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Research Article

Physics Teachers' Competence and Extent of Use of Laboratory Approaches

John Marvin F. Remigio*, Vida V. Antonio, Marc Paul T. Calzada

Mariano Marcos State University – Graduate School, Laoag City, Ilocos Norte, 2900, Philippines

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**Corresponding author:*
E-mail:
mhavzremigio@gmail.com

ABSTRACT

Science education is vital for developing students' critical thinking, problem-solving skills, and scientific literacy. Effective scientific training relies on both theoretical instruction and hands-on experience using laboratory equipment. Laboratories serve as essential instructional environments where students explore scientific principles, conduct experiments, and apply theoretical knowledge in practical situations. The efficient utilization of laboratory equipment predominantly depends on the expertise of science educators in administering and integrating these resources into their instruction. Hence, a descriptive-correlational research approach was conducted to determine the knowledge and skill competence of public school teachers in the Schools Division of Ilocos Norte. Using a researcher-made survey questionnaire, it was revealed that the respondents have very high competence when it comes to laboratory instruction. With a positive correlation, the results revealed that teachers with high competence in laboratory techniques, equipment handling, and experiment facilitation are more likely to integrate laboratory activities into their teaching, fostering active learning and scientific inquiry among students. The study emphasizes the importance of continuous professional development and skills training to maximize the use of laboratory resources. Thus, Schools should invest in training programs and provide adequate facilities to ensure teachers can effectively implement laboratory-based instruction, enhancing instructional effectiveness and student engagement in science learning.

Keywords: *Utilization, Knowledge competence, Skill competence, Laboratory-based instruction, Science, Science teachers*

Introduction

Science education plays a pivotal role in cultivating students' critical thinking, problem-solving abilities, and scientific literacy. Central to effective science instruction is the integration of both conceptual teaching and experiential learning—particularly using laboratory-based instruction. Laboratories serve as essential educational environments where students can explore scientific concepts, conduct

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experiments, and apply theoretical knowledge to real-world problems. However, the effectiveness of laboratory instruction is largely dependent on the competence of science teachers in managing, facilitating, and incorporating laboratory resources into their pedagogical practices.

Teacher competence in laboratory utilization encompasses both theoretical knowledge—such as understanding equipment functions and scientific principles—and practical skills, including conducting experiments, ensuring safety, and designing inquiry-driven learning experiences. Despite the widely acknowledged importance of laboratory-based teaching, science educators in many contexts continue to encounter persistent barriers, such as limited training, lack of confidence, insufficient laboratory facilities, and inadequate professional development. These challenges hinder teachers' ability to fully leverage laboratory instruction, ultimately affecting student engagement and learning outcomes.

The introduction of the K–12 curriculum in the Philippines, which added two years to basic education, has increased the demand for innovative teaching strategies and effective science instruction. Educators are expected to not only adapt to curricular reforms but also to maintain competence amidst rapid technological advancement and globalization. As Nopas and Kerdsomboon (2024) emphasize, ongoing professional development is imperative for teachers to implement curriculum changes effectively and remain responsive to 21st-century educational demands.

In the Philippine context, disparities in the quality of science education, particularly laboratory instruction, remain a pressing concern. For example, Abas and Marasigan (2020) report a lack of sufficient laboratory resources in public junior high schools in Lanao del Sur, while de Borja and Marasigan (2020) highlight how inadequate equipment, safety issues, and scheduling conflicts hinder science teaching. Likewise, Pacala and Cabrales (2023) found that rural schools often suffer from poor infrastructure and low teacher morale, which further weakens science instruction in under-resourced settings.

While these studies have illuminated various systemic and structural barriers to effective science education in the Philippines, there is a critical research gap concerning how science teachers' actual competence, both knowledge and skills, in laboratory instruction correlates with their utilization of laboratory-based teaching methods. Specifically, little is known about how such competence is manifested among public secondary science teachers in specific local contexts such as the Schools Division of Ilocos Norte. Moreover, limited empirical data is evaluating the degree to which competent teachers in this region incorporate laboratory activities into their instructional practices, or how this correlates with the availability of laboratory resources.

This study aims to fill that gap by assessing the knowledge and skills competence of public secondary science teachers in the Schools Division of Ilocos Norte and examining how these competencies influence the use and integration of laboratory instruction. By addressing this gap, the study offers valuable insights into localized strengths and deficiencies in laboratory utilization and provides evidence-based recommendations for professional development initiatives. Ultimately, the findings aim to support the improvement of science education quality through better-informed instructional strategies and resource allocation tailored to teachers' needs.

Methods

Research Design

This study utilized a descriptive-correlational design. This study is descriptive, aiming to determine the relationship between science instructors' knowledge and their skill competency in laboratory instruction. The study was correlational, aiming to determine the relationship between laboratory skill and its application.

Population and Sampling Procedure

The respondents of this study were deliberately selected public secondary science instructors from the Schools Division of Ilocos Norte (SDOIN). A total of 198 respondents were identified from the overall population of science teachers in the specified division.

Through purposive sampling method, the researcher gathered data from all Junior and Senior High School Science teachers who were teaching in the Schools Division of Ilocos Norte. Since this paper centered on identifying the situation of laboratory utilization and the teachers' competencies in conducting laboratory activities, the total enumeration of teachers was ideal.

Research Instrument

This study employed a survey questionnaire entitled "Physics Teachers Laboratory Competence," adapted from the instrument utilized by Gecer and Zengin (2016), and validated by the thesis advisor and panel members. A two-part survey questionnaire was employed for the study. The initial component collected demographic data from the respondents, encompassing their gender, teaching role, tenure, highest educational qualification, and field of expertise. The second section comprised a 20-item checklist that delineated the teacher's competency about science laboratory. It aimed to assess the proficiency of teachers on their knowledge and skills in delivering laboratory instruction. Additionally, another instrument to assess the level of teachers' utilization of laboratory instruction was derived from Gecer and Zengin (2016).

Data Gathering Procedures

An ethical approval was obtained from the University Research Ethics and Review Board (URERB) to validate the study. Approval to do the study was also requested from the College Dean. Correspondence was dispatched to the Schools Division Superintendent of SDOIN to solicit the involvement of the educators. Following the clearance of the sheet, data collection was conducted via an internet platform. The link was disseminated through a chat group and publicized on Facebook

Data Analysis

Descriptive and inferential statistics, including frequency counts, percentages, means, and Pearson-r correlation with a 0.01 level of significance, were used to tabulate, organize, analyze, and interpret the data.

Ethical Considerations

This study adhered to the research methodology established by the URERB to guarantee that no volunteer was coerced. Their participation was guaranteed to be voluntary, and no personal or private information would be disclosed without their approval. Moreover, no financial or alternative forms of compensation were provided to the responders.

Result and Discussion

Knowledge Competence of Teachers in Science Laboratory

Table 1 delineates the ten criteria for assessing the knowledge competence of science teachers in a laboratory setting. The data indicates that teachers expressed strong agreement with 3 out of the 10 statements. Notably, teachers acknowledged their understanding of the significance of laboratory methods in science instruction, achieving a mean score of 4.53. They also emphasized their familiarity with laboratory safety regulations and teaching methodologies, with mean scores of 4.33 and 4.27, respectively. However, despite an overall mean of 4.08, it was evident that teachers possess insufficient foundational knowledge regarding all science laboratory equipment and facilities.

Table 1. Knowledge competence of teachers in science laboratory

Statements	Mean	Descriptive Interpretation
I know the importance of laboratory methods in science teaching.	4.53	Strongly Agree
I know the teaching methods and techniques that are used in laboratory studies.	4.27	Strongly Agree
I have all the knowledge to create a safe working environment in the laboratory.	3.98	Agree
I know all the tools in the science lab.	3.50	Agree

Statements	Mean	Descriptive Interpretation
I have knowledge related to simple maintenance equipment in the laboratory.	3.86	Agree
I know about measuring students' knowledge and skills related to laboratory work.	4.05	Agree
I know about measuring students' attitudes regarding their laboratory studies.	4.03	Agree
I know how to select the appropriate tools for a given experiment.	4.11	Agree
I know how to follow safety rules when using equipment.	4.33	Strongly Agree
I know how to interpret test results.	4.14	Agree
Weighted Mean	**4.08**	**Agree**

A growing body of research underscores the pivotal influence of teachers' knowledge competency on the effective utilization of science laboratories in secondary education. Zabala and Dayaganon (2022) reported that educators with advanced competencies in laboratory procedures and equipment handling not only demonstrate heightened confidence but are also more adept at facilitating inquiry-based instruction. This finding is corroborated by Alfred (2023), whose study revealed that teachers who engage in sustained professional development in laboratory techniques are significantly more likely to integrate hands-on, experiential activities into their pedagogy—thereby enhancing student engagement and academic outcomes. In contrast, Nipales (2019) found that teachers lacking sufficient laboratory training often struggle with experiment execution, resulting in the underutilization of laboratory facilities and a diminished quality of science instruction.

These findings collectively highlight the disparity in laboratory usage that stems from variability in teacher preparedness, drawing attention to systemic gaps in science education training. The synthesis of these studies suggests that competency is not merely a desirable trait but a necessary condition for the full pedagogical deployment of laboratory resources. The implications for practice are substantial: teacher education programs must prioritize laboratory-based training, not as peripheral content but as core instructional competence. Furthermore, educational institutions should institutionalize continuous, practice-based professional development that equips teachers with both the technical and pedagogical skills required for effective laboratory instruction. Addressing these gaps is essential to maximizing the educational potential of laboratory environments and promoting equitable science learning opportunities across diverse school settings.

Skills Competence of Teachers in Science Laboratory

Science teachers' competence in laboratory settings is a critical determinant of instructional effectiveness and student engagement. To facilitate meaningful learning experiences, teachers must demonstrate a range of proficiencies, including laboratory management, safety procedures, experimental design and execution, and the ability to troubleshoot equipment and procedural issues.

Data presented in Table 2 reveal that teachers generally perceive their students as demonstrating considerable proficiency in laboratory skills. Specifically, respondents agreed strongly with statements indicating their ability to establish and maintain a safe working environment, adhering closely to laboratory safety protocols, as evidenced by high mean values of 4.30 and 4.36. This suggests that science teachers are capable of fostering a secure and structured learning atmosphere that supports the acquisition of scientific knowledge and procedural understanding. However, the data also indicate a notable gap in teachers' proficiency with the full range of laboratory instruments. This shortcoming may be attributed to the limited availability of laboratory equipment and resources, a common issue in underfunded educational settings. Without access to adequate tools, teachers are less likely to explore or develop familiarity with advanced or specialized laboratory apparatus, thereby constraining the scope of laboratory instruction.

This observation aligns with previous research. For instance, Nipales (2019) found that teachers with strong laboratory competencies are adept at setting up experiments, handling scientific tools, and applying correct laboratory procedures, which contributes significantly to instructional quality and student engagement. Furthermore, these teachers demonstrate an enhanced capacity to manage safety risks, ensuring a supportive environment for experiential learning. Conversely, teachers who lack access to laboratory equipment or sufficient training often struggle to incorporate practical activities into their lessons, ultimately impeding students' hands-on learning opportunities.

To address these challenges, targeted professional development initiatives are essential. Germuth (2018) emphasized that ongoing training—particularly in the form of hands-on workshops and skill-building programs—substantially improves teachers' confidence and technical competence in laboratory settings. Such programs should be systemic and continuous, rather than episodic, to ensure sustained improvement. Moreover, collaboration among educators, school leaders, and policymakers is vital to bridge resource gaps and promote an institutional commitment to laboratory-based science instruction.

Ultimately, strengthening science teachers' laboratory competencies is fundamental to advancing a more engaging, inquiry-driven approach to science education. Doing so not only enhances teachers' instructional efficacy but also enriches students' scientific literacy and skill development, preparing them for further studies and careers in STEM fields.

Table 2. Skills competence of teachers in science laboratory

Statements	Mean	Descriptive Interpretation
I can use appropriate teaching methods and techniques in laboratory studies.	4.18	Agree
I can create and maintain a safe working environment in the laboratory.	4.30	Strongly Agree
I can use all the tools in the science lab.	3.32	Somewhat Agree
I can execute simple laboratory equipment maintenance.	4.11	Agree
I can organize an effective teaching environment in the laboratory.	4.17	Agree
I can develop and use simple tools for laboratory work.	4.12	Agree
I follow safety rules when doing laboratory activities.	4.36	Strongly Agree
I can interpret test results.	4.15	Agree
I can combine experimental results with theoretical knowledge to achieve new results.	4.05	Agree
I can execute science skills well.	4.00	Agree
Weighted Mean	**4.08**	**Agree**

Teachers' Overall Competence in Science Laboratory

Table 3 talks about the relationship between the knowledge competence and skill competence of teachers in laboratory-based teaching instruction.

Table 3. Overall teaching competence of teachers in laboratory-based instruction

Competency	Mean	r-value	Interpretation
Knowledge	4.08	0.1391	Weak positive
Skills	4.08		

Table 3 reveals a positive correlation between public-school teachers' knowledge and skills in scientific laboratory work. This relationship highlights the critical need for educators to possess both theoretical understanding and practical competencies to effectively communicate scientific concepts. These dimensions are not only complementary but also mutually reinforcing; the development of one supports the growth of the other. Therefore, fostering both knowledge and skill is essential for the holistic professional development of science teachers.

Empirical evidence supports this interpretation. Supriyatman (2024) emphasizes that teachers with high levels of competence in laboratory-based instruction are more likely to deliver interactive and experiential science lessons. Their command of laboratory procedures enables them to guide students through scientific investigations with confidence and precision, promoting the development of critical thinking, problem-solving, and analytical reasoning. These instructional strategies align closely with the goals of inquiry-based science education and are crucial in fostering scientific literacy among students. Furthermore, research indicates that teachers with robust laboratory competence are better equipped to navigate common instructional challenges such as limited laboratory equipment, restricted instructional time, and diverse student learning needs. Their adaptability allows them to innovate within constraints, ensuring that students still benefit from meaningful hands-on experiences. In contrast, educators who lack training in laboratory management and instructional strategies often default to lecture-based approaches, resulting in a more theoretical and less engaging science learning environment. This not only diminishes student interest but also reduces opportunities for the development of essential scientific process skills.

Given these findings, the integration of laboratory skills development into teacher training programs is imperative. Ongoing professional development should emphasize both conceptual knowledge and applied laboratory practices, supported by institutional investments in laboratory infrastructure and instructional resources. Such efforts are crucial to enhancing the quality of science education and ensuring that teachers are well-prepared to facilitate dynamic, inquiry-driven learning environments.

Utilization of Laboratory Instruction Method

Table 4 delineates the frequently employed laboratory teaching methodologies among science educators in the Schools Division of Ilocos Norte. The data is presented as frequency and percentage for each strategy, offering insights into educators' preferences and practices in laboratory instruction.

Table 4. Level of Laboratory Teaching Approach

Laboratory Teaching Approach	Frequency	Percentage
1. Confirmation Inquiry (CI)	0	0%
2. Demonstration (D)	31	46.970%
3. Guided Inquiry (GI)	29	43.940%
4. Open Inquiry (OI)	2	3.030%
5. Structured Inquiry (SI)	4	6.060%
Total	**66**	**100%**

The findings indicate that the Demonstration Approach is the most employed laboratory teaching method among educators in the Schools Division of Ilocos Norte, with a utilization rate of 46.97%. This predominance suggests a preference for teacher-led demonstrations over more participatory, student-centered methods. While this approach effectively conveys complex or abstract scientific concepts, it may limit students' opportunities for hands-on engagement. Recent studies reinforce the instructional value of demonstrations. For instance, Montgomery et al. (2022) found that students who observed instructor-led experiments in chemistry labs performed significantly better on conceptual assessments and reported increased confidence in applying observed strategies. These findings underscore the potential of demonstrations to support foundational understanding, especially in contexts where resources or time may constrain more interactive methods

The Guided Inquiry Approach, employed by 43.94% of educators, is nearly as prevalent and offers a more student-centered alternative. This method involves structured student exploration, guided by instructor support. Orosz et al. (2022) demonstrated that guided inquiry significantly enhances students' problem-solving abilities, retention of scientific concepts, and capacity to apply knowledge to real-world situations. Furthermore, students involved in guided inquiry reported heightened motivation and a stronger sense of ownership over their learning. Thompson et al. (2023) corroborated these findings in undergraduate biology laboratories, highlighting gains in students' critical thinking, hypothesis development, and data interpretation skills. These results suggest that guided inquiry strikes a balance between structure and autonomy, making it a powerful tool for deepening conceptual understanding while cultivating scientific reasoning.

In contrast, the Structured Inquiry Approach—in which students are provided with procedures but must determine explanations—is notably underutilized, with only 6.06% of educators implementing it. Despite its low adoption, this approach has demonstrated positive effects on students' scientific and mathematical literacy. Wang et al. (2022) found that structured inquiry can significantly improve learning outcomes by encouraging students to make inferences and apply logic within a controlled experimental framework. However, the current study reveals that teachers in the division overwhelmingly favor teacher-directed strategies, possibly due to time constraints, limited training, or concerns about classroom management. This underuse reflects a missed opportunity to support the development of student autonomy and analytical skills. Additionally, research suggests that structured inquiry can foster reading and interpretation abilities by allowing students to engage more deeply with scientific texts and procedures.

The Open Inquiry Approach, representing only 3.03% of implementation, is the least utilized among active methodologies. Open inquiry empowers students to formulate their own research questions, design experiments, and explore scientific phenomena independently. Despite its demands, this approach yields strong learning outcomes. Dah et al. (2024) found that students engaged in open inquiry demonstrated superior skills in hypothesis formulation, experimental design, and data analysis, as well as greater proficiency in applying scientific concepts to novel contexts. Moreover, these students reported increased motivation, deeper engagement, and improved collaborative problem-solving skills. The minimal use of this method in the study suggests a hesitance among educators to relinquish control over the learning process, often due to doubts about students' readiness for such autonomy or fears about safety and feasibility within limited instructional timeframes.

Remarkably, the Confirmation Inquiry Approach, in which students replicate established experiments to confirm known scientific principles, was not used at all (0%). This absence may indicate a deliberate move away from rote procedural learning toward more constructivist strategies. However, confirmation inquiry can serve as a transitional method for developing fundamental lab skills and building confidence before progressing to more open-ended inquiries. The complete absence of this method may suggest a gap in providing foundational, scaffolded experiences that support inquiry progression.

The preference for demonstration and guided inquiry, while supported by evidence, may reflect broader challenges inhibiting the implementation of more student-directed approaches. These include insufficient training, lack of laboratory facilities, time limitations, and safety concerns. While these barriers are valid, their persistence limits students' opportunities to engage in authentic scientific inquiry—an essential component of developing critical thinking and problem-solving skills.

To address these disparities, targeted and sustained professional development is imperative. Workshops and mentoring programs should focus on equipping teachers with practical strategies for implementing structured and open inquiry within real-world classroom constraints. Additionally, the development of collaborative professional learning communities can facilitate the sharing of best practices and encourage pedagogical innovation. Investment in infrastructure, safety protocols, and teaching materials is also essential to support broader adoption of diverse instructional approaches. By diversifying laboratory pedagogies and aligning them with students' developmental needs, educators can foster a more inclusive, inquiry-rich science education environment that prepares learners for future scientific challenges.

Extent of Using Laboratory Teaching Approach

Table 5 provides a comprehensive summary of the frequency of various laboratory teaching methodologies utilized by science educators in the Schools Division of Ilocos Norte. The data classifies usage into several intervals, offering significant insights on the instructional methods of instructors in the area.

Table 5. Extent of Using Laboratory Teaching Approach

Extent of Using Laboratory Approach	Frequency	Percentage
Everyday	2	3.03%
Once a week	17	25.76%
Twice a week	4	0.06%
Thrice a week	3	4.55%
Once every two weeks	17	25.76%
Once every three weeks	5	7.58%
Once a month	9	13.64%
Once a quarter	8	12.12%
When students want	0	0%
Never	1	1.52%
Total	66	100%

The data reveal that only 3.03% of teachers conduct laboratory activities daily, highlighting a substantial deficiency in the regular integration of hands-on science instruction. This infrequent usage of laboratory work may be attributed to constraints such as rigid curricular schedules, limited resources, inadequate training, and safety concerns. Efendi and Jayanti (2024) emphasize that infrequent exposure to laboratory experiences can hinder the development of students' conceptual understanding and experimental skills, both of which are essential in fostering scientific literacy and inquiry-based learning. Daily laboratory engagement has the potential to enhance comprehension, critical thinking, and student motivation by connecting theoretical knowledge to practical applications; however, the current implementation rate suggests that such opportunities remain largely untapped in the studied division.

A more considerable proportion of teachers, 25.76%, reported conducting laboratory instruction every week. This frequency indicates a moderate integration of laboratory-based learning into the science curriculum and reflects an acknowledgement of its pedagogical value. Weekly laboratory activities offer students regular opportunities to engage in experimental procedures, reinforce concepts, and practice scientific methods. However, Efendi and Jayanti (2024) caution that without sufficient planning, alignment with instructional goals, and formative assessment, even weekly laboratory instruction may result in underutilized resources and limited learning outcomes. Similarly, another 25.75% of respondents conduct laboratory activities bi-weekly, a frequency that may provide a balanced approach between practical engagement and curriculum coverage. While bi-weekly instruction allows for thoughtful preparation and implementation, it may not provide the continuity required for students to develop strong laboratory habits or mastery of investigative techniques.

The study also shows that 13.64% of teachers implement laboratory work every month, while 12.12% do so quarterly. These lower frequencies indicate a significant gap in experiential learning, particularly in science disciplines that demand consistent engagement with physical materials, observation, and experimentation. Students in these classrooms may miss opportunities to apply theoretical knowledge, develop problem-solving strategies, and build confidence in their scientific abilities. Research by Kranz et al. (2022) asserts that the frequency of laboratory engagement plays a crucial role in strengthening students' conceptual understanding and scientific reasoning. Monthly or quarterly laboratory instruction, while better than none, may not be sufficient to foster sustained inquiry or deepen scientific skills.

Alarmingly, 1.52% of teachers indicated that they never implement laboratory instruction. This total absence of hands-on learning deprives students of critical experiences necessary for meaningful science education. Garcia et al. (2022) describe such situations as "discovering illumination in obscurity," a metaphor that captures the lost potential and the disconnection students may feel when learning science becomes solely theoretical. Without laboratory exposure, students are less likely to develop essential skills such as hypothesis formulation, data analysis, and experimental design, which are central to modern science education.

Overall, the findings in Table 5 indicate a disconnect between the recognized importance of laboratory instruction and its actual implementation in practice. While weekly and bi-weekly sessions suggest a degree of effort to incorporate hands-on learning, the infrequency of daily laboratory activities and the existence of classrooms with no laboratory work point to systemic limitations. These may include insufficient laboratory facilities, a lack of instructional time, and inadequate professional development in laboratory pedagogy. As Kranz et al. (2022) emphasize, the development of scientific inquiry skills requires not just occasional engagement, but continuous, structured, and well-supported practice.

To address these challenges, schools must prioritize sustained and consistent laboratory instruction. This includes investing in laboratory infrastructure, providing adequate teaching materials, and offering professional development opportunities that empower teachers to confidently facilitate inquiry-based science education. Additionally, curriculum planners should ensure that science programs allocate sufficient time and flexibility for hands-on experimentation. By enhancing the frequency and quality of laboratory instruction, educational institutions can cultivate learning environments that promote discovery, curiosity, and scientific competence, ultimately preparing students for the demands of higher education and careers in science and technology.

Table 6. Relationship between teachers' competence and utilization of laboratory instruction

Knowledge	Mean	R-value	Interpretation
1	4.53	0.093	Very Weak
2	4.27	0.228	Weak
3	3.98	0.193	Very Weak
4	3.50	0.359	Weak
5	3.86	0.379	Weak
6	4.05	0.459	Moderate
7	4.03	0.385	Weak
8	4.11	0.419	Moderate
9	4.33	0.332	Weak
10	4.14	0.416	Moderate

Skills	Mean	R-value	Interpretation
1	4.18	0.339	Weak
2	4.30	0.316	Weak
3	3.32	0.292	Weak
4	4.11	0.253	Weak
5	4.17	0.34	Weak
6	4.12	0.284	Weak
7	4.36	0.237	Weak
8	4.15	0.334	Weak
9	4.05	0.2	Weak
10	4.00	0.331	Weak

Table 6 reveals a positive correlation between educators' expertise in laboratory instruction and their frequency of laboratory integration in classroom teaching. This finding suggests that as teachers' proficiency in laboratory procedures, equipment management, and experimental execution increases, so does their likelihood of incorporating laboratory-based learning into their instructional practices. Educators who possess a strong command of laboratory techniques tend to exhibit greater confidence in facilitating experiments, which in turn leads to more consistent and effective utilization of laboratory resources. This aligns with earlier studies that underscore the centrality of teacher competence in shaping instructional approaches. For instance, Datoy (2020) found that science teachers with higher competency levels were significantly more effective in incorporating laboratory tools and materials into their lessons, thereby enhancing the instructional quality and learning engagement in secondary science classrooms.

Furthermore, teachers with advanced laboratory skills are better equipped to design experiential learning activities that promote scientific exploration and inquiry. This relationship indicates that professional development initiatives and targeted laboratory training can play a pivotal role in increasing the adoption of hands-on, inquiry-based instruction. The data reinforce the idea that teacher competence is not only a facilitator of laboratory integration but also a critical determinant of students' opportunities to engage in meaningful scientific investigations and develop higher-order thinking skills.

This correlation is further supported by studies such as Eajess (2020), who investigated the implementation of a competence-based science curriculum in Tanzanian public schools. The findings emphasized that teachers' proficiency in utilizing laboratory facilities directly impacts the effectiveness of curriculum delivery. Teachers with stronger technical and procedural skills were more likely to conduct regular experiments, manage laboratory sessions efficiently, and adapt laboratory activities to align with instructional goals despite resource limitations.

In essence, the data from Table 6 underscore that both knowledge and skill-based competencies in laboratory instruction are fundamental to enhancing the quality and frequency of laboratory use in science teaching. The implications for practice are clear: sustained investment in teacher training, particularly in laboratory methodology, is crucial for advancing science education. When teachers are empowered with the necessary expertise and resources, they can more effectively implement laboratory-based strategies that support student-centered learning and promote deeper scientific understanding.

Conclusion

This study aimed to assess the current competence of public secondary science teachers in the Schools Division of Ilocos Norte regarding their knowledge and skills in laboratory-based instruction. The findings revealed that teachers generally possess high levels of both knowledge and practical skills related to laboratory work. Furthermore, there was a significant positive correlation between teachers' laboratory competence and their implementation of laboratory-based teaching strategies. This means that as teachers become more proficient in laboratory techniques, equipment handling, and experiment facilitation, they are more likely to integrate laboratory activities into their teaching, enriching students' learning experiences. These findings are significant because they reinforce the central role of teacher competence in shaping the quality and effectiveness of science instruction. The results indicate that teacher training is not only a support mechanism but a critical driver of instructional innovation. Teachers with high laboratory competence can better foster student engagement, promote inquiry-based learning, and cultivate essential scientific skills such as critical thinking, experimentation, and data interpretation.

However, the study also pointed to specific areas needing attention, such as limited use of student-centered laboratory approaches like structured and open inquiry. This underutilization suggests gaps in training, confidence, or resources, which may restrict opportunities for deeper scientific exploration among students. The implications for science teaching are clear. First, school administrators and policymakers must prioritize sustained professional development focused on laboratory instruction, especially in newer or underused methodologies like open and structured inquiry. Second, improving access to laboratory facilities and materials is essential to ensure that competence translates into practice. Third, fostering a school culture that values experimentation, collaboration, and pedagogical flexibility can support teachers in diversifying their instructional strategies.

Future efforts must address both the systemic and instructional barriers that prevent optimal use of laboratory-based instruction. By investing in teacher competence and infrastructure simultaneously, science education in public schools can be transformed into a more active, inquiry-driven, and engaging experience that better prepares students for scientific thinking and real-world problem solving.

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