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# Associating Teachers' Pedagogical Strategies and Students' Mastery of Learning Competencies in Science 7

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## ABSTRACT

This research determined the teaching strategies employed by Science teachers and their relationship to students' performance and mastery of the prescribed Science learning competencies at Awihao National High School, Toledo City Division, South District–Cluster 1 during the School Year 2026–2027. Using a descriptive-correlational research design, the study involved eight (8) Science teachers and fifty (50) Grade 7 learners. Data were collected through a researcher-made questionnaire and an achievement test and analyzed using frequency, percentage, weighted mean, standard deviation, ranking, and Pearson Product-Moment Correlation Coefficient. The findings revealed that teachers employed teaching strategies to a high extent, while students demonstrated an overall Moving Towards Mastery level of performance. A significant and very strong positive relationship was found between teachers' teaching strategies and students' performance ($r = 0.918$, $p = 0.0013$), indicating that greater reported use of teaching strategies was associated with higher student performance. The study also identified resource- and facility-related concerns that affect Science instruction. Based on the findings, a Science Enrichment Activity Program (SEAP) was developed to strengthen inquiry-based, differentiated, and collaborative instructional practices and enhance students' mastery of Science learning competencies.

***KEYWORDS:*** *MAEd major in Administration and Supervision, teaching strategies, students' performance, Science learning competencies, inquiry-based instruction, differentiated instruction, collaborative learning, enrichment activity program, Awihao, Toledo City.*

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## INTRODUCTION

In the modern global knowledge economy, science education is a crucial pillar of innovation, critical thinking, technological progression, and socioeconomic growth. As countries become more reliant on scientific breakthroughs and technical knowledge, the quality of STEM training has emerged as a critical criterion for national success. Recognizing this requirement, educational systems around the world have made significant investments in revamping curricula to promote deep conceptual comprehension rather than rote memorization.

In the Philippines, the Department of Education (DepEd) has consistently reformed its instructional frameworks to improve scientific literacy and global competitiveness among Filipino students. At the heart of this systemic shift is the teacher's pedagogical competency. Contemporary educational research views pedagogical competence as a dynamic, multidimensional construct that connects profound content knowledge, psychological readiness, classroom management, adaptive methodologies, and socio-cultural responsiveness (Al-Khresheh, 2021; Apoko & Cahyono, 2024). When teachers have strong pedagogical skills, they can successfully scaffold complicated concepts, and develop inclusive learning.

The progressive statewide adoption of the MATATAG Curriculum, a landmark educational reform aiming to reduce learning poverty and decongest previous instructional frameworks, has dramatically increased the stakes for teacher competence (DepEd, 2024). In science education, the

MATATAG curriculum expressly calls for a change away from traditional teacher-centered lectures and toward deep, participatory, and inquiry-based STEM activities that emphasize real-world applications and critical problem-solving skills (Santos & Delgado, 2025). This revised curriculum requires teachers to guide students through four key conceptual, spiral-progression strands: Science of Materials, Life Science, Force, Motion, and Energy, and Earth and Space Science. To help students attain true mastery of these core domains, classroom educators must demonstrate outstanding mastery not only in content knowledge but also in diversified learning settings, individualized instruction, and community-linked professional involvement (Madrid & Oco, 2025).

However, converting these high-level curricular innovations into excellent student learning outcomes is a persistent and localized difficulty in secondary public schools. Recent studies in the Philippine public school system show a significant gap between modern pedagogical theories and actual classroom implementation, which is frequently exacerbated by uneven professional teacher development, heavy administrative loads, and a lack of continuous institutional feedback (Avenido & Buquia, 2024; Jumawan & Fabiania, 2025). When teachers face moderate problems in certain science strands or fail to use instructional strategies tailored to learner variety, pupils struggle to fulfill minimum competence criteria. This results in the accumulation of "least learned competencies" that follow children to higher grade levels (Dordas & Accad, 2024). This pedagogical misalignment underlines the urgent need for localized diagnostic assessments that can identify exactly where teachers need help and how their instructional characteristics interact with student demographics.

At Awihao National High School, Toledo City Division, South District–Cluster 1, this study describes teachers' demographic and professional profiles and examines the relationship between their use of teaching strategies and students' mastery of selected Science 7 learning competencies. The Philippine Professional Standards for Teachers provide a broader context for instructional practice, while the study specifically measures inquiry-based, differentiated, and collaborative strategies.

The study establishes a local baseline for the use of these three teaching strategies and for learners' mastery of scientific models, the particle model of matter, and the properties and behavior of particles. The findings informed the proposed Science Enrichment Activity Program (SEAP), which provides contextualized inquiry-based, differentiated, and collaborative activities for Grade 7 learners at Awihao National High School.

**Theoretical and Conceptual Framework and Legal Bases**

The theoretical framework draws on Shulman's Pedagogical Content Knowledge framework, Vygotsky's Sociocultural Theory, Inquiry-Based Learning associated with Dewey and Schwab, and Bloom's Mastery Learning Theory. These perspectives connect instructional approaches with conceptual learning and mastery. Knowles' Theory of Andragogy additionally informs the teacher-support component of the proposed enrichment activities.

The key independent variable in this study-teachers' pedagogical competence-is profoundly anchored in Lee Shulman's Pedagogical Content Knowledge (PCK) model (1986). According to Shulman, professional teaching skill necessitates an active integration of deep subject-matter knowledge with highly flexible educational approaches. A teacher must be able to turn difficult, abstract scientific principles into understandable representations, analogies, and classroom examples. Simply understanding science is insufficient. This framework supports the study's examination of inquiry-based, differentiated, and collaborative strategies for teaching the three selected Science 7 competencies.

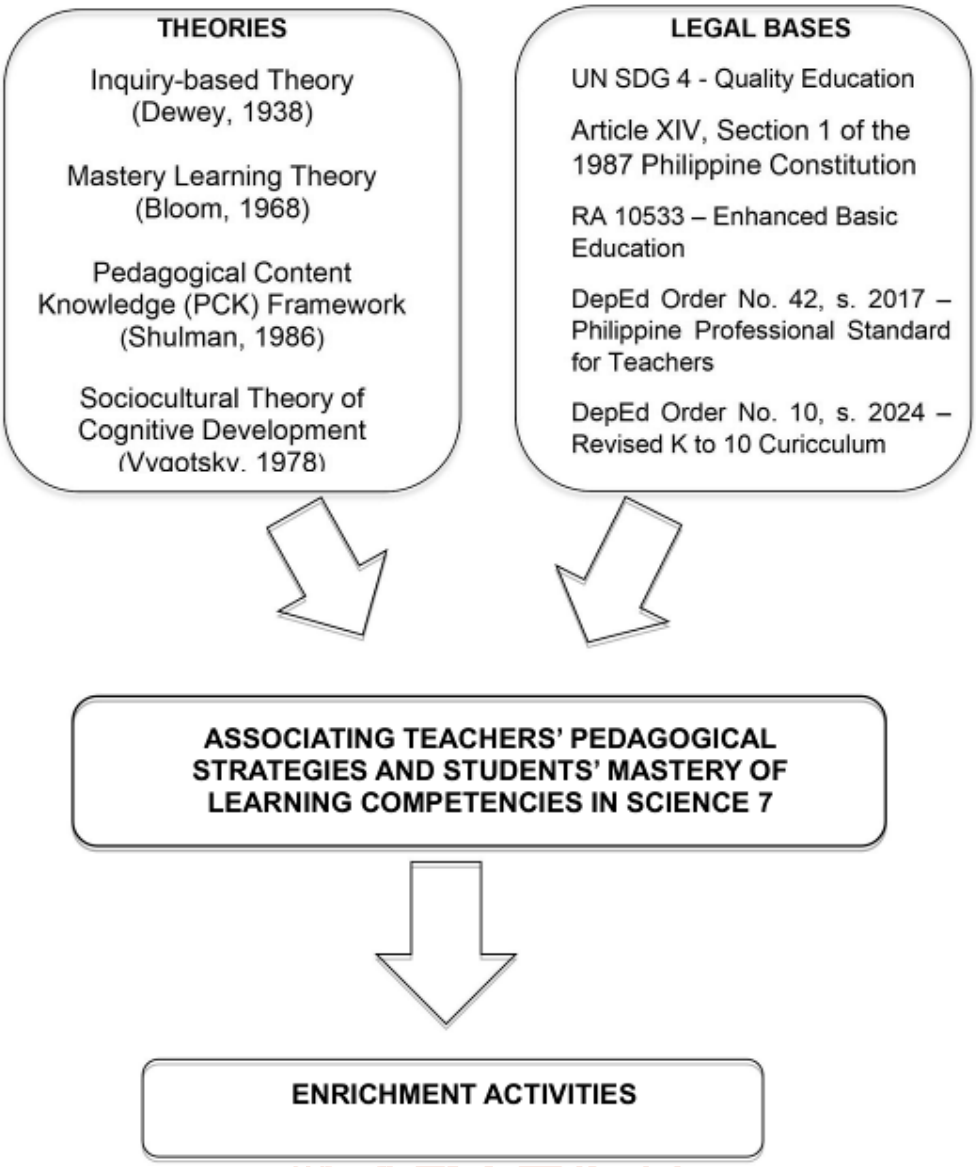



**Figure 1** ***The Theoretical Framework***

Apoko and Cahyono (2024) found that a teacher's PCK score is a direct predictor of their instructional flexibility and resourcefulness while delivering conceptual abstractions in a recent study verifying this framework in contemporary STEM classrooms. Similarly, a process-analysis study conducted by Huang and Lajoie (2021) found that teachers who actively combine their technological, pedagogical, and subject knowledge bases had a considerably higher aptitude for self-regulated lesson planning. Locally, Madrid and Oco (2025) contended that under present Philippine educational standards, a teacher's localized topic understanding and unique pedagogical competency across complicated subject areas are critical to overcoming systemic classroom deficits.

The dependent variable-students' mastery of scientific models, the particle model of matter, and the properties and behavior of particles-is based on Lev Vygotsky's Sociocultural Theory of Cognitive Development (1978), with a particular emphasis on the Zone of Proximal Development (ZPD) and scaffolding. Vygotsky describes the ZPD as the gap between what a learner can do on their own and what they can achieve with directed adult supervision or peer participation. "Scaffolding" refers to the teacher's temporary, structured aid, which fades out as the pupil acquires complete conceptual mastery. In this study, the teacher's pedagogical competency is the major instrument used to provide scaffolding, allowing students to cross their ZPD and successfully master the curriculum guide's complicated, spiral-progression competencies.

Recent literature strongly supports this dynamic use in specialized science programs. According to Main (2023), when teachers use purposeful, targeted scaffolding strategies such organized graphic organizers and thinking aloud during hard problem solving, students have significantly better long-term retention of scientific notions. In secondary education, Graham (2024) observed that when

teachers use sociocultural models that include debate and collaborative problem-solving, pupils go considerably faster from superficial memorization to true knowledge of abstract principles. Furthermore, Dordas and Accad's (2024) local study of public high school outcomes found that a primary reason of pupils accumulating "least learned competencies" in core science strands is a teacher's absence of planned, responsive scaffolding during critical weekly classes.

This study is anchored on the Inquiry-Based Learning Theory, which originated from the educational philosophy of John Dewey (1938) and was later expanded by Joseph Schwab (1962). The theory posits that meaningful learning occurs when students actively construct knowledge through questioning, investigating, experimenting, analyzing evidence, and drawing conclusions rather than passively receiving information. Inquiry-based instruction places learners at the center of the learning process while teachers serve as facilitators who guide students in exploring scientific concepts through authentic experiences. This theoretical perspective directly supports one of the major dimensions of this study, which examines the extent to which Science teachers employ inquiry-based strategies in classroom instruction.

Contemporary studies support the effectiveness of inquiry-based instruction in Science education. Furtak, Glancy, and Seidel (2023) reported that inquiry-based teaching significantly improves students' conceptual understanding, scientific reasoning, and problem-solving skills. Likewise, Lazonder and Harmsen (2022) found that structured inquiry activities enhance students' achievement and long-term retention of scientific concepts when accompanied by appropriate teacher guidance. These findings affirm that inquiry-based teaching serves as an effective instructional approach for improving students' mastery of Science learning competencies.

The dependent variable of this study is anchored on Benjamin Bloom's Mastery Learning Theory (1968). Bloom proposed that nearly all learners are capable of attaining mastery of learning competencies when provided with sufficient time, appropriate instructional strategies, timely feedback, and corrective interventions. Rather than accepting differences in achievement as fixed, Mastery Learning emphasizes continuous assessment, remediation, and enrichment until learners achieve the desired level of competence. This theory supports the present study in determining the level of students' mastery of the prescribed Grade 7 Science learning competencies and underscores the importance of effective teaching strategies in promoting improved academic performance.

Recent studies continue to validate the effectiveness of Mastery Learning in improving academic achievement. Guskey (2023) emphasized that mastery-oriented instruction significantly enhances students' learning outcomes by allowing teachers to provide immediate feedback and targeted remediation based on learners' needs. Similarly, Zhang and Lin (2024) found that mastery learning approaches improve students' conceptual understanding and retention in Science by ensuring that foundational concepts are mastered before introducing more complex topics. These studies reinforce the importance of mastery-oriented instructional practices in achieving higher levels of student performance.

Malcolm Knowles' Theory of Andragogy (1980) informs the teacher-support component of the proposed Science Enrichment Activity Program. According to Knowles, adult learners (such as practical public school teachers) have unique traits that set them apart from child learners. Adult learning must be self-directed, intrinsically motivated, problem-centered rather than content-centered, and thoroughly entrenched in the current issues of their work experience. As a result, teacher support for the enrichment activities for educators at Awihao National High School cannot be based on generic lectures; rather, it must be empirically built on the specific pedagogical gaps, challenges, and concerns identified by the teachers themselves throughout the study process.

CEDEFOP's (2026) global policy brief confirmed that modern continuing professional development opportunities for educators are most effective when they shift away from top-down delivery and toward an andragogical model that values teacher autonomy and prioritizes collaborative, hands-on skill-building. Groß Ophoff and Hartmann (2023) found that data-driven decision-making models, which base professional training on direct diagnostic classroom data, result in significantly higher engagement and implementation rates among adult teachers. Locally, Santos and Delgado (2025) concluded that in order to successfully navigate systemic curriculum updates, training workshops must directly address the specific issues and localized needs of adult educators on the ground, thus validating the andragogical approach as the primary framework for institutional program development.

The regulatory framework that underpins this study extends from global educational compacts to national legislation and particular localized requirements of the Department of Education, establishing a clear legal requirement for improving teacher performance and student results.

On a worldwide scale, this inquiry is primarily in response to the United Nations Sustainable Development Goal 4 (SDG 4), which requires member countries to ensure inclusive and equitable quality education and encourage lifelong learning opportunities for everyone. Specifically, Target 4.c of this global agenda underlines the critical need to significantly increase the supply of qualified teachers through structured professional training and international capacity-building collaboration. By assessing local pedagogical competence and developing contextualized Science enrichment activities at Awihao National High School, this study directly contributes to the achievement of SDG 4 by supporting teachers' continuing development and learners' access to quality Science instruction.

This global commitment is reflected locally in the fundamental law of the land, specifically Article XIV, Section 1 of the 1987 Philippine Constitution, which states that the State shall protect and promote all citizens' right to quality education at all levels, and shall take appropriate steps to make such education available to all. To accomplish this vision of accessible quality education, Section 5, Paragraph 4 of the same fundamental provision specifically states that the State must strengthen teachers' rights to professional advancement and continued career growth. This constitutional provision serves as the ultimate legal justification for this study, demonstrating that providing a data-driven, localized training intervention for Science teachers is more than just an optional administrative exercise, but a constitutional obligation to promote professional excellence.

Republic Act No. 10533, often known as the Enhanced Basic Education Act of 2013, codifies these constitutional obligations in statute. This legislation specifically states that the basic education curriculum must be contextualized, globally competitive, and built around a spiral progression model-principles that directly influence the design of the secondary Science curriculum guide. Furthermore, Section 7 of RA 10533 requires the Department of Education to collaborate with local schools and divisions to implement significant, ongoing, and specialized teacher training programs. This study is directly aligned with this legislative act by assessing present pedagogical capacities to ensure that local public school teachers are legally and instructionally prepared to carry out the tough curricular standards required by law.

DepEd Order No. 42, s. 2017 establishes the National Adoption and Implementation of the Philippine Professional Standards for Teachers (PPST). Its domains provide a broader professional context for instructional quality. Within that context, this study specifically examines inquiry-based, differentiated, and collaborative strategies rather than measuring all PPST domains.

DepEd Order No. 011, s. 2019 on the National Academy of the Philippines (NEAP) Transformation supports the source manuscript's emphasis on targeted professional development informed by identified needs. The study's proposed enrichment activities respond to the instructional concerns and learning needs documented at Awihao National High School; the study does not establish that the program has obtained NEAP recognition.

Finally, the learning competencies examined in this study are anchored on the Revised K to 10 Curriculum of the Department of Education, which serves as the current curriculum framework for basic education. The revised curriculum emphasizes the development of essential competencies, conceptual understanding, scientific inquiry, and the practical application of knowledge to real-life situations. In Science, the curriculum promotes learner-centered, inquiry-based, and competency-based instruction to develop scientifically literate learners who can think critically, solve problems, and make evidence-based decisions. The competencies assessed in this study, namely scientific models, particle model of matter, and properties and behavior of particles, are prescribed under the Grade 7 Science Curriculum Guide of the Revised K to 10 Curriculum. Hence, this study supports the Department of Education's goal of ensuring that teachers effectively implement the prescribed curriculum and employ appropriate pedagogical strategies that enhance students' mastery of the required Science learning competencies.

## THE PROBLEM

### Statement of the Problem

This research aimed to evaluate the extent of pedagogical strategies utilized by the science teachers and its relationship to the level of mastery of Science 7 learning competencies among students in Awihao National High School, South District, Cluster 1, Toledo City Division during the School Year 2026–2027 as basis for enrichment activities.

Specifically, this study seeks to answer the following questions:

1. What is the profile of the:
1.1. teachers'
1.1.1. age and gender,
1.1.2. civil status,
1.1.3. position,
1.1.4. teaching experience,
1.1.5. highest educational attainment,

1.1.6. relevant seminars, training and workshops attended,

1.2. learners age and gender?

2. To what extent are the pedagogical strategies as to:

2.1. inquiry-based,
2.2. differentiated instruction, and
2.3. collaborative?

3. What is the level of students' performance and mastery of the Science learning competencies as to:

3.1. Recognizing scientific models;
3.2. Describing particle model of matter; and
3.3. Differentiating properties and behavior of particles?

4. Is there a significant relationship between the teachers' pedagogical strategies and the students' performance and mastery in Science7?

5. What are the issues and concerns related to pedagogical strategies and the students' performance and mastery in Science 7?

6. Based on the findings, what enrichment activities can be facilitated?

**Null Hypothesis**

Ho. There is no significant relationship between the teachers' strategies and the students' performance in Science.

**Significance of the Study**

The outcomes of this study are expected to yield valuable insights and substantial benefits to various stakeholders within the educational ecosystem. By establishing an empirical link between teaching standards and student performance under the current curriculum, this research serves as a data-driven guide for the following groups:

Department of Education and Division Administrators. The findings of this study provided high-level education managers within the Toledo City Division with localized, diagnostic data regarding the current state of teacher readiness and student mastery. As the department continuously refines its instructional delivery frameworks, this research offers a concrete baseline that demonstrates how national teaching standards translate into actual classroom performance at the district level. This allows division and district supervisors to make strategic decisions, optimize the distribution of instructional resources, and design macro- level training roadmaps that target documented pedagogical gaps rather than relying on generalized educational assumptions.

School Heads and Instructional Supervisors. For the administrative leadership of Awihao National High School, this research provides an immediate diagnostic tool to assess the operational strengths and weaknesses of their science department. Instead of relying on subjective performance reviews, school principals and master teachers will gain access to clear data linking the three reported teaching-strategy dimensions to mastery of the three assessed Science 7 competencies. This information is directly applicable for planning highly contextualized School-Based In-Service Trainings (INSET), optimizing teacher assignments based on subject-matter expertise, and fostering a collaborative culture of targeted professional growth.

Science Teachers. The findings describe teachers' reported use of inquiry-based, differentiated, and collaborative strategies and identify instructional concerns. The proposed SEAP provides contextualized activities, differentiated tasks, and collaborative procedures that teachers may use to address the documented learning needs. These are intended benefits rather than measured implementation outcomes.

Students. As the ultimate beneficiaries of the educational system, public school learners are the primary focus of this investigation. When teachers refine their pedagogical skills and adopt more responsive, inclusive, and inquiry-based instructional methodologies, students are directly provided with a higher quality of education. Improved teacher competence translates to clearer explanations, better structured laboratory or classroom activities, and highly responsive scaffolding within the classroom. This direct support helps students overcome learning difficulties, eliminate persistent conceptual misconceptions, and achieve genuine academic mastery across all mandated science domains.

Future Researchers. Finally, this study contributes significantly to the local body of literature surrounding curriculum execution and teacher performance evaluation. Future researchers can utilize this study as a foundational reference, baseline data, or a comparative guide when conducting parallel investigations in other divisions or subject areas. The methodologies, instruments, and statistical relationships established in this research can serve as a springboard for deeper investigations into the long-term impacts of professional development initiatives on institutional learning outcomes.

**Methodology**

**Research Design**

The study used a descriptive-correlational research design to describe the profiles of eight Science teachers and 50 Grade 7 learners, the extent of inquiry-based, differentiated, and collaborative

teaching strategies, students' mastery of three selected Science 7 competencies, and instructional concerns. Pearson's product–moment correlation was used to examine the reported relationship between teaching strategies and learner performance without manipulating the variables. The findings informed the proposed Science Enrichment Activity Program.

**Flow of the Study**

The conceptual structure of this research follows a systematic Input-Process-Output (IPO) framework, illustrating the sequential path the researcher takes to analyze the variables and achieve the ultimate output of the study.

The process begins with the Input phase, which involves gathering the baseline data required to address the specific research objectives. This includes the demographic profiles of the respondents-specifically the teachers' age, gender, civil status, position, teaching experience, highest educational attainment, and relevant training, alongside the learners' age and gender. It further encompasses the quantified level of teaching strategies employed by teachers in teaching Science in terms of inquiry-based, differentiated instruction and collaborative strategies. Finally, it details the baseline mastery scores of the students extracted across the three competencies of the Revised K to 10 Curriculum Guide in Science: scientific models, particle model of matter, and properties and behavior of particles as well as the documented issues and concerns encountered in teaching Science.

The process involved obtaining school permission, distributing and retrieving the teacher questionnaire, administering the curriculum-aligned learner achievement test, and consolidating responses. Descriptive statistics summarized respondent profiles, teaching strategies, mastery scores, and instructional concerns. Pearson's product–moment correlation was used to examine the reported association between teaching strategies and learner performance at the 0.05 significance level.

The output is the proposed Science Enrichment Activity Program, comprising contextualized activities for scientific models, the particle model of matter, and the properties and behavior of particles. Its inquiry-based tasks, differentiated products, collaborative roles, and low-cost materials respond to the instructional concerns and learner mastery patterns identified in the study. The effectiveness of the proposed activities was not evaluated within this study.

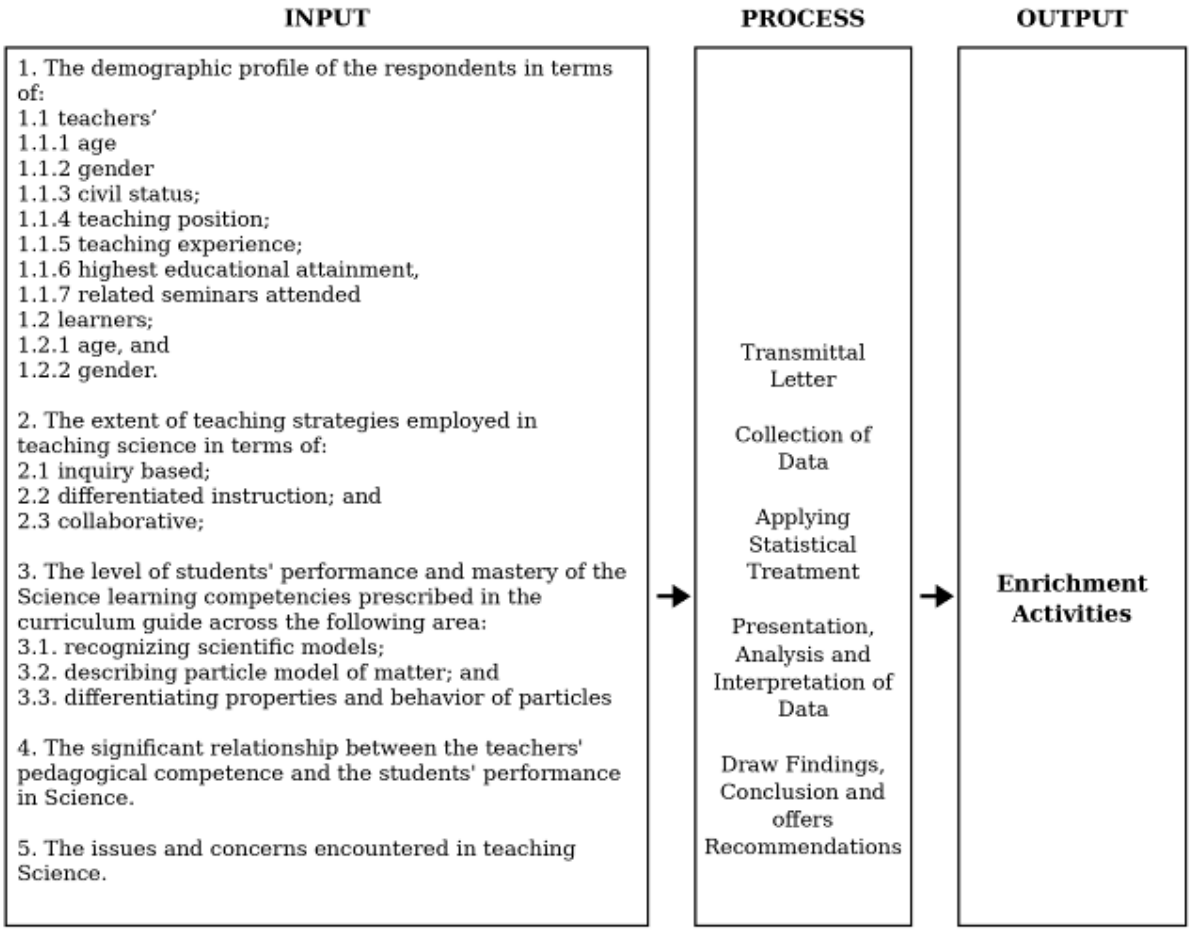



**Figure 2** ***The Flow of the Study***

**Research Environment**

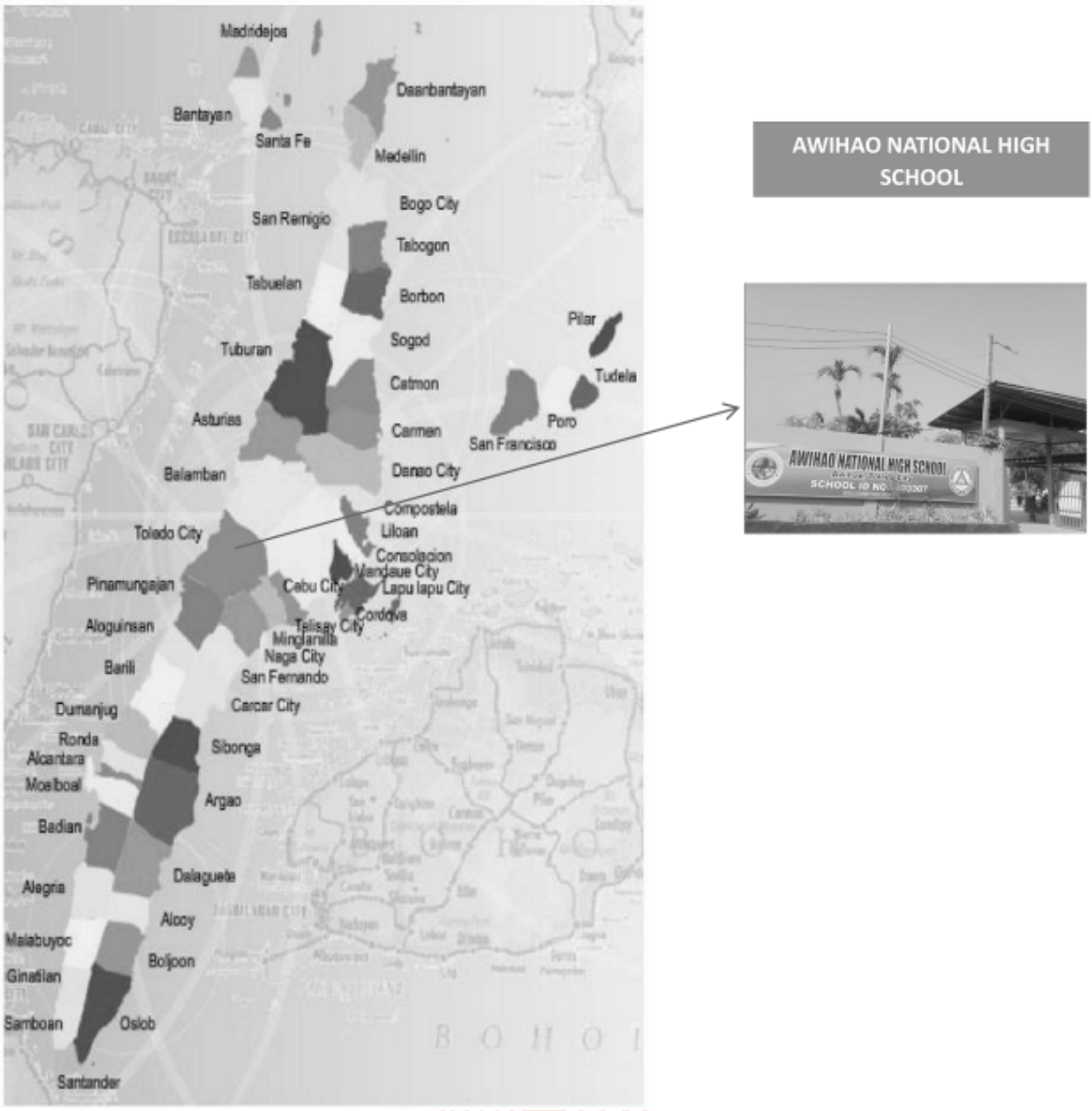



**Figure 3** ***Research Environment of the Study***

This research was conducted at Awihao National High School (School ID: 303307), one of the public high schools under the South District, Toledo City Division. The school is located in the City of Toledo, Province of Cebu. Established in 1977, the school has continuously served the community by providing quality secondary education for several decades. The school is classified as a high school with a total land area of roughly 4000 square meters. At present, it caters to 1351 learners under the supervision of one (1) school administrator and the teaching staff. The school maintains a conducive learning environment that supports both academic and co-curricular activities. The institution is recognized for its excellence and achievements not only in academics but also in co-curricular activities that shaped the learners holistically. This school year, Awihao National High School bagged second place during the CENRO Consistent Ridge to Ocean Winner for Nature (CROWN) Award 2026, second place in Fostering Livelihood, Promoting Innovation and Environmental Care - Recycling Contest. For the past years, Awihao National High School bagged awards in academic and co-curricular activities, First Place in Sulatanghal Contest, Division Festival of Talents Champion in Pintahusay Contest 2025, and Champion in Bayle sa Kayle 2025. Division Press Conference 2025 Awards - First Placer in Column Writing (English), Third Placer in Photojournalism (Filipino), Fourth Placer in Copyreading and Headline Writing (English), Third Placer in Collaborative Desktop Publishing, and Fourth Place in Best in School Paper Layouting. Awihao National High School produces student athletes who advanced to CVIRAA in the field of table tennis, athletics, billiards and sepak takraw. Truly, Awihao National High School is a home of champions and nurtured learners to develop their full potential, which is supported by the efforts and dedication of the school head, teachers, admin, staff, parents and other stakeholders.

**Respondents**

The respondents of the study are the 50 Grade 7 learners and 8 science teachers of Awihao National High School.

**Table 1** ***Distribution of Respondents***

| Respondents Groups | Frequency | Percentage |
|---|---|---|
| Teachers | 8 | 13.79 |
| Learners | 50 | 86.21 |
| Total | 58 | 100 |

**Research Instrument**

The study used a structured teacher questionnaire and a curriculum-aligned learner achievement test. The teacher instrument contains demographic items and five indicators for each of the three teaching-strategy dimensions. Learner performance was assessed across scientific models, the particle model of matter, and the properties and behavior of particles.

Part I (Profile of the Respondents) captures the demographic characteristics of the two respondent groups, recording the teachers' age, gender, civil status, position, teaching experience, highest educational attainment, and relevant seminars, training, and workshops attended, alongside the learners' age and gender.

Part II assesses the reported use of inquiry-based, differentiated, and collaborative teaching strategies on a four-point frequency scale. The source attributes its adaptation to the teaching-needs framework of Abay and Morallo (2019).

The learner achievement test assesses the three selected competencies prescribed in the Revised K to 10 Science Curriculum Guide. The supplied learner questionnaire contains 20 multiple-choice items. Domain results are reported as percentage scores and interpreted using the mastery categories specified below.

**Data Gathering Procedures and Ethics**

The research commenced after receiving approval of the title from the Dean of the Graduate School at Cebu Technological University, Main Campus.

To facilitate the administration of the questionnaire, the researcher sent a request letter to the School Head seeking permission to conduct the survey and specifying the retrieval date. Prior to answering the survey, the details of the questionnaire were thoroughly explained to the respondents via social media platforms or face-to-face discussions. The respondents were assured of the confidentiality of the information collected, with strict adherence to the Data Privacy Law and other relevant regulations protecting their rights. The collected data were then consolidated, tallied, and analyzed using statistical methods.

The source reports expert validation and pilot testing of the instruments, together with voluntary participation, informed consent, confidentiality, anonymity, and protection of respondents' rights.

**Data Analysis**

Data were consolidated and analyzed using frequency counts, percentages, means, standard deviations, ranking, and Pearson's product–moment correlation, as documented in the source.

Frequency counts and percentages described teachers' and learners' demographic characteristics, including age, gender, civil status, teaching position, experience, educational attainment, and training attended, as applicable.

Means summarized the reported frequency of the three teaching-strategy dimensions. Item standard deviations described variability in individual indicators; averages of those SDs are identified as descriptive averages rather than composite-score SDs. Learner achievement results were reported as percentage scores, with an overall mean calculated by equally weighting the three reported domain means.

Pearson's product–moment correlation coefficient summarized the reported direction and strength of association between teaching strategies and student performance. Statistical significance was evaluated at $\alpha = .05$; the reported p-value was compared with this threshold to determine whether to reject the null hypothesis.

Ranking ordered the reported instructional concerns by their mean scores, from the highest to the lowest.

**Scoring Procedures**

Teacher-strategy means and learner percentage scores were interpreted using the following scales.

**Teaching Strategies**

The four-point teacher questionnaire measures the frequency of inquiry-based, differentiated, and collaborative strategies. The interpretation intervals below follow the repeated result-table legends and classifications in the source manuscript.

**Table 2** ***Scale for Teaching Strategies***

| Statistical Limit | Rating / Score | Qualitative Interpretation | Operational Description |
|---|---|---|---|
| 3.26 – 4.00 | 4 | High Extent | The teaching strategy is consistently implemented in Science instruction and is evident in most classroom learning activities. |
| 2.51 – 3.25 | 3 | Moderate Extent | The teaching strategy is frequently implemented in Science instruction but is not consistently evident in all classroom learning activities. |
| 1.76 – 2.50 | 2 | Low Extent | The teaching strategy is occasionally implemented in Science instruction and is evident only in limited classroom learning activities. |
| 1.00 – 1.75 | 1 | Very Low Extent | The teaching strategy is rarely or never implemented in Science instruction and is generally absent from classroom learning activities. |

**Students' Mastery**

Percentage scores summarized learners' performance in the three assessed competencies: scientific models, the particle model of matter, and the properties and behavior of particles.

The source manuscript uses the following mastery categories:

**Table 3** ***Scale for Students' Mastery***

| Percentage Range | Qualitative Interpretation | Performance Description |
|---|---|---|
| 96% – 100% | Mastered | The student demonstrates complete, comprehensive, and advanced cognitive mastery of the specific curriculum strand. |
| 86% – 95% | Closely Approaching Mastery | The student shows strong conceptual understanding and can easily apply procedural skills within the strand. |
| 75% – 85% | Moving Towards Mastery | The student has met the minimum passing requirements but still exhibits minor conceptual gaps. |
| 66% – 74% | Average Mastery | The student struggles with regular application and demonstrates a superficial or inconsistent understanding of the topics. |
| 65% and Below | Low Mastery / Least Learned | The student struggles to grasp foundational concepts, categorizing these topics as immediate training targets. |

**Results and Discussion**

The results describe eight Science teachers and 50 Grade 7 learners at Awihao National High School, South District–Cluster 1, Toledo City Division, followed by teaching strategies, learner mastery, the reported correlation, and instructional concerns.

**Profile of Teacher-Respondents**

**Age Profile of Teacher-Respondents**

**Table 4** ***Age Profile of Teacher-Respondents***

| Age | Frequency n = 8 | Percentage |
|---|---|---|
| 36 – 40 years old | 4 | 50.00 |
| 31 – 35 years old | 1 | 12.50 |
| 26 – 30 years old | 2 | 25.00 |
| 20 – 55 years old | 1 | 12.50 |
| Total | 8 | 100 |
| Average | 35.13 | - |
| Standard Deviation | 5.03 | - |

Table 4 illustrates the demographic characteristics of the teacher-respondents regarding their age. The results indicate that 4 (50.00%) of the participants were aged 36–40, representing the predominant age category. Subsequently, 2 (25.00%) participants were aged between 26 and 30 years, whilst 1 (12.50%) participant was into the 31 to 35 years' age bracket, and another 1 (12.50%) participant was recorded in the source category labeled "20–55 years old". The participants exhibited a mean age of 35.13 years and a standard deviation of 5.03 years, suggesting that the educators were predominantly in their mid-thirties with minimal age variance.

This discovery aligns with the Organisation for Economic Co-operation and Development's 2024 Teaching and Learning International Survey (TALIS), which indicated that educators in the mid-phase of their careers frequently exhibit enhanced instructional confidence and pedagogical efficacy due to their accumulated classroom experience and ongoing professional development. Similarly, research conducted by Toropova, Myrberg, and Johansson (2022) revealed that educators' professional development and experience enhance teaching efficacy and lead to better student performance. UNESCO (2023) similarly highlighted that sustaining a skilled and professionally cultivated teaching personnel is crucial for enhancing educational quality and student success.

The age profile describes the composition of the eight teacher-respondents. It does not, by itself, establish instructional expertise or the effect of age on learner achievement.

**Gender Profile of Teacher-Respondents**

**Table 5** ***Gender Profile of Teacher-Respondents***

| Gender | Frequency n = 8 | Percentage |
|---|---|---|
| Male | 1 | 12.50 |
| Female | 7 | 87.50 |
| Total | 8 | 100 |

Table 5 delineates the characteristics of the teacher-respondents regarding gender. The results indicate that 7 (87.50%) of the participants were female, whilst merely 1 (12.50%) was male. This suggests that most of the respondents among Science teachers are women.

The current discovery aligns with the UNESCO Global school Monitoring Report (2023), which indicated that women remain the predominant demographic among educators in primary and secondary school globally. The OECD Teaching and Learning International Survey (TALIS 2024) similarly indicated that the teaching staff in numerous participating nations is primarily female, especially in lower secondary education. Moreover, Kim and Cho (2022) discovered that while there are gender disparities in the teaching field, the efficacy of educators is more closely linked to their pedagogical skills, instructional methodologies, and ongoing professional development than to their gender.

The results suggest that the teaching profession remains largely comprised of female educators, mirroring the current demographic pattern in the education field. Irrespective of gender, the efficacy of teaching is chiefly determined by educators' pedagogical expertise, instructional methodologies, and dedication to ongoing professional growth, which are crucial for fostering significant student learning and enhancing academic success.

**Civil Status Profile**

**Table 6** ***Civil Status Profile***

| Civil Status | Frequency n = 8 | Percentage |
|---|---|---|
| Married | 4 | 50.00 |
| Single | 3 | 37.50 |
| Widow | 1 | 12.50 |
| Total | 8 | 100 |

Table 6 presents the characteristics of the teacher-respondents regarding their marital status. The results indicate that 4 (50.00%) of the participants were wed, representing the predominant segment of the educator demographic. This was succeeded by 3 (37.50%) individuals who were unmarried, and 1 (12.50%) individual was bereaved. The findings suggest that half of the teacher-participants were wed.

The results align with the OECD Teaching and Learning International Survey (TALIS 2024), which indicated that a significant percentage of educators in the involved nations are married, showcasing the maturity and stability of the teaching profession. UNESCO (2023) also highlighted that the demographic traits of educators, such as marital status, are essential for comprehending workforce structure and are beneficial for educational

planning and policy formulation. Furthermore, Adu and Galloway (2022) observed that although teachers' marital status constitutes a segment of their demographic profile, their professional proficiency, dedication, and teaching efficacy are the principal factors influencing successful pedagogy and enhanced student learning results.

The results suggest that the teaching staff comprises individuals from varied civil status backgrounds. Irrespective of marital status, the efficacy of educators is chiefly determined by their professional expertise, commitment to pedagogy, and ongoing participation in professional growth, all of which enhance the provision of high-quality education.

**Teaching Position Profile**

**Table 7** ***Teaching Position Profile***

| Teaching Position | Frequency n = 8 | Percentage |
|---|---|---|
| Master Teacher I | 1 | 12.50 |
| Teacher III | 2 | 25.00 |
| Teacher I | 5 | 62.50 |
| Total | 8 | 100 |

Table 7 illustrates the characteristics of the teacher-respondents based on their instructional roles. The results indicate that 5 (62.50%) of the participants were Teacher I, representing the predominant segment of the teaching demographic. Subsequently, 2 (25.00%) respondents were classified as Teacher III, whereas 1 (12.50%) respondent was designated as Master Teacher I. The findings suggest that most of the teacher-respondents hold entry-level teaching roles.

The results are corroborated by Sulla and David (2023), who discovered that the majority of public school educators hold Teacher I roles as they continue to advance through the professional hierarchy set by the Department of Education. Similarly, Day and Gu (2022) highlighted that novice teachers enhance their pedagogical skills and instructional proficiency via classroom experiences, mentorship, and ongoing professional growth. Furthermore, Darling-Hammond (2022) contended that the efficacy of educators is influenced more by their teaching skills, ongoing professional development, and reflective practices than by their status or title.

Teacher I was the most frequently reported position. Teaching rank alone does not establish career stage, years of experience, or instructional effectiveness; teaching experience is described separately in Table 8.

**Teaching Experience**

**Table 8** ***Teaching Experience***

| Teaching Experience | Frequency n = 8 | Percentage |
|---|---|---|
| 11 – 15 years | 1 | 12.50 |
| 7 – 10 years | 3 | 37.50 |
| 4 – 6 years | 1 | 12.50 |
| 0 – 3 years | 3 | 37.50 |
| Total | 8 | 100 |
| Average | 6.31 | - |
| Standard Deviation | 4.38 | - |

Table 8 depicts the characteristics of the teacher-respondents regarding their teaching experience. The results indicate that 3 (37.50%) of the participants possessed 0–3 years of teaching experience, whereas another 3 (37.50%) had 7–10 years of teaching experience, thus constituting the two predominant categories. Simultaneously, one respondent (12.50%) possessed 4–6 years of pedagogical expertise, while another respondent (12.50%) had 11–15 years of instructional experience. The participants possessed an average of 6.31 years of teaching experience, accompanied by a standard deviation of 4.38 years, suggesting a moderate fluctuation in their teaching tenure.

These findings are consistent with Kini and Podolsky (2023), who highlighted that teaching experience is crucial for enhancing instructional quality, classroom management, and student success as educators hone their pedagogical abilities with time. In a similar vein, Kraft and Papay (2022) discovered that educators persist in their professional development throughout the initial and intermediate stages of their careers via collected classroom experience and ongoing instructional practice. Moreover, Darling-Hammond (2022) contended that ongoing teaching experience allows educators to enhance their pedagogical skills, modify instructional approaches to accommodate varied learner requirements, and foster more successful educational settings.

The results suggest that the teaching staff comprises educators with diverse degrees of professional experience. Irrespective of years of experience, persistent classroom engagement, introspective teaching, and continual professional growth are vital for augmenting pedagogical proficiency and elevating student learning results.

**Highest Educational Attainment**

**Table 9** ***Highest Educational Attainment***

| Highest Educational Attainment | Frequency n = 8 | Percentage |
|---|---|---|
| Doctor's Degree | 1 | 12.50 |
| Master's Degree Units | 5 | 62.50 |
| Bachelor Degree | 2 | 25.00 |
| Total | 8 | 100 |

Table 9 delineates the characteristics of the teacher-respondents based on their greatest level of educational achievement. The results indicate that 5 (62.50%) of the participants possessed master's degree credits, representing the predominant segment of the educator demographic. Subsequently, 2 (25.00%) participants possessed a bachelor's degree, whereas 1 (12.50%) participant had acquired a doctoral degree. The findings suggest that most of the teacher-participants have engaged in postgraduate education following their undergraduate degree.

The results are supported by Caena (2023), who highlighted that educators participating in graduate studies exhibit improved professional proficiency, reflective methodologies, and teaching efficacy. Similarly, Darling-Hammond (2022) contended that comprehensive academic training endows educators with enhanced pedagogical expertise and superior instructional abilities, allowing them to address varied learner requirements adeptly. In a similar vein, Schleicher (2023) emphasized that educators who seek advanced academic credentials are more equipped to adopt innovative pedagogical approaches, incorporate evidence-based methods into their teaching, and enhance student learning results.

The results suggest that educators are progressively acknowledging the need of obtaining advanced academic credentials for their professional development. Ongoing scholarly development bolsters teaching proficiency, fosters perpetual education, and amplifies educators' ability to provide high- caliber instruction that facilitates student success.

**Relevant Training, Seminars, and Workshops Attended**

**Table 10** ***Relevant Training, Seminars, and Workshops Attended***

| Relevant Training, Seminars, and Workshops Attended | Frequency n = 8 | Percentage |
|---|---|---|
| Regional | 2 | 25.00 |
| Division | 4 | 50.00 |
| District | 2 | 25.00 |
| Total | 8 | 100 |

Table 10 indicates the characteristics of the teacher-respondents for the highest degree of pertinent training, seminars, and workshops they have participated in. The results indicate that 4 (50.00%) of the participants engaged in division-level training, seminars, and workshops, representing the predominant segment of the teaching staff. Subsequently, 2 (25.00%) respondents engaged in regional-level activities, while another 2 (25.00%) took part in district-level professional development initiatives. The findings reveal that half of the teacher-respondents have engaged in professional development initiatives at the division level.

These findings are consistent with Desimone (2023), who highlighted that engagement in ongoing professional development activities improves instructors' subject matter expertise, teaching skills, and instructional efficacy. Opfer and Pedder (2022) contended that superior seminars, workshops, and training initiatives afford educators the chance to gain novel instructional techniques, contemplate their pedagogical methods, and enhance classroom efficacy. Similarly, Darling-Hammond, Hyler, and Gardner (2022) emphasized that ongoing professional development is crucial for empowering educators to apply evidence-based teaching methods that enhance student involvement and academic success.

The results suggest that educators engage in professional development initiatives across different administrative tiers as a demonstration of their dedication to continuous learning. Ongoing participation in pertinent training, seminars, and workshops enhances educators' pedagogical skills, fosters instructional creativity, and leads to better educational results.

**Profile of Learner-Respondents**

**Age Profile of Learner-Respondents**

**Table 11** ***Age Profile of Learner-Respondents***

| Age | Frequency n = 50 | Percentage |
|---|---|---|
| 14 years old | 6 | 12.00 |
| 13 years old | 37 | 74.00 |
| 12 years old | 7 | 14.00 |
| Total | 50 | 100 |
| Average | 12.98 | - |
| Standard Deviation | 0.51 | - |

Table 11 presents the characteristics of the learner-respondents regarding their age. The results indicate that 37 (74.00%) of the participants were 13 years of age, representing the predominant segment of the students. Subsequently, 7 (14.00%) participants were 12 years of age, whilst 6 (12.00%) participants were 14 years old. The participants exhibited a mean age of 12.98 years and a standard deviation of 0.51 years, suggesting that their ages were tightly grouped around the average with little fluctuation.

The research is confirmed by Eccles and Roeser (2022), who articulated that individuals in early adolescence, especially between the ages of 12 and 14, undergo considerable cognitive, social, and emotional growth that improves their ability for scientific reasoning and conceptual comprehension. In a similar vein, Sawyer (2023) highlighted that learners in this demographic are evolving towards advanced cognitive capabilities, enhancing their ability to participate in inquiry- driven education, problem-solving, and cooperative classroom endeavors. Moreover, Hattie (2023) emphasized that comprehending the developmental traits of learners allows educators to create age-suitable teaching methods that proficiently enhance academic success and mastery of learning skills.

The results suggest that the student demographic primarily consists of early adolescents, whose developmental traits significantly facilitate the acquisition of scientific information and abilities. Acknowledging the developmental requirements associated with learners' ages allows educators to adopt suitable teaching methods that promote significant learning experiences and enhance academic achievement.

**Gender Profile of Learner-Respondents**

**Table 12** ***Gender Profile of Learner-Respondents***

| Gender | Frequency n = 50 | Percentage |
|---|---|---|
| Male | 25 | 50.00 |
| Female | 25 | 50.00 |
| Total | 50 | 100 |

Table 12 shows the gender breakdown of the students who filled out the survey. The results show that there were 25 male respondents and 25 female respondents, each representing 50.00% of the 50 learners. This means that the study encompasses a balanced representation of the sexes, with an equal mix of male and female learners among the respondents.

The results are in line with what Hyde (2022) found; she stressed that students of both sexes have similar cognitive capacities and the ability to learn, and that variations in academic performance are caused more by differences in teaching methods, classroom dynamics, and student traits than by gender. Gender variations in student accomplishment are frequently influenced by factors other than biological sex, according to OECD (2023). These factors include educational experiences, motivation, and opportunity to study. In addition, as pointed out by UNICEF (2024), ensuring that male and female learners have equal access to educational opportunities fosters inclusive education and allows all students to reach their maximum academic potential.

The results show that there is a balanced proportion of male and female pupils in the learner population. Having students of both sexes in the classroom highlights the need for inclusive teaching methods that help students of all genders succeed academically and opens doors for more equitable classroom participation.

**Extent of Teaching Strategies**

**Inquiry-Based**

Inquiry-based. This dimension focuses on the extent to which teachers employ inquiry-based teaching strategies that encourage students to ask questions, investigate scientific phenomena, analyze evidence, and construct knowledge through exploration and discovery.

**Table 13** ***Inquiry-Based***

| Items | Weighted Mean | Standard Deviation | Interpretation |
|---|---|---|---|
| I start science units with an open-ended question or real-world phenomenon to spark curiosity rather than just defining terms. | 3.13 | 0.35 | Moderate Extent |
| Students design their own experimental procedures to test scientific hypotheses rather than just following prescribed 'cookbook' lab steps. | 2.50 | 0.76 | Low Extent |
| I guide students to rely on collected data and scientific evidence to justify their conclusions during lab activities. | 3.88 | 0.35 | High Extent |
| Students are given opportunities to revise their ideas or scientific models when presented with conflicting experimental evidence. | 3.38 | 0.52 | High Extent |
| I act as a facilitator of scientific discovery, prompting students with questioning techniques instead of lecturing the answers right away. | 3.38 | 0.52 | High Extent |
| Composite Mean / Average Item SD | 3.25 | 0.50 | Moderate Extent |

Note. Source results cutoffs: 3.26–4.00 High Extent; 2.51–3.25 Moderate Extent; 1.76–2.50 Low Extent; 1.00–1.75 Very Low Extent.

Note. The SD value in the final row is the average of the displayed item SDs; it is not a verified SD of respondents' composite scores.

Table 13 presents the extent of inquiry-based teaching strategies employed in teaching Science. The findings reveal a composite mean of 3.25 with an average reported item SD of 0.50, interpreted as Moderate Extent. These findings indicates that teachers moderately employ inquiry-based strategies in facilitating Science instruction. Among the indicators, the highest weighted mean was 3.88 (SD = 0.35), interpreted as High Extent, indicating that teachers consistently emphasize the use of scientific evidence in drawing conclusions during learning activities. This was followed by two indicators, each obtaining a weighted mean of 3.38 (SD = 0.52), also interpreted as High Extent. Meanwhile, one indicator obtained a weighted mean of 3.13 (SD = 0.35), interpreted as Moderate Extent. The lowest- rated indicator obtained a weighted mean of 2.50 (SD = 0.76), interpreted as Low Extent, suggesting that opportunities for students to independently design and conduct scientific investigations are less frequently provided.

The findings are supported by Lazonder and Harmsen (2022), who found that guided inquiry is more commonly practiced than open inquiry because teacher scaffolding enables learners to develop scientific reasoning while maintaining effective classroom instruction. Similarly, Furtak et al. (2023) emphasized that inquiry-based instruction promotes deeper conceptual understanding and critical thinking when students are actively engaged in investigating scientific problems and interpreting evidence. Likewise, Bybee (2024) stressed that effective Science teaching should gradually provide learners with greater responsibility in planning investigations and constructing scientific explanations to foster scientific literacy and inquiry skills.

Overall, the findings indicate that inquiry-based teaching strategies are implemented to a moderate extent. Increasing opportunities for learners to independently explore, investigate, and construct scientific knowledge may further strengthen inquiry skills and improve mastery of Science learning competencies.

**Differentiated Instruction**

Differentiated Instruction. This dimension examines the extent to which teachers adapt their instructional methods, learning activities, and assessments to accommodate the diverse learning needs, abilities, interests, and readiness levels of students.

**Table 14** ***Differentiated Instruction***

| Items | Weighted Mean | Standard Deviation | Interpretation |
|---|---|---|---|
| I modify the reading difficulty or format of scientific texts (e.g., graphic organizers, multimedia, simplified articles) to match different reading levels. | 3.38 | 0.52 | High Extent |
| I offer tiered laboratory activities where tasks vary in complexity based on student scientific readiness. | 3.13 | 0.64 | Moderate Extent |
| Students are allowed to choose their preferred method to demonstrate mastery of a science concept (e.g., written lab report, oral presentation, physical model). | 3.00 | 0.53 | Moderate Extent |
| I use ongoing formative assessment data (like exit tickets or quick warm-ups) to adjust the pacing and structure of the daily science lesson. | 3.38 | 0.52 | High Extent |
| I provide targeted, personalized scaffolding and extra coaching for struggling learners while offering extension activities for advanced students. | 3.38 | 0.52 | High Extent |
| Composite Mean / Average Item SD | 3.25 | 0.55 | Moderate Extent |

Note. Source results cutoffs: 3.26–4.00 High Extent; 2.51–3.25 Moderate Extent; 1.76–2.50 Low Extent; 1.00–1.75 Very Low Extent.

Note. The SD value in the final row is the average of the displayed item SDs; it is not a verified SD of respondents' composite scores.

Table 14 presents the extent of differentiated instruction employed in teaching Science. The findings reveal a composite mean of 3.25 with an average reported item SD of 0.55, interpreted as Moderate Extent. These findings indicates that teachers moderately implement differentiated instructional strategies to address the diverse learning needs of students. Among the indicators, three obtained the highest weighted mean of 3.38 (SD = 0.52), interpreted as High Extent, suggesting that teachers frequently modify instructional resources, utilize formative assessment to inform instruction, and provide targeted support to learners with varying abilities. Meanwhile, one indicator obtained a weighted mean of 3.13 (SD = 0.64), interpreted as Moderate Extent, while the lowest-rated indicator obtained a weighted mean of 3.00 (SD = 0.53), also interpreted as Moderate Extent, indicating that providing learners with multiple options for demonstrating mastery is practiced less consistently.

The findings are consistent with Tomlinson (2022), who emphasized that differentiated instruction enhances student engagement and achievement by adapting content, learning processes, products, and the learning environment to learners' readiness, interests, and learning profiles. Similarly, Pozas and Letzel (2023) found that teachers who effectively implement differentiated instruction are better able to address learner diversity and create more inclusive classroom environments. Furthermore, Darling-Hammond (2022) asserted that responsive instructional practices, including differentiation based on formative assessment, contribute significantly to improved learning outcomes by ensuring that instruction is aligned with students' individual needs and abilities.

Overall, the findings indicate that differentiated instruction is implemented to a moderate extent. Strengthening the consistent use of varied assessment options and differentiated learning experiences may further enhance student engagement, accommodate diverse learner needs, and improve mastery of Science learning competencies.

**Collaborative**

Collaborative. This dimension determines the extent to which teachers utilize collaborative teaching strategies that promote teamwork, peer interaction, communication, and shared problem-solving among students to enhance learning outcomes in Science.

**Table 15** ***Collaborative***

| Items | Weighted Mean | Standard Deviation | Interpretation |
|---|---|---|---|
| Students work in small groups with clearly defined individual roles (e.g., Principal Investigator, Data Recorder, Materials Manager) during labs. | 3.13 | 0.83 | Moderate Extent |
| I design peer-review sessions where student teams critique each other's experimental designs, graphs, or scientific arguments. | 3.25 | 0.46 | Moderate Extent |
| Students participate in structured cooperative learning structures like the Jigsaw method or Think-Pair-Share to master complex science topics. | 3.38 | 0.52 | High Extent |
| Group tasks are designed so that the final scientific outcome requires individual accountability paired with team interdependence. | 3.13 | 0.64 | Moderate Extent |
| I explicitly teach and evaluate collaborative team skills (e.g., active listening, constructive debate, consensus-building) alongside science content. | 3.50 | 0.53 | High Extent |
| Composite Mean / Average Item SD | 3.28 | 0.60 | High Extent |

Note. Source results cutoffs: 3.26–4.00 High Extent; 2.51–3.25 Moderate Extent; 1.76–2.50 Low Extent; 1.00–1.75 Very Low Extent.

Note. The SD value in the final row is the average of the displayed item SDs; it is not a verified SD of respondents' composite scores.

Table 15 presents the extent of collaborative teaching strategies employed in teaching Science. The findings reveal a composite mean of 3.28 with an average reported item SD of 0.60, interpreted as High Extent. These findings indicates that teachers highly employ collaborative strategies in facilitating Science instruction. Among the indicators, the highest weighted mean of 3.50 (SD = 0.53) was interpreted as High Extent, suggesting that teachers consistently develop and assess learners' collaborative skills alongside Science content. This was followed by an indicator with a weighted mean of 3.38 (SD = 0.52), also interpreted as High Extent, reflecting the frequent use of structured cooperative learning strategies. Meanwhile, one indicator obtained a weighted mean of 3.25 (SD = 0.46), interpreted as Moderate Extent, while two indicators each obtained a weighted mean of 3.13, interpreted as Moderate Extent, indicating that role assignment in group activities and designing tasks that balance individual accountability with team interdependence are implemented less consistently.

The findings are supported by Johnson and Johnson (2022), who emphasized that collaborative learning promotes higher academic achievement, stronger interpersonal relationships, and improved problem-solving skills when learners work together toward shared goals. Similarly, Gillies (2023) found that structured collaborative learning enhances students' conceptual understanding, communication skills, and engagement by encouraging active participation and peer interaction. Moreover, Slavin (2024) asserted that cooperative learning strategies are most effective when they incorporate both individual accountability and positive interdependence, enabling students to contribute meaningfully to group success while developing essential teamwork skills.

Overall, the findings indicate that collaborative teaching strategies are implemented to a high extent. Sustaining the use of structured cooperative learning while strengthening individual accountability within group tasks may further enhance students' collaborative competencies, scientific understanding, and mastery of Science learning competencies.

**Summary of Teaching Strategies**

**Table 16** ***Summary on the Extent of Teacher Intervention Strategies***

| Items | Weighted Mean | Average Item SD | Interpretation |
|---|---|---|---|
| Inquiry-based | 3.25 | 0.50 | Moderate Extent |
| Differentiated instruction | 3.25 | 0.55 | Moderate Extent |
| Collaborative | 3.28 | 0.60 | High Extent |
| Overall Mean / Average Item SD | 3.26 | 0.55 | High Extent |

Note. Source results cutoffs: 3.26–4.00 High Extent; 2.51–3.25 Moderate Extent; 1.76–2.50 Low Extent; 1.00–1.75 Very Low Extent.

Table 16 presents the summary of the extent of teaching strategies employed in teaching Science in terms of inquiry-based, differentiated instruction, and collaborative strategies. The findings reveal an overall mean of 3.26 with an average reported item SD of 0.55, interpreted as High Extent. These findings indicates that teachers highly employ a variety of instructional strategies in facilitating Science learning. Among the three dimensions, collaborative strategies obtained the highest weighted mean of 3.28 (average item SD = 0.60), interpreted as High Extent, indicating that collaborative learning approaches are the most frequently implemented. Meanwhile, both inquiry-based and differentiated instruction obtained a weighted mean of 3.25, interpreted as Moderate Extent, suggesting that although these strategies are regularly practiced, there remains room for further enhancement to maximize their effectiveness in Science instruction.

The findings are consistent with Hattie (2023), who emphasized that the use of varied evidence-based instructional strategies significantly enhances student engagement, conceptual understanding, and academic achievement. Similarly, Darling-Hammond (2022) asserted that effective teaching requires the integration of multiple pedagogical approaches that respond to learners' diverse needs and promote active participation in the learning process. Furthermore, OECD (2024) highlighted that teachers who employ a balanced combination of inquiry-based, differentiated, and collaborative instructional strategies create more inclusive learning environments and contribute to improved student learning outcomes.

Overall, the findings indicate that Science teachers employ teaching strategies to a high extent, demonstrating their commitment to providing meaningful and learner-centered instruction. Continued strengthening of inquiry-based and differentiated instructional practices, alongside sustained implementation of collaborative learning, may further enhance students' engagement, scientific understanding, and mastery of Science learning competencies.

**Students' Performance and Mastery**

**Scientific Models**

Scientific models. This area determines the level of students' performance and mastery in recognizing and understanding the use of scientific models to explain phenomena that cannot be directly observed or easily detected.

**Table 17** ***Scientific Models***

| Mastery Level | Frequency n = 50 | Percentage |
|---|---|---|
| Mastered (96 - 100) | 35 | 70.00 |
| Closely Approaching Mastery (86 - 95) | 0 | 0 |
| Moving Towards Mastery (75 - 85) | 9 | 18.00 |
| Average Mastery (66 - 74) | 0 | 0 |
| Low Mastery (65 below) | 6 | 12.00 |
| Total | 50 | 100 |
| Average | 84.70 | - |
| Standard Deviation | 24.92 | - |

Table 17 presents the level of students' performance and mastery of the Science learning competencies in terms of scientific models. The findings reveal that 35 (70.00%) of the learners attained the Mastered level, representing the largest proportion of the respondents. This was followed by 9 (18.00%) learners who were classified under Moving Towards Mastery, while 6 (12.00%) learners fell under the Low Mastery level. No learners were classified under the Closely Approaching Mastery and Average Mastery levels. The learners obtained an average mastery score of 84.70 with a standard deviation of 24.92, indicating a relatively wide variation in students' mastery of scientific models.

The findings are supported by Gilbert and Justi (2022), who emphasized that scientific models play a fundamental role in helping learners understand abstract scientific concepts and phenomena that cannot be directly observed. Similarly, OECD (2023) reported that students who are provided with opportunities to use and interpret scientific models demonstrate stronger conceptual understanding and improved scientific literacy. Furthermore, Bybee (2024) asserted that engaging learners in model-based learning enables them to construct scientific explanations, develop critical thinking skills, and enhance their mastery of Science concepts through active knowledge construction.

Overall, the findings indicate that most students have achieved mastery of competencies related to scientific models. However, the presence of learners at the Moving Towards Mastery and Low Mastery levels suggests the

need for sustained instructional support and targeted learning interventions to ensure that all students attain the expected level of competency in understanding and applying scientific models.

**Particle Model of Matter**

Particle Model of Matter. This area examines the level of students' performance and mastery in understanding that all matter is composed of tiny particles, with each pure substance consisting of its own kind of particles.

**Table 18** ***Particle Model of Matter***

| Mastery Level | Frequency n = 50 | Percentage |
|---|---|---|
| Mastered (96 - 100) | 24 | 48.00 |
| Closely Approaching Mastery (86 - 95) | 19 | 38.00 |
| Moving Towards Mastery (75 - 85) | 4 | 8.00 |
| Average Mastery (66 - 74) | 0 | 0 |
| Low Mastery (65 below) | 3 | 6.00 |
| Total | 50 | 100 |
| Average | 89.81 | - |
| Standard Deviation | 17.76 | - |

Table 18 presents the level of students' performance and mastery of the Science learning competencies in terms of the particle model of matter. The findings reveal that 24 (48.00%) of the learners attained the Mastered level, constituting the largest proportion of the respondents. This was followed by 19 (38.00%) learners who were classified under Closely Approaching Mastery, 4 (8.00%) learners under Moving Towards Mastery, and 3 (6.00%) learners under Low Mastery. No learners were classified under the Average Mastery level. The learners obtained an average mastery score of 89.81 with a standard deviation of 17.76, indicating that the students generally demonstrated a high level of mastery with relatively moderate variation in their performance.

The findings are supported by Harrison and Treagust (2022), who emphasized that learners develop a deeper understanding of the particle model of matter when instruction integrates conceptual explanations with visual representations, hands-on activities, and model-based learning. Similarly, Gilbert and Justi (2023) found that teaching the particle nature of matter through multiple representations enables students to relate abstract microscopic concepts to observable phenomena, thereby improving conceptual understanding and mastery. Furthermore, Bybee (2024) asserted that inquiry-oriented Science instruction strengthens learners' understanding of fundamental scientific concepts, such as the particle model of matter, by engaging them in observation, investigation, and evidence-based reasoning.

Overall, the findings indicate that most students have attained mastery or are closely approaching mastery of the competencies related to the particle model of matter. Nevertheless, the presence of a few learners in the lower mastery levels highlights the need for continuous instructional support and enrichment activities to help all students achieve the desired learning competencies.

**Properties and Behavior of Particles**

Properties and Behavior of Particles. This area assesses the level of students' performance and mastery in describing the properties and behavior of particles, including their constant motion, the spaces between them, the attractive forces among them, and the effect of temperature on their movement.

**Table 19** ***Properties and Behavior of Particles***

| Mastery Level | Frequency n = 50 | Percentage |
|---|---|---|
| Mastered (96 - 100) | 21 | 42.00 |
| Closely Approaching Mastery (86 - 95) | 0 | 0 |
| Moving Towards Mastery (75 - 85) | 21 | 42.00 |
| Average Mastery (66 - 74) | 0 | 0 |
| Low Mastery (65 below) | 8 | 16.00 |
| Total | 50 | 100 |
| Average | 79.16 | - |
| Standard Deviation | 24.95 | - |

Table 19 presents the level of students' performance and mastery of the Science learning competencies in terms of the properties and behavior of particles. The findings reveal that 21 (42.00%) of the learners attained the Mastered level, while another 21 (42.00%) were classified under Moving Towards Mastery, making these the

two largest groups of respondents. Meanwhile, 8 (16.00%) learners were classified under the Low Mastery level. No learners were classified under the Closely Approaching Mastery and Average Mastery levels. The learners obtained an average mastery score of 79.16 with a standard deviation of 24.95, indicating that the students generally demonstrated a Moving Towards Mastery level with a relatively wide variation in their performance.

The findings are consistent with Treagust and Chandrasegaran (2022), who emphasized that concepts related to the properties and behavior of particles are among the most abstract topics in Science, making them challenging for learners to understand without the aid of appropriate instructional strategies and multiple representations. Similarly, Taber (2023) found that misconceptions about particle motion, intermolecular spaces, and the effects of temperature on particles remain common among students, highlighting the need for conceptual teaching approaches that address these misunderstandings. Furthermore, Gilbert and Justi (2024) asserted that the effective use of models, simulations, and inquiry-based activities helps learners visualize microscopic processes, thereby strengthening their conceptual understanding and improving mastery of particle behavior.

These findings indicate that while a considerable proportion of students have attained mastery of the competencies related to the properties and behavior of particles, an equally large proportion is still moving toward mastery, and some remain at the low mastery level. These results underscore the need for continuous instructional reinforcement and targeted enrichment activities to deepen students' conceptual understanding and improve their mastery of this fundamental Science topic.

**Summary of Students' Performance**

**Table 20** ***Summary on the Students' Level of Performance***

| Domains | Weighted Mean | Standard Deviation | Interpretation |
|---|---|---|---|
| Scientific models | 84.70 | 24.92 | Moving Towards Mastery |
| Particle model of matter | 89.81 | 17.76 | Closely Approaching Mastery |
| Properties and behavior of particles | 79.16 | 24.95 | Moving Towards Mastery |
| OVERALL MEAN | 84.56 | 11.20 | Moving Towards Mastery |

Note. Source legend: 96–100 Mastered; 86–95 Closely Approaching Mastery; 75–85 Moving Towards Mastery; 66–74 Average Mastery; 65 and below Low Mastery.

Table 20 presents the summary of the students' level of performance and mastery of the Science learning competencies across the three learning areas: scientific models, particle model of matter, and properties and behavior of particles. The findings reveal an overall mean of 84.56 with a standard deviation of 11.20, interpreted as Moving Towards Mastery. These findings indicates that, on average, the students have not yet fully attained the expected level of mastery of the prescribed Science learning competencies. Among the three domains, particle model of matter obtained the highest mean of 89.81 (SD = 17.76), interpreted as Closely Approaching Mastery, suggesting that learners demonstrated better understanding of this competency than the other areas. This was followed by scientific models, which obtained a mean of 84.70 (SD = 24.92), and properties and behavior of particles, which registered the lowest mean of 79.16 (SD = 24.95). Both domains were interpreted as Moving Towards Mastery, indicating that learners still require further reinforcement to achieve the desired mastery level.

The findings are supported by Bybee (2024), who emphasized that students develop stronger conceptual understanding when Science instruction provides meaningful opportunities for inquiry, model construction, and evidence-based reasoning. Similarly, Gilbert and Justi (2023) asserted that mastery of Science concepts is strengthened when learners are actively engaged in model-based learning and are encouraged to connect abstract scientific ideas with observable phenomena. Furthermore, OECD (2023) reported that students' mastery of scientific competencies improves when teachers consistently employ learner-centered instructional strategies that promote critical thinking, problem-solving, and conceptual understanding.

Overall, the findings indicate that students are moving towards mastery of the prescribed Science learning competencies. While learners demonstrated relatively stronger performance in understanding the particle model of matter, additional instructional support and enrichment activities are necessary to strengthen mastery of scientific models and the properties and behavior of particles, thereby enabling students to attain the expected level of proficiency across all learning domains.

**Relationship Between Teaching Strategies and Student Performance**

**Table 21** ***Testing of Significant Relationships***

| Variables | Computed r | p-value | Decision | Interpretation |
|---|---|---|---|---|
| Teachers' strategies and students' performance | 0.918 | 0.0013 | Reject Ho | Significant |

Note. Significance level: α = .05.

Table 21 presents the results of the test of the significant relationship between teachers' teaching strategies and students' performance in Science. The findings reveal a computed Pearson correlation coefficient (r) of 0.918 with a p-value of 0.0013, which is lower than the 0.05 level of significance. Consequently, the null hypothesis was rejected, indicating a significant relationship between teachers' teaching strategies and students' performance in Science. The computed correlation coefficient further indicates a very high positive relationship, suggesting that greater implementation of effective teaching strategies is associated with higher levels of students' performance and mastery of the prescribed Science learning competencies.

The findings are consistent with Hattie (2023), who emphasized that teachers' instructional practices are among the most influential school-related factors affecting students' academic achievement. Likewise, Darling-Hammond (2022) asserted that the effective use of evidence-based pedagogical strategies enhances student engagement, conceptual understanding, and overall learning outcomes. Similarly, OECD (2023) reported that learner-centered instructional approaches, including inquiry-based, differentiated, and collaborative teaching strategies, positively influence students' academic performance by promoting active participation, critical thinking, and meaningful learning experiences.

The reported correlation indicates an association between greater use of teaching strategies and higher learner performance. It does not establish a causal effect. The findings support considering further instructional development and testing the proposed enrichment activities in future research.

**Issues and Concerns**

**Table 22** ***Issues and Concerns***

| Rank | Issues and Concerns | Mean |
|---|---|---|
| 1st | Insufficient or non-existent supply of consumable chemical reagents and raw laboratory materials. | 3.75 |
| 2nd | Absence of up-to-date science textbooks, modules, or verified reference library materials. | 3.70 |
| 3rd | Substandard physical classroom layouts lacking basic utility safety features (e.g., proper ventilation, gas lines, running water outlets, safety eyewashes). | 3.68 |
| 4th | Difficulty in managing oversized student sections during critical, high-risk laboratory experiment periods. | 3.50 |
| 5th | Inadequate institutional budget allocation or administrative support for initiating science fairs, field trips, and hands-on investigative activities. | 3.48 |
| 6th | Excessive clerical, administrative, and extra-curricular non-teaching duties that compress daily lesson preparation time. | 3.40 |
| 7th | Lack of clear alignment between high-stakes standardized tests and the inquiry-based performance targets set by the curriculum. | 3.30 |
| 8th | Inadequate technology resources (e.g., computers, simulation software, or stable internet) to demonstrate virtual scientific phenomena. | 3.28 |
| 9th | Insufficient allotted laboratory time slots within the standard school schedule to successfully complete hands-on scientific tasks. | 3.10 |
| 10th | A lack of localized or contextualized instructional guides that make science relevant to students' immediate regional realities. | 3.05 |

Table 22 presents the concerns and issues encountered by teachers in teaching Science. The findings reveal that the most pressing concern identified by the respondents was the insufficient or non-existent supply of consumable chemical reagents and raw laboratory materials, which obtained the highest mean of 3.75. This was followed by the absence of up-to-date science textbooks, modules, or verified reference library materials (M = 3.70) and substandard physical classroom layouts lacking essential laboratory safety features (M = 3.68). Other notable concerns included the difficulty of managing oversized classes during laboratory activities (M = 3.50), inadequate institutional budget and administrative support for science fairs, field trips, and investigative activities (M = 3.48), excessive clerical and non-teaching responsibilities (M = 3.40), lack of alignment between standardized assessments and inquiry-based curriculum goals (M = 3.30), inadequate technology resources (M =

3.28), insufficient laboratory time (M = 3.10), and the lack of localized or contextualized instructional guides (M = 3.05).

The findings are supported by UNESCO (2023), which emphasized that inadequate laboratory facilities, insufficient instructional resources, and limited funding continue to hinder the effective delivery of quality Science education in many schools. Similarly, OECD (2024) reported that shortages in teaching materials, technological resources, and instructional support reduce teachers' capacity to implement learner-centered and inquiry-based instructional approaches effectively. Furthermore, Darling-Hammond (2022) asserted that providing teachers with adequate instructional resources, supportive learning environments, and sufficient preparation time is essential for improving instructional quality and student achievement. Likewise, DepEd (2024) highlighted that strengthening school resources, laboratory facilities, and professional support systems is necessary to improve the implementation of Science instruction and the attainment of curriculum standards.

Overall, the findings indicate that Science teachers continue to encounter resource-, facility-, and workload-related challenges that may affect the effective implementation of learner-centered instruction. Addressing these concerns through adequate funding, improved laboratory facilities, updated instructional materials, technology integration, and strengthened administrative support can enhance the quality of Science teaching and promote better student learning outcomes.

**Output of the Study**

The findings show moderate implementation of inquiry-based and differentiated instruction (both M = 3.25) and high implementation of collaborative strategies (M = 3.28). Students' lowest mean was in Properties and Behavior of Particles (M = 79.16), followed by Scientific Models (M = 84.70), while the Particle Model of Matter received M = 89.81. These findings informed the proposed Science Enrichment Activity Program (SEAP), which combines inquiry, differentiated tasks, and structured collaboration across the three assessed competencies.

The reported shortages of laboratory consumables, current references, suitable facilities, and technology informed the use of low-cost, contextualized materials. The supplied activities address diffusion and thermal energy, three-dimensional particle models and phase transitions, and the evaluation and revision of scientific models. The activities, procedures, and rubrics below are proposed enrichment materials; the manuscript does not report post-implementation measurements of their effectiveness.

**Rationale**

The findings of the study revealed that Science teachers employed teaching strategies to a high extent, with collaborative strategies being the most frequently utilized. However, inquiry-based and differentiated instructional strategies were implemented only to a moderate extent. Likewise, students demonstrated an overall Moving Towards Mastery level in the prescribed Science learning competencies, with the Properties and Behavior of Particles emerging as the least-mastered competency. Furthermore, teachers identified several challenges, including insufficient laboratory materials, outdated instructional resources, inadequate technology, and limited laboratory time, which may hinder the effective delivery of Science instruction.

In response to these findings, this enrichment activity is designed to strengthen teachers' implementation of inquiry-based and differentiated instructional strategies while providing students with meaningful, engaging, and contextualized learning experiences. The program emphasizes low-cost, hands- on, collaborative, and inquiry-oriented activities that can be implemented despite limited school resources. Ultimately, it aims to improve students' conceptual understanding, increase mastery of Science learning competencies, and promote learner-centered Science instruction.

**Objectives**

At the end of the implementation of the enrichment activity, the participants are expected to:

1. strengthen teachers' implementation of inquiry-based, differentiated, and collaborative teaching strategies in Science;
2. improve students' mastery of the Science learning competencies, particularly on the Properties and Behavior of Particles;
3. develop students' critical thinking, scientific reasoning, communication, and collaborative skills through inquiry-based investigations;
4. utilize contextualized and low-cost instructional materials in conducting Science learning activities; and

5. increase students' engagement and participation in Science learning through varied learner-centered instructional approaches.

**Scheme of Implementation**

This output will be submitted to the Science Coordinator for preliminary approval and be endorsed to the School Head for validation and for deliberation and possible appropriate action. Target Clientele

**Target Clientele**

The participants for the enrichment activities are the grade 7 learners at Awihao National High School.

**Sample Output 1: THE INVISIBLE MOTION: MODELING DIFFUSION AND THERMAL ENERGY IN PARTICLES**

**Table 23** ***Activity 1 Specifications***

| Component | Details |
|---|---|
| Target Competency | Differentiating properties and behavior of particles (Particle Motion & Temperature Effects) |
| Pedagogical Strategy Focus | Inquiry-Based Learning (5E Instructional Model) & Differentiated Task Options |
| Time Allocation | 60 Minutes (Single Class Period) |
| Materials / Resources Required | Clear plastic/glass cups, room-temperature water, hot water, cold water, food coloring (or liquid dye/coffee/soy sauce), timer/stopwatch, observation activity sheet. |

**Activity Overview and Learning Rationale**

This activity addresses the lowest-mastered competency identified in the study. Students directly investigate how thermal energy affects the kinetic energy and spread of particles through fluid mediums. Instead of simply reading a textbook definition of diffusion, learners observe, measure, and analyze particle behavior in real-time using low-cost, readily available household materials.

**Instructional Procedure (5E Inquiry Model)**

- Engage (10 mins): The teacher places a drop of food coloring into a clear container of still water without stirring and asks: 'Why does the color spread on its own without anyone touching it? What is happening at the microscopic level?' Students record initial predictions.
- Explore (15 mins): In small groups, students add one drop of food coloring simultaneously into three cups with identical volumes of cold, room- temperature, and hot water. Groups use a stopwatch to record the rate of diffusion and observe visual patterns.
- Explain (15 mins): Student teams present their observations and draw molecular-level particle diagrams illustrating particle spacing and speed in cold vs. hot water. The teacher introduces formal concepts of thermal expansion, kinetic energy, and intermolecular motion.
- Elaborate (10 mins): Differentiated Extension Task - Students choose one tier: (Tier A) Create a comic strip depicting 'A Day in the Life of a Water Particle in Hot Water', (Tier B) Write a formal scientific claim-evidence- reasoning (CER) paragraph, or (Tier C) Design a real-world application concept (e.g., explaining why tea brews faster in hot water).
- Evaluate (10 mins): Students complete a 3-item formative exit ticket requiring them to predict particle behavior in varying thermal conditions and self-assess their group collaboration.

**Assessment Matrix and Performance Rubric**

**Table 24** ***Activity 1 Performance Rubric***

| Criteria | Excellent (4) | Satisfactory (3) | Needs Improvement (2-1) |
|---|---|---|---|
| Scientific Understanding | Accurately explains particle motion, kinetic energy, and temperature effects with complete conceptual clarity. | Explains particle diffusion accurately with minor gaps in connecting heat to kinetic energy. | Shows significant misconceptions regarding particle motion or heat effects. |
| Data Collection & Inquiry | Records precise diffusion times, detailed visual observations, and clear particle diagrams. | Records complete diffusion times and basic diagrams with minor inaccuracies. | Incomplete data recording; fails to draw particle diagrams. |
| Differentiated Product | Demonstrates exceptional creativity, depth, and mastery in chosen tier output (Comic/CER/Application). | Successfully completes chosen tier output with clear basic understanding. | Output is incomplete or fails to address target concept. |

**Sample Output 2: PARTICLE REALM: 3D MOLECULAR MODELING AND PHASE TRANSITION CHALLENGE**

**Table 25** ***Activity 2 Specifications***

| Component | Details |
|---|---|
| Target Competency | Describing the Particle Model of Matter (Arrangement, Spacing, and Intermolecular Forces in Solids, Liquids, and Gases) |
| Pedagogical Strategy Focus | Collaborative Learning (Structured Team Roles) & Differentiated Artifact Creation |
| Time Allocation | 60 Minutes (Single Class Period) |
| Materials / Resources Required | Improvised materials (clay, seeds, dried beans, small stones, or recycled paper balls), cardboard bases, glue/tape, marker pens, role assignment badges. |

**Activity Overview and Learning Rationale**

This collaborative enrichment activity provides concrete visual and tactile representations of microscopic particle arrangements. Addressing findings that students require active peer engagement to grasp abstract physical concepts, learners work in cooperative quads with designated roles to construct, explain, and defend 3D physical models depicting solid, liquid, and gas molecular structures.

**Instructional Procedure (5E Inquiry Model)**

- Team Formation & Role Assignment (5 mins): Students form groups of four and assign structured roles: Principal Investigator (leads discussion), Material Manager (handles model supplies), Data Recorder (documents group explanations), and Spokesperson (presents output).
- Model Construction (20 mins): Using provided low-cost materials (e.g., clay balls or seeds), teams construct three distinct physical models on a shared cardboard board representing particle arrangement, spacing, and relative freedom of movement in Solids, Liquids, and Gases.
- Peer Gallery Walk & Review (15 mins): Groups rotate to examine peer models. The Spokesperson remains to present, while other members evaluate other groups using a structured peer-review checklist assessing model accuracy, particle density, and force representation.
- Conceptual Synthesis (10 mins): Teams return to their stations, review peer feedback, and adjust their models or written explanations based on constructive critiques.
- Closure & Assessment (10 mins): The teacher facilitates a whole-class summary emphasizing how intermolecular forces hold solid particles rigidly while gas particles overcome forces due to high energy.

**Assessment Matrix and Performance Rubric**

**Table 26** ***Activity 2 Performance Rubric***

| Criteria | Excellent (4) | Satisfactory (3) | Needs Improvement (2-1) |
|---|---|---|---|
| Model Accuracy & Detail | 3D models perfectly depict correct spacing, arrangement, and movement potential across all 3 phases. | Models depict phase differences accurately with minor scale or spacing errors. | Models show significant conceptual errors (e.g., solid particles drawn far apart). |
| Collaborative Dynamics | All members strictly execute assigned roles; demonstrates active communication and mutual support. | Members execute roles with minor teacher prompting; good teamwork. | Dominant individual work or confusion regarding assigned group roles. |
| Peer Review & Synthesis | Provides insightful peer feedback and effectively uses received critiques to refine team output. | Participates in gallery walk and completes peer review forms accurately. | Superficial participation in peer review without meaningful feedback. |

**Sample Output 3: SCIENTIFIC MODEL DETECTIVE: EVALUATING AND REFINING SUBMICROSCOPIC VISUALIZATIONS**

**Table 27** ***Activity 3 Specifications***

| Component | Details |
|---|---|
| Target Competency | Recognizing Scientific Models and Evaluating Their Strengths and Limitations |
| Pedagogical Strategy Focus | Inquiry-Based Learning (Critique & Revision) & Higher-Order Thinking (Analogy Analysis) |
| Time Allocation | 60 Minutes (Single Class Period) |
| Materials / Resources Required | Printed model comparison cards (showing historical vs. modern atomic/particle models, analogies like 'marbles in a box'), comparison graphic organizers, highlighters. |

**Activity Overview and Learning Rationale**

Scientific literacy requires understanding that models are tools for representing phenomena, not exact replicas of reality. This activity engages Grade 7 students in evaluating various scientific models of matter (analogy models, physical representations, computer simulations). Learners identify what each model successfully explains and where it fails or oversimplifies reality, fostering critical scientific reasoning.

**Instructional Procedure (5E Inquiry Model)**

- Phenomenon & Hook (10 mins): The teacher shows a globe and a wall map, asking: 'Are these real Earths? Why do we use them? What details does a map miss that a globe captures?' The teacher connects this to submicroscopic scientific models.
- Model Analysis Challenge (20 mins): In pairs, students analyze three distinct models of matter: (1) A box filled tightly with marbles, (2) A syringe filled with compressed air, and (3) A computer animation of water molecules. Using a Graphic Organizer, pairs identify the Target Concept, Model Strengths, and Model Limitations.
- Guided Debate & Refinement (15 mins): The teacher facilitates a class debate: 'Which model best represents the expansion of gas when heated? What limitations does the marble box model have when explaining phase changes?' Pairs refine their organizers based on evidence.
- Model Revision Task (10 mins): Pairs are challenged to modify one of the provided flawed models or create a original analogy model that overcomes a identified limitation (e.g., adding rubber bands to represent intermolecular forces).
- Reflective Summary (5 mins): Students complete a reflection log: 'Why do scientists use multiple models for the same phenomenon?'

**Assessment Matrix and Performance Rubric**

**Table 28** ***Activity 3 Performance Rubric***

| Criteria | Excellent (4) | Satisfactory (3) | Needs Improvement (2- 1) |
|---|---|---|---|
| Critical Evaluation | Identifies specific strengths and subtle limitations for all evaluated scientific models with deep reasoning. | Identifies basic strengths and obvious limitations of models accurately. | Struggles to identify limitations; treats models as literal physical realities. |
| Model Revision & Innovation | Proposes highly creative, scientifically valid modifications to overcome identified model limits. | Proposes feasible revisions that address basic model limitations. | Revisions are scientifically inaccurate or fail to address model limits. |
| Scientific Reasoning | Articulates clearly why scientific models change over time when new evidence is discovered. | Understands that models are simplified tools used by scientists. | Views scientific models merely as simple classroom drawings or toys. |

## Conclusion

The teacher-respondents differed in age, gender, civil status, teaching position, experience, educational attainment, and training attended. The study describes these characteristics but does not test their separate relationships with teaching-strategy use or learner mastery.

Teachers' overall reported use of teaching strategies was classified as High Extent under the result-table scale (M = 3.26). Collaborative strategies had the highest mean (M = 3.28), while inquiry-based and differentiated instruction each received M = 3.25, classified as Moderate Extent. These are descriptive differences and do not establish statistically significant differences among the three dimensions.

Moreover, students generally demonstrated a Moving Towards Mastery level in the prescribed Science learning competencies, indicating that while learners have acquired substantial understanding of the concepts, they have not yet consistently attained the expected mastery level across all competency areas. This implies that sustained instructional interventions and enrichment activities remain necessary to strengthen conceptual understanding and improve learning outcomes.

Teachers' reported use of teaching strategies was strongly and positively associated with student performance ($r = 0.918$, $p = 0.0013$). This descriptive-correlational result does not demonstrate that the strategies caused improved mastery. The association should be interpreted within the study's sample and correlational design.

Finally, despite teachers' commitment to implementing effective instructional strategies, several challenges continue to affect the delivery of quality Science education, particularly the inadequacy of laboratory resources, instructional materials, learning facilities, technology, and institutional support. Addressing these concerns through enhanced resource allocation, continuous professional development, and strengthened administrative support will contribute to more effective Science instruction and improved student learning outcomes.

## Recommendations

Based on the findings and conclusions of the study, the following recommendations are offered. School administrators may strengthen support for Science instruction by allocating sufficient resources for laboratory equipment, consumable materials, updated instructional references, and educational technologies. They may also provide continuous administrative assistance and create opportunities for teachers to implement learner-centered and inquiry-based instructional practices effectively.

Science teachers are encouraged to further enhance their pedagogical competence by consistently integrating inquiry-based, differentiated, and collaborative teaching strategies in classroom instruction. Greater emphasis may also be given to providing students with opportunities to conduct independent investigations, engage in higher-order thinking activities, and participate in meaningful collaborative learning experiences that promote mastery of Science concepts.

Students are encouraged to actively participate in classroom discussions, laboratory activities, collaborative learning tasks, and inquiry-based investigations to strengthen their conceptual understanding and improve their mastery of Science learning competencies. They should likewise develop positive learning habits through active engagement, critical thinking, and continuous practice of scientific skills.

The Department of Education may intensify its support for Science education by providing schools with adequate laboratory facilities, updated

instructional materials, technology resources, and sustained professional development programs that enhance teachers' pedagogical competence and instructional effectiveness.

Future researchers may replicate this study using a larger sample size, different research settings, or additional variables that may influence students' academic performance in Science, such as teachers' pedagogical competence, classroom environment, learning motivation, scientific attitude, or instructional leadership.

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