategies and practices to adequately prepare students for high-stakes assessments such as the National Achievement Test (NAT) and PISA. These assessments have significant implications for student promotion, graduation, and even school funding. As a result, developing effective approaches to teaching science has become a major focus of scholars and educators worldwide.

One such approach is the inquiry-based method, which has been widely recognized as an effective strategy in science education. Inquiry-based learning (IBL) helps students develop essential skills and cognitive processes needed for scientific exploration. By encouraging learners to pose questions, conduct investigations, and collaborate with peers, IBL fosters critical thinking and deeper understanding. It also integrates technology, as students conduct online research, analyze information, and present findings, thereby enhancing their research and investigative skills. Importantly, inquiry-based methodologies benefit students from diverse backgrounds by promoting active engagement and cultivating lifelong learning skills.

Despite its proven advantages, however, the effective implementation of IBL in science classrooms remains uncertain. Challenges such as insufficient teacher preparation, lack of resources, and varying levels of institutional support have limited its widespread adoption. These barriers highlight the need for further exploration of both the effectiveness and practicality of IBL in the Philippine educational setting.

In this regard, the present study seeks to evaluate the extent to which the inquiry-based approach is utilized in teaching science. Specifically, within the context of Lucsuhin National High School, it aims to examine both the benefits and the constraints of implementing inquiry-based instruction and to provide practical recommendations for strengthening science education. Ultimately, this study supports the broader goal of enhancing science literacy, fostering lifelong learning, and equipping students with the skills necessary to meet the challenges of the twenty-first century.

Review of Related Literature

Inquiry-based learning (IBL) is a teaching approach that mirrors scientific inquiry, encouraging students to actively investigate, ask questions, and construct knowledge through exploration and problem-solving (Dmoshinskaia et al., 2021). By shifting the learning process from teacher-centered instruction to student-driven discovery, IBL promotes ownership of learning and enhances cognitive and critical thinking skills (Chen et al., 2018; Wale & Bishaw, 2020). Core inquiry skills—such as formulating questions, designing investigations, and executing research—are closely tied to students' analytical and planning abilities, requiring both critical thinking and organizational competencies (Pedaste et al., 2021).

Different models of IBL, including structured, guided, open, and coupled inquiry, offer varying degrees of teacher support. Structured and guided inquiry provide direction, while open and coupled inquiry fosters independence and critical analysis (Martin-Hansen, 2002). These approaches are rooted in constructivist principles, emphasizing active engagement, prior knowledge activation, and scaffolding, which enable students to connect new concepts to existing knowledge for deeper learning (Chien et al., 2019; Hollingsworth & Ybarra, 2019).

A consistent finding across research is that IBL improves student motivation, engagement, and higher-order thinking. Stimulating activities, class discussions, and collaborative tasks enhance intrinsic motivation, critical thinking, and communication skills (Hake, 2019; Jonassen et al., 2019). Active participation, rather than passive knowledge consumption, fosters dialogue, problem-solving, and deeper comprehension (Prince, 2019; Crawford, 2019). Scaffolding further sustains interest and supports students in building meaningful connections (Bransford et al., 2019).

Empirical studies strongly support the effectiveness of IBL in improving academic performance across subjects and grade levels. For example, Alqawasmi (2024) reported significant gains in science achievement among third-grade students taught through IBL compared to conventional methods, while Ali and Ulker (2020) found improvements in reading and writing skills among university students. Similar positive outcomes were reported in chemistry (Yeboah & Siaw, 2020), computer science (Edeh, 2020),

mathematics (Santos & Boyon, 2020), and science education (Salazar, 2020; Kaya & Avan, 2020). Furthermore, IBL enhances retention (Issaka, 2020), research skills (Urdanivia, 2023), and problem-solving abilities related to socioscientific issues (Qamariyah et al., 2021).

Large-scale studies also highlight IBL's broader impact. Cairns (2019), using PISA 2015 data across 69 countries, found positive associations between inquiry practices and science achievement, though the frequency of certain practices (e.g., experiments, idea explanations) influenced outcomes. Similarly, Wang et al. (2020) and Garcia et al. (2021) confirmed that activating prior knowledge significantly improves comprehension and performance in inquiry-based tasks.

Despite its recognized benefits, implementing IBL presents significant challenges in classroom practice. Systematic reviews indicate that many teachers struggle to align their teaching practices with inquiry-based methods, particularly during initiation, planning, and classroom implementation phases of practical work (Akuma & Callaghan, 2019). Some practices align with IBL principles but are not applied to their full potential, leading to inconsistencies in execution. Likewise, Marimuthoo and Nasri (2019) identified barriers such as inadequate teaching aids, lack of institutional support, and insufficient teacher confidence, which hinder effective implementation. These findings highlight the need to reassess disparities between teaching models and systemic expectations, ensuring that instructional approaches are better aligned with student needs and classroom realities.

Collectively, these studies underscore IBL's capacity to promote academic achievement, critical thinking, and 21st-century skills, while also drawing attention to the practical challenges teachers face in applying it consistently. By integrating prior knowledge, encouraging active engagement, and providing appropriate scaffolding, inquiry-based instruction offers a powerful alternative to traditional teacher-centered approaches. However, successful adoption requires adequate teacher training, sufficient resources, and systemic support to overcome barriers and maximize its impact on student learning (Saavedra & Opfer, 2019; Chen & Lee, 2023).

- Statement of the problem

The study aimed to evaluate the level of inquiry-based approach in teaching science at Lucsuhin National High School. Specifically, it sought answers to the following questions:

1. What is the demographic profile of the students in terms of:
 - 1.1 age, and
 - 1.2 sex
2. What is the level of scientific inquiry approach in terms of:
 - 2.1 prior knowledge activation,
 - 2.2. class engagement,
 - 2.3. creation of a student-centered environment, and
 - 2.4. cultivation of the 21st-century skills
3. What is the significant difference between the level of scientific inquiry approach and the demographic profile of the respondents?
4. What is the grade performance of the respondents in their science class during the first quarter?
5. What is the significant relationship between the grade performance of the respondents and the level of scientific inquiry approach?
6. What action plan can be proposed based on the findings of the study?

- Objectives and/or research hypotheses

This study will test the following hypotheses.

1. There is no significant difference between the level of scientific inquiry approach and the demographic profile of the respondents.
2. There is no significant relationship between the grade performance of the respondents and the level of scientific inquiry approach.

MATERIALS AND METHODS

• Research Design

This study employed a descriptive research design to investigate the level of an inquiry-based approach to the grade performance of the students at Lucsuhin National High School. Data collection was facilitated through a survey or questionnaire administered to the participants, with a focus on eliciting detailed insights into the respondents' opinions, ideas, and perceptions.

Quantitative data analysis was conducted using appropriate statistical techniques, including descriptive statistics to summarize the data and inferential statistics to explore relationships and associations. These analyses provided empirical evidence and contributed to exploring the level of inquiry-based approach to the grade performance of the student, providing a comprehensive view of the issue's ramifications. Ethical considerations, such as informed consent and data privacy, were upheld throughout the study.

• Participants

In this research context, the utilization of purposive sampling involves selecting participants based on specific criteria relevant to the study objectives. In this case, the researchers have opted to focus on Grade 9 students, specifically targeting four sections since they are under the direct supervision and instruction of the researcher herself. This selection method allows the researchers to ensure consistency and control over the data collection process, as they are intimately involved in the educational environment of these sections. Overall, this approach enhances the researchers' ability to gather relevant and reliable data aligned with the study's objectives.

• Instruments

This study used an adapted questionnaire developed by Ali and Ulker (2020) as the primary data collection instrument. The researcher first sought permission from the authors to use the questionnaire, and upon receiving approval, the instrument was subjected to pilot testing to assess its reliability. The survey questionnaire is made up of 16 questions evaluating scientific inquiry skills. It was divided into parts based on the four (4) dimensions of scientific inquiry regarding prior knowledge activation, class engagement, creation of a student-centered environment, and cultivation of 21st-century skills.

Moreover, it consisted of scales designed to evaluate the effectiveness of teaching strategies under the inquiry-based approach in teaching science. Respondents indicated their level of agreement with each item on a four-point Likert scale, ranging from "strongly agree" to "strongly disagree," with 1 representing the lowest and 4 representing the highest level of agreement. The scale was defined as follows:

Options	Scale Ranges	Verbal Interpretation
4	3.50-4.00	Strongly Agree
3	2.50-3.49	Agree
2	1.50-2.49	Disagree
1	1.00-1.49	Strongly Disagree

In addition, the first quarterly grade in Science from Form 138 of the students was reviewed to analyze the academic performance of the Grade 9 student respondents in Science for SY 2024-2025. The following categories of range were used to measure students' academic performance.

Equivalent Numerical Value	Level of Proficiency
90% and above	Outstanding
85% - 89%	Very Satisfactory
80% - 84%	Satisfactory
75% - 79%	Fairly Satisfactory
74% and below	Did not meet expectations

Source: DepEd order 31, S. 2012

- **Procedure**

First, a formal letter was drafted to request permission to conduct the study and administer the survey questionnaires to Grade 9 students at Lucsuhin National High School. After receiving approval, the researcher printed copies of the survey questionnaire for use in the study. The questionnaires were then distributed to the participants, accompanied by clear instructions for completion.

Once the data was collected, the completed survey questionnaires were meticulously organized to facilitate systematic analysis. Additionally, the researcher compiled records of the students from their science classes, as this data was also relevant to the study. The researcher then tallied, classified, and tabulated the data. The results were interpreted in light of the research questions and objectives. Finally, a comprehensive report summarizing the study's methodology, key findings, and implications was prepared, adhering to academic standards and guidelines.

- **Data Analysis**

To interpret the data, the researcher employed a variety of statistical tools to address research questions. The following statistical treatments were used to analyze and interpret the data:

Frequency and Percentage. This was used to determine the demographic characteristics of the respondents in terms of age and sex.

Weighted Mean. This was used to determine the students' assessment of the level of inquiry approach in teaching Science about prior knowledge activation, class engagement, creation of a student-centered environment, and cultivation of 21st century skills.

Pearson product-moment correlation. This is a statistical measure used to explore relationships between the level of scientific inquiry-based teaching strategies and the grade performance of the students.

Independent T-Test. This statistical hypothesis test is used to determine if there is a significant difference between the level of scientific inquiry approach when grouped according to profile.

RESULTS

Problem 1. What is the demographic profile of the students in terms of age and sex?

This part presents the distribution of the profile of the respondents in terms of age and sex.

Age. Table 1 provides valuable insights into the age demographics of the study's participants.

Table 1

Profile of the Respondents in terms of Age

Age	Frequency	Percent (%)
14 years old	80	78%
15 years old	22	22%
Total	102	100%

According to the data, 78% of the sample's participants are 14 years of age, and 15-year-olds make up just 22%. This indicates that this group has more 14-year-olds than 15-year-olds. This age distribution is likely because the study focused on grade 9 students, where most students are typically 14 years old. In many educational systems, grade 9 is generally made up of students who are around 14 years old, which explains why this age group is more represented in the sample. The smaller percentage of 15-year-olds (22%) could be because some students in grade 9 may be a year older than their peers, or some may have repeated a grade, making them older.

In conclusion, the higher number of 14-year-old respondents is directly related to the grade 9 student population, where most students are 14, while a smaller number of 15-year-olds is expected, given the grade structure.

Sex. Table 2 presents the distribution of respondents based on sex.

Table 2

Profile of the Respondents in terms of Sex

Sex	Frequency	Percent (%)
Male	40	39%
Female	62	61%
Total	102	100%

The data shows the gender distribution of the sample, with 40 males (39%) and 62 females (61%). This indicates that the sample consists of a higher proportion of females compared to males, with females making up 61% of the total group, while males make up 39%.

Problem 2. What is the level of scientific inquiry approach in terms of prior knowledge activation, class engagement, creation of a student-centered environment, and cultivation of the 21st-century skills?

This study presents the level of scientific inquiry approach in terms of prior knowledge activation, class engagement, creation of a student-centered environment, and cultivation of 21st-century skills.

Prior knowledge activation. Table 3 presents the level of scientific inquiry approach in terms of prior knowledge activation.

Table 3

The level of scientific inquiry approach in terms of prior knowledge activation

Statements	Mean	Interpretation
1. The teaching strategies used in the class encouraged me to recall and connect previous knowledge to new topics.	3.38	Agree
2. The teacher provides activities that help me identify what I already know about the topic.	3.44	Agree
3. Lessons begin with questions or discussions that stimulate my prior understanding of the topic.	3.36	Agree
4. The existing knowledge is valued and built upon during lessons.	3.32	Agree
Composite Mean	3.38	Agree

Legend: 3.50-4.00 = Strongly Agree; 2.50-3.49 = Agree; 1.50-2.49 = Disagree; 1.00-1.49 = Strongly Disagree

The data presented shows that students generally agree with the statements about the teaching strategies employed in the classroom, indicating that these strategies effectively facilitate the recall and connection of prior knowledge to new topics. The highest mean score of 3.44 for the statement, "The teacher provides activities that help me identify what I already know about the topic," reflects that students feel the activities help them activate their prior knowledge, which is essential for deeper learning. Similarly, the mean score of 3.38 for the statement "The teaching strategies used in the class encourage me to recall and connect previous knowledge to new topics" suggests that students recognize the importance of their previous learning experiences in understanding new content. The statement "Lessons begin with questions

or discussions that stimulate my prior understanding of the topic" also received a positive response with a mean score of 3.36, implying that students appreciate how their initial understanding is stimulated at the start of lessons through questioning or discussions. Finally, the mean score of 3.32 for "The existing knowledge is valued and built upon during lessons" suggests that students feel their prior knowledge is acknowledged and used as a foundation for learning throughout the lessons. The overall composite mean of 3.38 reinforces that, as a whole, the teaching strategies are well-received by students in terms of connecting and building on prior knowledge.

These results are consistent with recent studies on successful teaching techniques. Prior knowledge activation is crucial for enhancing learning outcomes, according to studies. Recent research, for instance, shows that improving comprehension and retention requires the activation of prior information. A 2019 study by Chien et al. found that students are better able to integrate and retain new content when they actively engage with their prior knowledge before acquiring new information. Furthermore, scaffolding—in which teachers help students build on their prior knowledge—has been recognized as a crucial component of successful instruction (Hollingsworth & Ybarra, 2019). This approach promotes more meaningful learning experiences by assisting students in making connections between new material and preexisting mental models. Research also supports the use of inquiry-based learning (IBL), which frequently starts with thought-provoking questions or discussions (Moss & Brookhart, 2019). These strategies are crucial in creating a student-centered learning environment that encourages active engagement and the application of prior knowledge to new contexts.

Class engagement. Table 4 presents the level of scientific inquiry approach in terms of class engagement.

Table 4

The level of scientific inquiry approach in terms of class engagement

Statements	Mean	Interpretation
1. The teaching strategies keep me actively involved throughout the lesson.	3.34	Agree
2. The class activities are interesting and encourage me to participate more.	3.31	Agree
3. During class discussions, my teacher gives me opportunities to ask questions and share my ideas.	3.30	Agree
4. The teaching strategies allow me to stay focused and involved in the learning process.	3.33	Agree
Composite Mean	3.32	Agree

Legend: 3.50-4.00 = Strongly Agree; 2.50-3.49 = Agree; 1.50-2.49 = Disagree; 1.00-1.49 = Strongly Disagree

The statement, "The teaching strategies keep me actively involved throughout the lesson," received the highest mean score of 3.34, suggesting that students feel actively engaged during lessons. The teaching strategies are seen as maintaining their involvement, which is essential for fostering deep learning. Active participation is a cornerstone of inquiry-based learning (IBL), where students engage with the content and the process of discovery, rather than passively receiving information. This is in line with studies on active learning techniques, where Prince (2019) highlights how active learning empowers students to take charge of their education through conversation, problem-solving, and interaction with the content, all of which are essential components of inquiry-based learning (IBL).

Similarly, the statement "The class activities are interesting and encourage me to participate more" had a mean score of 3.31, indicating that students find the class activities engaging, which motivates further participation. Engaging activities are a key factor in fostering intrinsic motivation, and the high mean score

suggests these activities are designed to spark curiosity, which is a critical element of scientific inquiry. This result is in line with Hake's (2019) assertion that engaging and relevant activities boost student motivation and involvement. Additionally, this supports constructivism, which holds that students are more motivated when they find the learning process interesting and meaningful (Bada & Olusegun, 2019).

The statement, "During class discussions, my teacher gives me opportunities to ask questions and share my ideas," received a mean score of 3.30, reflecting that students feel they have opportunities to contribute during class discussions. Encouraging students to ask questions and share their ideas is vital for fostering an environment where inquiry thrives, as it reflects a student-centered approach where teachers act as facilitators rather than lecturers, guiding students to explore topics in-depth. According to Jonassen et al. (2019), class discussions and chances for students to express their opinions are crucial elements of inquiry-based learning and collaborative learning. Fostering an environment where students can create and investigate their questions is just as important as providing answers in inquiry-based learning (Crawford, 2019).

Lastly, the statement, "The teaching strategies allow me to stay focused and involved in the learning process," received a mean score of 3.33, suggesting that students feel the teaching strategies employed help them remain focused and involved throughout the lesson. This demonstrates the value of scaffolding, in which the instructor offers just enough assistance to maintain students' attention without being overbearing. According to Bransford et al. (2019), it's critical to keep students' attention by using organized teaching techniques that offer direction while promoting participation. In the context of inquiry-based learning, scaffolding improves student engagement by providing prompt assistance that enables students to maintain attention on learning goals and build on prior knowledge.

The composite mean of 3.32 reflects a general agreement that the teaching strategies employed in the classroom successfully promote student engagement. Students are actively involved, find class activities interesting, and feel encouraged to participate and share their ideas during discussions. These findings suggest that the teaching approach is effective in maintaining focus and fostering an environment conducive to active, inquiry-based learning. The findings are consistent with modern educational ideas that emphasize the value of participation, engagement, and inquiry in the learning process. With its focus on inquiry, investigation, and student-led conversations, inquiry-based learning (IBL) has gained widespread recognition as a successful strategy for raising student engagement and improving learning outcomes (Jonassen et al., 2019). Furthermore, the notion that giving students the chance to interact with the material and share their thoughts promotes greater comprehension and retention is supported by the combination of active learning and scaffolding.

Creation of a student-centered environment. Table 5 presents the level of scientific inquiry approach to the creation of a student-centered environment.

Table 5

The level of scientific inquiry approach to the creation of a student-centered environment

Statements	Mean	Interpretation
1. The teaching strategies allow me to explore topics independently or in groups.	3.36	Agree
2. My opinions and contributions are respected and encouraged during lessons.	3.32	Agree
3. There is freedom in exploring and discovering solutions to problems on my own.	3.35	Agree
4. Lessons are designed in a way that considers my learning pace or preferences.	3.30	Agree
Composite Mean	3.34	Agree

Legend: 3.50-4.00 = Strongly Agree; 2.50-3.49 = Agree; 1.50-2.49 = Disagree; 1.00-1.49 = Strongly Disagree

The statement "The teaching strategies allow me to explore topics independently or in groups" received the highest mean score of 3.36, suggesting that students feel the teaching strategies provide ample opportunities for both independent and group exploration of topics. This aligns with the principles of constructivist learning, which emphasizes the importance of engaging students in the learning process by allowing them to explore topics according to their interests and needs. According to Jonassen et al. (2019), providing opportunities for independent or group exploration enhances critical thinking and problem-solving skills, which are key components of the scientific inquiry approach. The statement "My opinions and contributions are respected and encouraged during lessons" scored 3.32, indicating that students feel their ideas are valued, which is crucial for fostering a student-centered environment. Crawford (2019), who argues that inquiry-based learning thrives when students actively engage in the process, claims that promoting student input increases engagement and cultivates a sense of ownership over one's education. The statement "There is freedom in exploring and discovering solutions to problems on my own" received a mean score of 3.35, reflecting those students appreciate the autonomy to explore and solve problems independently, which is a hallmark of scientific inquiry. According to Bransford et al. (2019), who stress the value of allowing students to find answers in student-centered contexts, this autonomy encourages critical thinking and problem-solving. Lastly, the statement "Lessons are designed in a way that considers my learning pace or preferences" had a mean score of 3.30, suggesting that while students generally feel their learning pace is considered, there is room for further improvement in personalizing lessons. This is aligned with the idea of individualized learning, which modifies training to suit each student's needs. Hattie (2019) asserts that recognizing and addressing a variety of learning styles and speeds is essential to effective teaching. Overall, students believe that the teaching practices are effective in creating a student-centered atmosphere, as indicated by the composite mean score of 3.34. These results are consistent with the tenets of student-centered learning and scientific inquiry, which provide students with chances for autonomous investigation, value their input, and adapt classes to meet their various learning requirements.

Cultivation of the 21st century skills. Table 6 presents the level of scientific inquiry approach in relation to cultivation of the 21st-century skills.

Table 6
The level of scientific inquiry approach to cultivation of the 21st-century skills

Statements	Mean	Interpretation
1. The teaching strategies improve my critical thinking and problem-solving skills.	3.31	Agree
2. My teacher encourages me to collaborate with my classmates during lessons.	3.30	Agree
3. The teaching strategies help me develop communication skills through discussions and presentations.	3.38	Agree
4. My teacher exposes me to real-world problems that enhance my creativity and innovation.	3.37	Agree
Composite Mean	3.34	Agree

Legend: 3.50-4.00 = Strongly Agree; 2.50-3.49 = Agree; 1.50-2.49 = Disagree; 1.00-1.49 = Strongly Disagree

The statement "The teaching strategies help me develop communication skills through discussions and presentations" received the highest mean score of 3.38, indicating that students feel the strategies are particularly effective in enhancing their communication skills. Through discussions and presentations, students have opportunities to express their ideas, which is crucial in both academic and real-world contexts. This aligns with Hattie (2019), who highlights the importance of discussion-based teaching strategies in improving communication, as well as Jonassen et al. (2020), who contend that inquiry-based learning environments help students refine their ability to articulate complex ideas clearly.

The statement "My teacher exposes me to real-world problems that enhance my creativity and innovation" received a mean score of 3.37, suggesting that students believe addressing authentic challenges encourages creative thinking and innovative problem-solving. This is a key aspect of scientific inquiry and problem-based learning, where students are encouraged to apply their knowledge to real-world scenarios. Bransford et al. (2019) assert that real-world problems stimulate creative thinking, while Crawford (2020) highlights their role in developing innovation and problem-solving skills in inquiry-based and project-based learning environments.

The statement "The teaching strategies improve my critical thinking and problem-solving skills" received a mean score of 3.31, indicating that students feel the strategies help enhance their ability to think critically and solve problems. These skills are essential to the scientific inquiry process, where students analyze information and devise solutions to complex challenges. Jonassen et al. (2020) argue that teaching strategies promoting critical thinking and problem-solving are fundamental to deep learning, while Bransford et al. (2019) emphasize the importance of these skills in inquiry-based learning, where students approach problems from multiple perspectives and generate evidence-based solutions.

Lastly, the statement "My teacher encourages me to collaborate with my classmates during lessons" received the lowest mean score of 3.30, but it still reflects general agreement. While students perceive collaboration as encouraged, they may feel that it is less emphasized compared to other strategies. Collaboration is crucial for sharing ideas, developing teamwork skills, and solving problems collectively. Crawford (2020) and Hake (2019) both highlight the importance of collaboration in inquiry-based learning, noting that it enhances cognitive and social development, allowing students to engage with diverse perspectives.

The composite mean score of 3.34 reflects that students generally agree that the teaching strategies effectively foster the development of critical thinking, collaboration, communication, and creativity. These strategies are seen as contributing positively to essential skills that are vital for both academic success and real-world applications.

Problem 3. What is the significant difference between the level of scientific inquiry approach and the demographic profile of the respondents?

This part presents the summary of statistical analysis performed to determine the differences in the level of scientific inquiry approach when they are grouped according to profile. To explain the differences in the level of occupational stress vulnerability of the teachers, the hypothesis was tested through a t-test. The null hypothesis stated that there is no significant difference between the level of scientific inquiry approach and the demographic profile of the respondents. This study used a 0.05 level of significance in deciding on the null hypothesis (H₀).

Table 7

Significant Differences in the Level of Scientific Inquiry Approach When They Group According To Age

Scientific Inquiry Approach	F-value	p-value	Decision on H₀	Interpretation
Prior knowledge activation	0.177	0.861	Failed to Reject	Not Significant
Class engagement	-0.217	0.830	Failed to Reject	Not Significant
Creation of a student-centered environment	-0.521	0.606	Failed to Reject	Not Significant
Cultivation of the 21st-century skills	-0.549	0.587	Failed to Reject	Not Significant

The results suggest that age does not significantly impact the application of various aspects of the scientific inquiry approach. Whether it was activating prior knowledge, engaging students in class, creating a student-centered environment, or cultivating 21st-century skills, no significant differences were found between the age groups.

In terms of prior knowledge activation, the F-value (0.177) is very small, and the p-value (0.861) is significantly greater than the typical significance level ($\alpha = 0.05$). This indicates that there is no significant difference in how different age groups activate prior knowledge in the context of scientific inquiry. This is in line with Huang, J., & Kuo, C.'s findings. (2021) discovered that when it comes to scientific inquiry, previous knowledge activation is essentially age independent. This is because both younger and older learners bring past knowledge that influences their learning in similar ways, even though they may access and apply it differently. According to the study, age has less of an impact on activating prior knowledge than experience and prior schooling.

With regards to class engagement, an F-value of -0.217 and a p-value of 0.830 fail to reject the null hypothesis. This suggests that there is no significant difference in the level of class engagement based on age. This aligns with the observations of Yang, L., & Chen, M. (2022), who found that while engagement in learning activities can vary by age, in the context of inquiry-based learning, engagement was largely determined by the teaching methods and the complexity of the tasks, rather than the age of the students. Both younger and older learners showed similar engagement levels when the class environment was designed to be interactive and inquiry-driven.

For the creation of a student-centered environment, the p-value (0.606) is much larger than 0.05, which means it fails to reject the null hypothesis. This indicates that age does not have a significant effect on how a student-centered environment is created in the context of scientific inquiry. This finding supports the conclusions of Kim, J. S. & Kim, H. K. (2020), who found no significant differences in the creation of student-centered environments among various age groups. The study suggested that a well-structured and inclusive environment that encourages participation and critical thinking is effective for learners across different age groups. Thus, the role of age in shaping the approach to creating such environments was minimal.

Lastly, the cultivation of 21st-century skills shows no significant difference between the age groups. The study of Li, J. & Zhang, Y. (2021) demonstrated that the cultivation of 21st-century skills like critical thinking, collaboration, and digital literacy is essential for learners at all age levels. Their research found that both young and adult learners benefit similarly from inquiry-based methods that focus on these skills.

Table 8

Significant Differences in the Level of Scientific Inquiry Approach When They Group According To Sex

Scientific Inquiry Approach	F-value	p-value	Decision on Ho	Interpretation
Prior knowledge activation	0.501	0.617	Failed to Reject	Not Significant
Class engagement	0.708	0.480	Failed to Reject	Not Significant
Creation of a student-centered environment	0.868	0.387	Failed to Reject	Not Significant
Cultivation of the 21st-century skills	-0.122	0.902	Failed to Reject	Not Significant

The p-value (0.617) is greater than the standard significance level of 0.05, which means it fails to reject the null hypothesis (H_0). This indicates that there is no significant difference in how males and females activate prior knowledge in the context of scientific inquiry. Engagement in learning activities tends to be influenced by the teaching method, interest in the subject, and the classroom environment, rather than gender (Fredricks, Blumenfeld, & Paris, 2019). Both male and female students can engage effectively in inquiry-based learning environments if they find the material relevant and engaging. A study by Sungur and Tekkaya (2021) also suggests that engagement is more about the structure of the inquiry activities than the sex of the participant.

Problem 4. What is the grade performance of the respondents in their science class during the first quarter?

This part presents the summary of the first quarterly grades in science for the respondents.

Table 9

The academic grades of the respondents in their science class during the first quarter

Grade	Frequency	Percent (%)	Cumulative Percent	Interpretation
90% and above	46	45.10	45.10	Outstanding
85% - 89%	55	53.92	99.02	Very Satisfactory
80% - 84%	1	0.98	100	Satisfactory
75% - 79%	0	0	100	Fairly Satisfactory
74% and below	0	0	100	Did not meet the expectation
Total	102	100%		
		Mode	85% - 89%	Very Satisfactory

Scale: 90% and above = Outstanding; 89%-85 % = Very Satisfactory; 84%-80 % = Satisfactory; 79%-75 % = Satisfactory; 74% and below = Did not meet expectations (Source: DepEd order 31, S. 2012)

The first quarter academic grades of the respondents in their science class are summarized in Table 9. The majority of respondents (53.92%) received a grade between 85% and 89%, which is categorized as "Very Satisfactory." This means that more than half of the respondents did well, barely missing the "Outstanding" mark. With a score of 90% or above, the second-largest group (45.10% of respondents) received an "Outstanding" rating. Only 0.98% of the respondents received a score between 80% and 84%, which is categorized as "Satisfactory." No student received a score lower than 80%, indicating that every respondent met or beyond the course's minimal requirements.

The grades' average falls within the "85% - 89%" range, which represents the highest grade achieved by respondents, which corresponds to the "Very Satisfactory" category.

Problem 5. What is the significant relationship between the grade performance of the respondents and the level of scientific inquiry approach?

This section provides an overview of the statistical analysis conducted to establish the relationship between the grade performance of the respondents and the level of scientific inquiry approach, Pearson's r Correlation Coefficient was employed to test the hypothesis. The null hypothesis posited that there is no significant relationship between the grade performance of the respondents and the level of scientific inquiry approach. The study utilized a significance level of 0.05 to make decisions regarding the null hypothesis (H_0).

Table 10

Significant Relationship between the grade performance of the respondents and the level of scientific inquiry approach in terms of prior knowledge activation

Student's Performance	R-value	Degree of Relationship	p-value	Decision on H_0	Interpretation
Prior knowledge activation	0.238	Weak Positive	0.016	Reject	Significant

Legend: Coefficient of correlation (r): +1.0 (Perfect relationship), +.76 to .99 (Very Strong relationship), +.51 to .75 (Strong relationship), +.26-.50 (Moderate Relationship), +.11 to .25 (Weak relationship), +.01 to .10 (Very weak relationship), .00 (No relationship)

The R-value of 0.238 and the p-value of 0.016 indicate that there is a weak positive correlation between the grade performance of the respondents and their level of scientific inquiry approach in terms of prior knowledge activation. This suggests that, as students' prior knowledge activation increases, their academic performance tends to increase slightly. However, the relationship is not very strong, indicating that other factors may influence the grade performance.

Since the p-value is 0.016, which is less than the typical significance level of 0.05, we reject the null hypothesis (H_0). This means that there is a statistically significant relationship between prior knowledge activation and grade performance, indicating that prior knowledge activation likely plays a role in enhancing students' academic outcomes, though it is a moderate one.

According to a 2020 study by Wang et al., students' comprehension and performance in scientific inquiry activities can be greatly enhanced by drawing on their prior knowledge. This is consistent with the current observation that grade performance and prior knowledge activation are positively correlated. Furthermore, prior knowledge activation promotes deeper learning engagement, which may lead to improved academic results, according to research by Garcia et al. (2021). According to a 2023 review by Chen and Lee, students are more likely to make connections between new information and preexisting concepts when they are encouraged to activate their prior knowledge. This leads to better academic achievement and problem-solving ability.

Table 11

Significant Relationship between the grade performance of the respondents and the level of scientific inquiry approach in terms of class engagement

Student's Performance	R-value	Degree of Relationship	p-value	Decision on H_0	Interpretation
Class Engagement	0.339	Moderate Positive	0.0004	Reject	Significant

Legend: Coefficient of correlation (r): +1.0 (Perfect relationship), +.76 to .99 (Very Strong relationship), +.51 to .75 (Strong relationship), +.26-.50 (Moderate Relationship), +.11 to .25 (Weak relationship), +.01 to .10 (Very weak relationship), .00 (No relationship)

The R-value of 0.339 and the p-value of 0.0004 indicate a moderate positive correlation between class engagement and student performance in the context of a scientific inquiry approach. This means that as students become more engaged in class activities, their academic performance tends to improve. The p-value of 0.0004, being significantly smaller than the standard significance level of 0.05, shows that this relationship is statistically significant, and the observed correlation is unlikely to have occurred by chance. Therefore, we reject the null hypothesis (H_0), concluding that class engagement positively influences student performance in a meaningful way, though the strength of the relationship is moderate.

According to a 2020 study by Wang et al., students' comprehension and performance in scientific inquiry activities can be greatly enhanced by drawing on their prior knowledge. This is consistent with the current observation that grade performance and prior knowledge activation are positively correlated. Furthermore, prior knowledge activation promotes deeper learning engagement, which may lead to improved academic results, according to research by Garcia et al. (2021). According to a 2023 review by Chen and Lee, students are more likely to make connections between new information and preexisting concepts when they are encouraged to activate their prior knowledge. This leads to better academic achievement and problem-solving abilities. Studies indicate that even a moderate activation of prior knowledge can have favorable effects, even though the link is weak in the current data.

Table 12

Significant Relationship between the grade performance of the respondents and the level of scientific inquiry approach in terms of the creation of a student-centered environment.

Student's Performance	R-value	Degree of Relationship	p-value	Decision on Ho	Interpretation
Creation of a Student-centered environment.	0.280	Weak Positive	0.004	Reject	Significant

Legend: Coefficient of correlation (r): +1.0 (Perfect relationship), +.76 to .99 (Very Strong relationship), +.51 to .75 (Strong relationship), +.26-.50 (Moderate Relationship), +.11 to .25 (Weak relationship), +.01 to .10 (Very weak relationship), .00 (No relationship)

The R-value of 0.280 and p-value of 0.004 indicate a weak positive correlation between the creation of a student-centered environment and student performance in the context of a scientific inquiry approach. This means that as the student-centered environment improves, students' academic performance tends to improve slightly. The p-value of 0.004 is less than the typical significance threshold of 0.05, indicating that the relationship is statistically significant. Therefore, the null hypothesis (Ho) is rejected, meaning there is a significant relationship between the creation of a student-centered environment and student performance. Although the relationship is weak, it is still meaningful and suggests that a more student-centered environment can contribute to better academic outcomes.

Table 13

Significant Relationship between the grade performance of the respondents and the level of scientific inquiry approach in terms of the creation of cultivation of 21st century skills.

Student's Performance	R-value	Degree of Relationship	p-value	Decision on Ho	Interpretation
Cultivation of 21st-century skills.	0.196	Weak Positive	0.048	Reject	Significant

Legend: Coefficient of correlation (r): +1.0 (Perfect relationship), +.76 to .99 (Very Strong relationship), +.51 to .75 (Strong relationship), +.26-.50 (Moderate Relationship), +.11 to .25 (Weak relationship), +.01 to .10 (Very weak relationship), .00 (No relationship)

The data above indicates a weak positive correlation (R-value = 0.196) between the cultivation of 21st-century skills and student performance, suggesting that as the cultivation of these skills increases, student performance slightly improves. The p-value of 0.048 suggests that this relationship is statistically significant, meaning that there is sufficient evidence to reject the null hypothesis (Ho). Therefore, we can conclude that there is a significant relationship between the cultivation of 21st-century skills and student performance, though the correlation is weak.

This result is consistent with recent research on the value of 21st-century abilities for academic success. Research has repeatedly demonstrated that developing abilities including communication, teamwork, problem-solving, and critical thinking can improve student performance (Saavedra & Opfer, 2019). These abilities are becoming more and more important for success in the workforce and contemporary schooling. Students who possess 21st-century abilities typically do better because they promote a deeper comprehension of the material and improve the capacity to apply knowledge in real-world situations, according to a study by Binkley et al. (2020).

Problem 6. What action plan can be proposed based on the findings of the study?

Title of the Program/Activity: Enhancing Inquiry-Based Learning for Improved Student Engagement and Academic Success in Science.

I. Rationale

This action plan aims to enhance the implementation of inquiry-based learning, leading to improved student engagement, better understanding of scientific concepts, and higher academic performance. Through ongoing teacher development, curriculum enhancements, differentiated support, and greater collaboration, students will be better prepared to succeed in Science and develop the critical skills needed for the 21st century. Furthermore, the integration of technology, peer collaboration, and student-centered learning strategies will foster curiosity, creativity, and independent thinking. By addressing existing challenges such as resource limitations and instructional gaps, this plan ensures a more inclusive, engaging, and effective learning environment. Continuous monitoring and evaluation will be conducted to assess progress, adapt strategies, and sustain long-term educational improvements.

II. Objectives:

1. To implement inquiry-based learning (IBL) strategies in science education
2. To improve students' academic performance and critical thinking skills
3. To address implementation challenges by providing teacher training and resources
4. To foster collaboration among students through peer-led activities and inquiry-driven discussions.
5. To integrate technology and interactive simulations to deepen scientific understanding and engagement.

III. Strategies/Activities

Key Results Area	Strategies	Key Persons	Resources Needed	Time Frame	Budgetary Requirement and Source of Fund	Success Indicators
Instructional Leadership and Capacity Building	1. Conduct Lac sessions to showcase best practices in applying inquiry-based strategies.	Head teachers, Master teacher, science teachers	Training materials, speakers	Once during each grading period	Training materials ₱ 5,000 Token and certificates ₱ 3,000 Source of Fund: MOOE	Trained faculty members

	2. Encourage active collaboration among teachers during LAC sessions to share inquiry-based teaching strategies, classroom experiences, and challenges.	Head teachers, Master teacher, science teachers	Training materials, speakers	Once during each grading period	Training materials ₱ 5,000 Token and certificates ₱ 3,000 Source of Fund: MOOE	Teachers will be able to share actionable strategies and resources, engage in reflective discussions, and ultimately improve their teaching practices
	3. Coordinate with the head teacher/master teacher on the conduct of teaching demonstration.	Head teachers, Master teacher, Science teachers	Teaching aids, evaluation tool	Once during each grading period	Resource materials: ₱ 3,000 Monitoring and Evaluation tool: ₱1,500 Source of Fund: MOOE	Teachers will be able to facilitate teaching demonstration of scientific inquiry-based instruction.
Instructional Enhancement and Reflection	4. Engage in a reflective discussion about the lesson, focusing on the specific inquiry-based strategies implemented, as well as the key areas that need improvement and further development.	Head teachers, Master teacher, Science teachers	Teaching aids, evaluation tool	Year-round	Monitoring and Evaluation tool: ₱1,500 Source of Fund: MOOE	High levels of participation and active questioning from students.
Curriculum and Resource Development	5. Prepare supplementary resources such as practice exercises, activity sheets,	Teachers, students	Reference book, internet, printed materials	Year-round	Printing materials: ₱ 2,000 Source of Fund:	The student will improve their performance in Science.

	and study guides to reinforce learning.				Teaching allowance	
Student Learning Support	6. Organize peer-led study groups where students can collaboratively work through difficult concepts, share study tips, and learn from each other.	Teacher s, students	Referen ce book, internet, printed material s	Year-round	Printing materials: ₱ 2, 000 Source of Fund: Teaching allowance	Students demonstrate better comprehensi on during class discussions
Technology Integration in Learning	7. Introduce interactive digital tools, online simulations, and virtual labs to support inquiry-based activities and help students access supplementary learning materials.	Teacher s, students	Referen ce book, internet, laborato ry, printed material s	Year-round	Internet: ₱3,000 Source of Fund: Teaching allowance	Technical Competency and Digital Literacy among the student
Monitoring and Evaluation	8. Conduct post implementation review and revision	All stakehol ders	Reports, meeting material s	Decemb er 2025	Resource materials: ₱ 3, 000 Source of Fund: MOOE	Revise IBL strategies based on feedbacks.

DISCUSSION

1. According to the data, the vast majority of participants are 14 years old, which is the average age of pupils in Grade 9. One possible explanation for the lower percentage of 15-year-olds is that some kids are older because they started school later or retake a grade. In terms of gender, there is a higher proportion of females compared to males, which is consistent with typical patterns seen in Grade 9 classrooms.

2. Inquiry-based teaching strategies are highly effective in connecting and building on students' prior knowledge, promoting student engagement, and fostering a student-centered environment. In this approach, students have opportunities for independent exploration, where their contributions are valued, and lessons

are designed to accommodate their diverse learning needs. Furthermore, inquiry-based teaching encourages the development of critical thinking, collaboration, communication, and creativity—skills that are essential for both academic success and real-world applications.

3. The study findings reveal that age and gender do not significantly influence the application of various aspects of the scientific inquiry approach. This suggests that there is no notable difference across age groups and genders in terms of activating prior knowledge, enhancing class engagement, fostering a student-centered environment, and developing 21st-century skills within the context of scientific inquiry.

4. Strong performance was indicated by the majority of respondents' grades, which fell into the "Very Satisfactory" range. A significant number of students demonstrated outstanding achievement, earning scores in the "Outstanding" category. A small group's performance was deemed satisfactory, as evidenced by their ratings falling into the "Satisfactory" category. Notably, no student received a score lower than the course minimum, indicating that every participant met or beyond expectations.

5. The study findings show that grade performance is significantly influenced by the scientific inquiry approach, particularly in activating prior knowledge, increasing class engagement, fostering a student-centered environment, and developing 21st-century skills. Activating prior knowledge helps students better understand new concepts, while high engagement leads to deeper learning and improved retention. A student-centered approach promotes autonomy and critical thinking, enhancing academic performance. Additionally, the development of 21st-century skills, like communication and collaboration, supports students' overall success, preparing them for the modern world.

6. The proposed action plan aims to enhance the implementation of inquiry-based learning, leading to improved student engagement, better understanding of scientific concepts, and higher academic performance. Through ongoing teacher development, curriculum enhancements, differentiated support, and greater collaboration, students will be better prepared to succeed in Science and develop the critical skills needed for the 21st century.

Conclusion

Based on the highlights of the findings, the following conclusions were drawn:

1. The age and gender distributions are consistent with the typical characteristics of Grade 9 students, with a predominance of 14-year-olds and a higher number of females in the sample.

2. Inquiry-based teaching strategies engage students actively in learning, connecting new knowledge to their prior understanding, and fostering critical thinking. By promoting independent exploration and a student-centered environment, these strategies value students' contributions and accommodate diverse learning needs. Additionally, inquiry-based learning develops key skills such as critical thinking, collaboration, communication, and creativity, which are essential for academic success and future real-world applications.

3. The aspects of the scientific inquiry approach—such as prior knowledge activation, class engagement, the creation of a student-centered environment, and the development of 21st-century skills—prove to be equally effective across various age groups and genders. This suggests that all students, regardless of these factors, can equally benefit from and actively engage with the approach.

4. The results of the study indicate that the majority of students demonstrated strong academic performance, with most achieving high levels of success through the application of the scientific inquiry approach in the classroom.

5. The scientific inquiry approach plays a crucial role in enhancing grade performance by effectively activating prior knowledge, fostering class engagement, creating a student-centered learning environment, and developing 21st-century skills. These elements work together to improve students' understanding, retention, and application of new concepts, while also promoting autonomy, critical thinking, and collaboration. By integrating these components, students are better prepared for academic success and equipped with the skills needed to thrive in an increasingly complex and interconnected world.

6. The proposed action plan increases student performance and overall academic accomplishment by strengthening and expanding the use of inquiry-based approaches in the science classroom.

After carefully gathering the necessary data, the researchers developed the following recommendations.

1. To provide a more comprehensive understanding of the study's findings, it is recommended that future research concentrate on attaining more balanced gender representation in their samples.
2. Teachers may be given continual training and assistance to successfully apply inquiry-based teaching methods. This will assist them in developing dynamic, student-focused classes and encouraging inquiry and critical thinking.
3. Educators may consistently apply the scientific inquiry approach to make sure that every student has an equal chance to participate actively in and gain from the learning process.
4. Teachers may continue to provide clear guidance and support to ensure students remain engaged and perform at their best. Targeted interventions such as additional review sessions or study resources could help them perform better.
5. Ongoing professional development may be provided to educators to enhance their understanding and application of the scientific inquiry approach. Moreover, to continuously enhance teaching strategies for the best learning results, schools should conduct assessments regularly to evaluate how well the scientific inquiry approach is working.
6. The proposed action plan may be examined, evaluated, and executed to further improve and enrich the utilization of inquiry-based approaches and the achievement of learners' performance.

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