

Teachers' Laboratory Engagement on Their Teaching Practices and Instructional Effectiveness in a Science Classroom

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Abstract—This study examines the correlation between teachers' laboratory engagement, their teaching practices, and instructional effectiveness in science classrooms. Specifically, it determines teachers' laboratory engagement in relation to their teaching practices in science classroom and (2) teachers' laboratory engagement in relation to their instructional effectiveness. Guided by Social Cognitive Theory, the study underscores teachers' role as facilitators of inquiry-based learning and emphasizes the importance of laboratory experiences. The study employed a quantitative-correlational research design using structured survey questionnaires administered to a total of one hundred eighteen Grade 11 STEM students. A stratified random sampling technique was used to ensure fair representation from three selected public senior high schools in Laguna. The instrument measured teachers' laboratory engagement, teaching practices, and instructional effectiveness using a five-point Likert scale. Data were analyzed using descriptive statistics such as mean and standard deviation, and inferential statistics through Pearson's Product-Moment Correlation Coefficient to determine the relationship among variables. The findings indicated that there is a significant correlation between Teachers' Laboratory Engagement and Teachers' Teaching Practices, which led to the rejection of the null hypothesis. Similarly, Teachers' Laboratory Engagement significantly correlates with Teachers' Instructional Effectiveness in Science classroom. Thus, the null hypothesis is also rejected. Furthermore, the results show a significant positive correlation between teachers' laboratory engagement and their teaching practices as well as instructional effectiveness. The study concludes that teachers' laboratory engagement is significantly associated with instructional effectiveness in science education. Greater involvement in laboratory activities enhances teachers' competence, confidence, and ability to provide meaningful learning experiences. Based on these findings, schools should support laboratory-based instruction by improving facilities, providing adequate resources, and offering continuous professional development. Teachers are also encouraged to use innovative, inquiry-based laboratory approaches to enhance student engagement and learning outcomes.

Keywords— Laboratory Engagement, Teaching Practices, Instructional Effectiveness.

I. INTRODUCTION

Science education plays a crucial role in shaping learners' understanding of the world and their ability to make reasoned decisions based on evidence. It equips students with the capacity to think critically, investigate systematically, and solve problems creatively, skills that extend beyond the classroom and into daily life. Across the globe, educators and policymakers recognize that strong foundations in science are

vital for national progress and global competitiveness, particularly in an era driven by technology, innovation, and environmental change. The effective teaching of science, therefore, is not limited to the transmission of facts and concepts but must involve experiences that allow learners to explore, question, and discover.

At the heart of this process is the science laboratory, a learning space where theories come alive and curiosity takes form through experimentation. Laboratory activities transform abstract concepts into tangible experiences, giving students opportunities to observe phenomena, test hypotheses, and draw conclusions through evidence. Research has long shown that active engagement in laboratory work enhances students' motivation, deepens conceptual understanding, and nurtures a spirit of inquiry that traditional lecture-based instruction often fails to achieve. However, the success of laboratory learning depends greatly on the teacher's ability to plan, facilitate, and assess experiments in ways that make science meaningful and relevant.

Teachers serve as the bridge between theory and practice. Their participation in laboratory activities not only determines the technical success of an experiment but also influences how students perceive and experience science. When teachers are actively involved in laboratory preparation and execution, they can design lessons that promote critical thinking, collaboration, and real-world application. In contrast, limited teacher engagement in laboratory work often results in routine demonstrations that fail to challenge or inspire learners. Thus, teachers' laboratory engagement becomes a key factor in promoting inquiry-based instruction and in shaping students' scientific literacy.

Despite widespread recognition of its importance, effective laboratory integration remains a challenge in many educational contexts. Studies across different countries have revealed barriers such as limited facilities, inadequate training, safety concerns, and lack of instructional time. These constraints often lead teachers to favor theoretical instruction over practical experimentation, reducing opportunities for experiential learning. Such gaps highlight the need to better understand how teachers' involvement in laboratory activities affects their pedagogical practices and overall instructional effectiveness.

In the Philippines, science education continues to be a national priority, as reflected in the Department of Education's

ongoing reforms under the K to 12 Curriculum. The curriculum underscores the value of inquiry-based and hands-on learning to promote scientific and technological advancement among Filipino learners. Yet, many schools continue to face challenges such as insufficient laboratory resources, uneven teacher training, and overcrowded classrooms. Local studies have observed that while teachers acknowledge the importance of laboratory work, their actual level of engagement often depends on the availability of equipment, administrative support, and personal confidence in conducting experiments. This persistent gap between intent and practice affects the quality of science instruction and students' learning experiences.

Against this backdrop, the present study explored the relationship between teachers' laboratory engagement, their teaching practices, and their instructional effectiveness within the Philippine setting. Specifically, the research conducted in selected public senior high schools in the province of Laguna. Situated in the CALABARZON region, Laguna presents a rich and varied educational landscape, encompassing both resource-equipped and resource-limited schools. This diversity makes it an ideal locale for examining how contextual factors influence teachers' laboratory participation and its impact on classroom practice. By focusing on this area, the study aims to contribute meaningful insights that can inform professional development initiatives, strengthen laboratory-based pedagogy, and enhance the overall quality of science education in the country.

1.1 Statement of the Problem

Problem/s which were addressed by the research

This study aimed to determine the relationship between teachers' laboratory engagement and their teaching practices and instructional effectiveness in science education. Specifically, it sought to answer the following research questions:

1. What is the level of teachers' laboratory engagement in science classroom in terms of:
 - 1.1 Laboratory skills;
 - 1.2 Experimental design;
 - 1.3 Self-efficacy
 - 1.4 Laboratory Safety
 - 1.5 Laboratory Proficiency;
 - 1.6 Equipment Mastery; and,
 - 1.7 Technical Expertise?
2. What is the level of teachers' teaching practices in science classroom terms of:
 - 2.1 Instructional Planning;
 - 2.2 Proper Supervision; and,
 - 2.3 Innovation in Assessment Practices?
3. What is the level of teachers' instructional effectiveness in science classroom in terms of:
 - 3.1 Resource Utilization;
 - 3.2 Lesson Delivery;
 - 3.3 Concept Mastery; and,
 - 3.4 Classroom Management?
4. Does teachers' laboratory engagement significantly correlate to their teaching practices in science classroom?

5. Does teachers' laboratory engagement significantly correlate to their instructional effectiveness in science classroom?

II. METHODOLOGY

The study employed a quantitative-correlational research design using structured survey questionnaires administered to a total of one hundred eighteen Grade 11 STEM students. A stratified random sampling technique was used to ensure fair representation from three selected public senior high schools in Laguna. The instrument measured teachers' laboratory engagement, teaching practices, and instructional effectiveness using a five-point Likert scale. Data were analyzed using descriptive statistics such as mean and standard deviation, and inferential statistics through Pearson's Product-Moment Correlation Coefficient to determine the relationship among variables.

III. RESULTS AND DISCUSSION

This part deals with the presentation, analysis, and interpretation of data gathered to answer the sub-problem relative to the main problem of this study. This part discusses the findings of the study based on the questions.

Level of Teachers' Laboratory Engagement

In this study, the level of Teachers' Laboratory Engagement refers to multiple dimensions, including Laboratory Skills, Experimental Design, Self-efficacy, Laboratory Safety, Laboratory Proficiency, Equipment Mastery, and Technical Expertise. These aspects collectively reflect how actively and effectively teachers participate in laboratory activities and manage hands-on learning experiences.

The level of Teachers' Laboratory Engagement is presented in the following tables, which provide the statements, mean, standard deviation, remarks, and verbal interpretation. Table 1 specifically illustrates the level of Teachers' Laboratory Engagement in terms of Laboratory Skills, highlighting how teachers plan, execute, and demonstrate practical laboratory procedures. This includes their ability to conduct experiments accurately, handle materials safely, and guide students in performing laboratory tasks effectively.

By examining Laboratory Skills, the study identifies the areas in which teachers excel and where further development may be needed. This focus ensures that laboratory instruction is conducted in a manner that maximizes student learning and safety while enhancing teachers' confidence and proficiency in laboratory settings.

The respondents strongly agree that their teachers organize laboratory materials and equipment effectively, provide detailed instructions for experiments, and emphasize safety protocols during laboratory activities. They also acknowledge that teachers encourage them to ask questions, explore concepts, and demonstrate skillful laboratory performance, which helps students feel more confident and competent in conducting experiments.

Table 1. Level of Teachers' Laboratory Engagement in terms of Laboratory Skills

Statement	Mean	SD	Remarks
My teacher...			
organizes effective laboratory materials and equipment.	4.81	0.46	Strongly Agree
provides detailed instruction for experiments.	4.80	0.42	Strongly Agree
emphasizes safety protocols during laboratory activities.	4.81	0.40	Agree
encourages us to ask questions and explore concept.	4.75	0.47	Agree
models efficient and skillful laboratory performance.	4.70	0.51	Strongly Agree
Weighted Mean	4.77		
SD	0.45		
Verbal Interpretation	Very High		

The level of Teachers' Laboratory Engagement in terms of Laboratory Skills attained an overall weighted mean of 4.77 with a standard deviation of 0.45, verbally interpreted as Very High. This indicates that teachers consistently facilitate structured, safe, and skill-focused laboratory experiences for students.

Table 2 illustrates the level of Teachers' Laboratory Engagement in terms of Experimental Design.

The respondents strongly agree that their teachers clearly explain the objectives of each experiment, create engaging activities to capture student interest, and guide them in analyzing experimental results and errors. They also provide adequate resources and challenge students to design or improve experiments, encouraging critical thinking and creativity in laboratory work. This indicates that teachers are effectively implementing student-centered and inquiry-based approaches in laboratory instruction.

Table 2. Level of Teachers' Laboratory Engagement in terms of Experimental Design

Statement	Mean	SD	Remarks
My teacher...			
explains clear objectives of each experiment	4.80	0.46	Strongly Agree
creates engaging activities that can capture our interest.	4.80	0.40	Strongly Agree
guides us in analyzing experimental results and errors.	4.69	0.55	Strongly Agree
provides adequate resources and materials.	4.61	0.60	Strongly Agree
challenges us to design or improve experiments.	4.56	0.62	Strongly Agree
Weighted Mean	4.69		
SD	0.54		
Verbal Interpretation	Very High		

The level of Teachers' Laboratory Engagement in terms of Experimental Design attained an overall weighted mean of 4.69 with a standard deviation of 0.54, verbally interpreted as Very High. This indicates that teachers consistently design laboratory experiences that are structured, meaningful, and stimulating for students.

Table 3 illustrates the level of Teachers' Laboratory Engagement in terms of Self-efficacy.

Respondents strongly agree that teachers manage laboratory sessions efficiently, encourage full participation,

provide constructive feedback, and adjust experiments to match varying skill levels. They further enhance students' understanding of scientific concepts through hands-on activities.

Table 3. Level of Teachers' Laboratory Engagement in terms of Self-efficacy

Statement	Mean	SD	Remarks
My teacher...			
manages laboratory sessions smoothly and efficiently.	4.75	0.47	Strongly Agree
encourages all of us to participate in laboratory activities.	4.84	0.41	Strongly Agree
offers constructive feedback on laboratory work.	4.48	0.69	Agree
modifies experiments to suit varying skills levels.	4.57	0.63	Strongly Agree
enhances our understanding of scientific concept through laboratory work.	4.76	0.50	Strongly Agree
Weighted Mean	4.68		
SD	0.56		
Verbal Interpretation	Very High		

The level of Teachers' Laboratory Engagement in terms of Self-efficacy attained an overall weighted mean of 4.68 with a standard deviation of 0.56, verbally interpreted as Very High. This indicates that teachers consistently build students' confidence and competence in laboratory tasks, promoting independent learning and active problem-solving.

Table 4 illustrates the level of Teachers' Laboratory Engagement in terms of Laboratory Safety.

Table 4. Level of Teachers' Laboratory Engagement in terms of Laboratory Safety

Statements	Mean	SD	Remarks
My teacher...			
ensures safety procedures before lab activities.	4.85	0.38	Strongly Agree
secures appropriate safety equipment is available for all laboratory activities.	4.68	0.60	Strongly Agree
monitors us throughout laboratory sessions.	4.76	0.53	Agree
prepares laboratory environment safe and free from hazards.	4.72	0.55	Strongly Agree
provides discussions as a regular part of laboratory activities.	4.86	0.37	Agree
Weighted Mean	4.77		
SD	0.50		
Verbal Interpretation	Very High		

The respondents strongly agree that teachers ensure safety procedures are followed, provide appropriate safety equipment, monitor students throughout the laboratory, maintain a hazard-free environment, and integrate safety discussions as part of regular laboratory activities.

The level of Teachers' Laboratory Engagement in terms of Laboratory Safety attained an overall weighted mean of 4.77 with a standard deviation of 0.50, verbally interpreted as Very High. This indicates that teachers consistently prioritize safety, creating a secure environment conducive to practical learning.

Table 5 illustrates the level of Teachers' Laboratory Engagement in terms of Laboratory Proficiency.

Respondents strongly agree that teachers demonstrate expertise in laboratory procedures, show step-by-step processes during experiments, apply problem-solving skills

when challenges arise, modify experiments to meet student needs, and effectively measure students' laboratory performance.

Table 5. Level of Teachers' Laboratory Engagement in terms of Laboratory Proficiency

Statement My teacher...	Mean	SD	Remarks
shows expertise in laboratory procedure a technique.	4.64	0.56	Strongly Agree
manifests skills in showing step-by-step processes during experiments.	4.75	0.53	Strongly Agree
performs strong problem-solving skills when challenges in laboratory.	4.61	0.61	Strongly Agree
adapts in modifying experiment based on our needs and feedback.	4.65	0.56	Strongly Agree
measures our skills effectively during lab work.	4.71	0.57	Strongly Agree
Weighted Mean	4.67		
SD	0.57		
Verbal Interpretation	Very High		

The level of Teachers' Laboratory Engagement in terms of Laboratory Proficiency attained an overall weighted mean of 4.67 with a standard deviation of 0.57, verbally interpreted Very High. This indicates that teachers consistently display proficiency and skill in laboratory execution, guiding students toward mastery of scientific procedures.

The results suggest that teachers' high level of proficiency serves as a model for students, enhancing their technical skills, problem-solving abilities, and confidence in performing laboratory experiments.

Table 6 illustrates the level of Teachers' Laboratory Engagement in terms of Equipment Mastery.

Table 6. Level of Teachers' Laboratory Engagement in terms of Equipment Mastery

Statement My teacher...	Mean	SD	Remarks
introduces clear functions of each piece of laboratory equipment.	4.74	0.48	Strongly Agree
states proper and safe techniques for using laboratory equipment.	4.82	0.41	Strongly Agree
distinguishes the role of specific tools in achieving experiment objectives.	4.74	0.53	Strongly Agree
involves the risk in using certain equipment and how to mitigate it.	4.67	0.54	Strongly Agree
demonstrates his/her own proficiency in handling lab equipment.	4.72	0.57	Strongly Agree
Weighted Mean	4.74		
SD	0.51		
Verbal Interpretation	Very High		

The respondents strongly agree that teachers introduce the functions of laboratory equipment, demonstrate proper and safe usage techniques, clarify the role of each tool in achieving experimental objectives, highlight potential risks and mitigation strategies, and showcase their own proficiency in handling equipment.

The level of Teachers' Laboratory Engagement in terms of Equipment Mastery attained an overall weighted mean of 4.74 with a standard deviation of 0.51, verbally interpreted as Very High. This indicates that teachers consistently ensure students

understand and correctly use laboratory equipment, promoting safe and effective experimentation.

Consequently, teachers' mastery of laboratory equipment enhances student learning by providing clear instruction, practical demonstration, and guidance in safe and accurate usage of tools, strengthening hands-on laboratory skills. This ultimately leads to more effective laboratory experiences where students can confidently apply theoretical knowledge in practical settings.

Table 7 illustrates the level of Teachers' Laboratory Engagement in terms of Technical Expertise.

Respondents strongly agree that teachers demonstrate practical techniques illustrating key scientific concepts, interpret experimental results with context, guide students needing extra support, model proficiency in various laboratory experiments, and assess student performance effectively.

Table 7. Level of Teachers' Laboratory Engagement in terms of Technical Expertise

Statement My teacher...	Mean	SD	Remarks
demonstrates hands-on that illustrate key scientific concepts.	4.64	0.59	Strongly Agree
interprets results and explain to us the significance in context.	4.70	0.54	Strongly Agree
guides individualized lab techniques for struggling students.	4.69	0.55	Strongly Agree
models proficiency in using lab for various experiment	4.67	0.54	Strongly Agree
assesses student performance in lab activities.	4.75	0.49	Strongly Agree
Weighted Mean	4.69		
SD	0.54		
Verbal Interpretation	Very High		

The level of Teachers' Laboratory Engagement in terms of Technical Expertise attained an overall weighted mean of 4.69 with a standard deviation of 0.54, verbally interpreted as Very High. This indicates that teachers consistently provide expert guidance and mentorship in laboratory activities, facilitating high-quality scientific learning.

Level of Teachers' Teaching Practices

In this study, the level of Teachers' Teaching Practices refers to key dimensions of effective classroom instruction, including Instructional Planning, Proper Supervision, and Innovation in Assessment Practices. These dimensions reflect the teachers' ability to design lessons, manage classroom dynamics, and implement assessment strategies that promote student learning and engagement.

The level of Teachers' Teaching Practices in terms of Instructional Planning is presented in the following table, which details the statements, mean, standard deviation, remarks, and verbal interpretation. This component evaluates how well teachers prepare lesson plans, structure activities to align with learning objectives, and ensure that instructional content is clear, organized, and appropriate for the learners' level. By examining Instructional Planning, the study highlights teachers' preparedness in facilitating meaningful learning experiences, identifying areas of strength, and uncovering opportunities for improvement in lesson design.

Table 8 illustrates the level of Teachers' Teaching Practices in terms of Instructional Planning.

The respondents strongly agree that their teachers conduct collaborative project planning, discuss lesson objectives before laboratory activities, reflect on past lab experiences to improve future planning, assess students' understanding to inform planning, and carefully plan upcoming lab activities for smooth execution.

Table 8. Level of Teachers' Teaching Practices in terms of Instructional Planning

Statement	Mean	SD	Remarks
My teacher...			
conducts collaboration among us using project planning.	4.65	0.58	Strongly Agree
discusses lesson objectives before lab activities.	4.76	0.52	Strongly Agree
reflects on past lab activities to improve future planning.	4.55	0.62	Strongly Agree
assesses our understanding to inform future planning	4.71	0.51	Strongly Agree
plans upcoming lab activities to smooth exertion .	4.78	0.47	Strongly Agree
Weighted Mean	4.69		
SD	0.55		
Verbal Interpretation	Very High		

The level of Teachers' Teaching Practices in terms of Instructional Planning attained an overall weighted mean of 4.69 with a standard deviation of 0.55, verbally interpreted as Very High. This indicates that teachers consistently plan lessons thoughtfully, ensuring that laboratory sessions are organized, goal-oriented, and responsive to students' learning needs.

General instructional efficiency in teaching science refers to a teacher's ability to effectively plan, deliver, and evaluate lessons in ways that maximize students' understanding and engagement. According to Sharpe and Abraham (2020), effective teachers demonstrate strong content mastery, clear instructional delivery, and the capacity to motivate learners toward achieving educational goals.

The results further suggest that instructional efficiency is strengthened when teachers continuously develop their laboratory competencies and teaching strategies. Teachers who integrate laboratory activities into their instruction provide students with opportunities to apply scientific knowledge in real-life contexts, thereby improving comprehension and retention of concepts. Consequently, the study highlights the importance of enhancing teachers' laboratory engagement as a means of improving instructional efficiency and promoting more effective science education. Table 9 illustrates the level of Teachers' Teaching Practices in terms of Proper Supervision.

Respondents strongly agree that teachers monitor student activities during laboratory sessions, guide students through complex procedures, encourage questions during experiments, communicate expectations clearly, and assess understanding in real time.

The level of Teachers' Teaching Practices in terms of Proper Supervision attained an overall weighted mean of 4.78 with a standard deviation of 0.48, verbally interpreted as Very

High. This indicates that teachers consistently provide attentive supervision, ensuring students stay on task, understand procedures, and receive guidance whenever necessary.

Table 9. Level of Teachers' Teaching Practices in terms of Proper Supervision

Statement	Mean	SD	Remarks
My teacher...			
monitors our activities during lab session.	4.83	0.46	Strongly Agree
guides us through complex procedures.	4.83	0.46	Strongly Agree
encourages us to asks question during experiments.	4.75	0.45	Strongly Agree
communicates expectations clearly to us.	4.72	0.52	Strongly Agree
assesses our understanding in real-time.	4.76	0.48	Strongly Agree
Weighted Mean	4.78		
SD	0.48		
Verbal Interpretation	Very High		

The results imply that teachers' careful supervision enhances safety, learning effectiveness, and student confidence in laboratory tasks, creating an environment conducive to active participation and successful experimentation. An effective supervisory practice also develops students' engagement, enhance the quality of laboratory instruction and highly contribute to the overall achievement of educational objectives in science education.

Table 10 illustrates the level of Teachers' Teaching Practices in terms of Innovation in Assessment Practices.

The respondents strongly agree that teachers integrate technology in assessments, track progress using formative tools, encourage collaborative learning through peer assessments, administer exploratory activities for creative expression, and follow standardized rubrics for consistent grading.

Table 10. Level of Teachers' Teaching Practices in terms of Innovation in Assessment Practices

Statement	Mean	SD	Remarks
My teacher...			
integrates technology in assessing our learning.	4.58	0.59	Strongly Agree
tracks our progress using formative assessment	4.58	0.60	Strongly Agree
uses peer-assessment opportunities to encourage collaborative learning.	4.58	0.59	Strongly Agree
administers explorative assessments that allow us for creative expression.	4.53	0.65	Strongly Agree
follows standardized rubric to ensure consisting in grading.	4.66	0.62	Strongly Agree
Weighted Mean	4.59		
SD	0.61		
Verbal Interpretation	Very High		

The respondents strongly agree that teachers integrate technology in assessments, track progress using formative tools, encourage collaborative learning through peer assessments, administer exploratory activities for creative expression, and follow standardized rubrics for consistent grading.

The level of Teachers' Teaching Practices in terms of Innovation in Assessment Practices attained an overall weighted mean of 4.59 with a standard deviation of 0.61, verbally interpreted as Very High. This indicates that teachers consistently implement innovative assessment methods that support active learning, creativity, and accurate evaluation of student performance.

Level of Teachers' Instructional Effectiveness in Science Classroom

In this study, the level of Teachers' Instructional Effectiveness in Science classroom refers to essential aspects of teaching that influence student learning, including Resource Utilization, Lesson Delivery, Concept Mastery, and Classroom Management. These dimensions reflect how effectively teachers organize and use instructional materials, communicate scientific concepts, ensure students understand core ideas, and maintain a productive learning environment.

The level of Teachers' Instructional Effectiveness in Science Class is shown in the following table, which presents the mean, standard deviation, and verbal interpretation. Assessing these components allows the study to determine how well teachers facilitate learning, manage classroom dynamics, and utilize available resources to enhance students' comprehension and engagement in science. Effective instructional practices in these areas contribute to improved student performance, higher engagement, and a stronger foundation in scientific concepts.

Table 11 illustrates the level of Teachers' Instructional Effectiveness in Science Classroom in terms of Resource Utilization.

Respondents strongly agree that teachers collaborate on projects that effectively utilize shared resources, adapt existing materials to align with instructional goals and learning outcomes, organize interactive sessions that maximize educational resources, use feedback to improve resource allocation and instructional strategies, and implement resource sharing for collaborative learning.

Table 11. Level of Teachers' Instructional Effectiveness in Science Classroom in terms of Resource Utilization

Statement	Mean	SD	Remarks
My teacher...			
collaborates project that utilize shared resources.	4.74	0.48	Strongly Agree
adopts existing materials to better suit instructional goals and learning outcomes.	4.69	0.53	Strongly Agree
organizes interactive learning sessions that maximize various educational resources.	4.69	0.55	Strongly Agree
utilizes feedback to improve resource allocation and instructional strategies.	4.61	0.67	Strongly Agree
implements available resource sharing for collaboration to enhance learning.	4.71	0.51	Strongly Agree
Weighted Mean	4.69		
SD	0.55		
Verbal Interpretation	Very High		

Respondents strongly agree that teachers collaborate on projects that effectively utilize shared resources, adapt existing materials to align with instructional goals and learning outcomes, organize interactive sessions that maximize

educational resources, use feedback to improve resource allocation and instructional strategies, and implement resource sharing for collaborative learning.

The level of Teachers' Instructional Effectiveness in terms of Resource Utilization attained an overall weighted mean of 4.69 with a standard deviation of 0.55, verbally interpreted as Very High. This indicates that teachers consistently use available resources efficiently, ensuring that instructional materials support learning objectives and promote collaboration among students.

Table 12 illustrates the level of Teachers' Instructional Effectiveness in Science Classroom in terms of Lesson Delivery.

The respondents strongly agree that teachers establish clear learning objectives to guide lesson delivery, select activities that capture students' interest, structure lessons with logical flow, apply diverse teaching methods to accommodate different learning styles, and create appropriate pacing to maintain student engagement. This reflects that teachers are effectively planning and delivering instruction in a way that promotes organized, inclusive, and engaging learning experiences.

Table 12. Level of Teachers' Instructional Effectiveness in Science Classroom in terms of Lesson Delivery

Statement	Mean	SD	Remarks
My teacher...			
establishes clear learning objectives to guide lesson delivery.	4.86	0.44	Strongly Agree
selects activities that capture students' interest and enhance lesson delivery.	4.75	0.49	Strongly Agree
structures lesson with logical flow of information.	4.64	0.61	Strongly Agree
applies diverse teaching methods to accommodate different learning styles during lesson delivery.	4.63	0.54	Strongly Agree
creates pacing and timing in lesson delivery to maintain student engagement.	4.69	0.51	Strongly Agree
Weighted Mean	4.71		
SD	0.52		
Verbal Interpretation	Very High		

The respondents strongly agree that teachers establish clear learning objectives to guide lesson delivery, select activities that capture students' interest, structure lessons with logical flow, apply diverse teaching methods to accommodate different learning styles, and create appropriate pacing to maintain student engagement.

The level of Teachers' Instructional Effectiveness in terms of Lesson Delivery attained an overall weighted mean of 4.71 with a standard deviation of 0.52, verbally interpreted as Very High. This shows that teachers consistently deliver lessons in a structured, engaging, and adaptive manner that promotes comprehension and sustained attention.

Table 13 illustrates the level of Teachers' Instructional Effectiveness in Science Classroom in terms of Concept Mastery.

Respondents strongly agree that teachers clearly explain key concepts, provide feedback to improve understanding, guide students in identifying areas needing improvement,

apply intervention strategies to support struggling learners, and connect concepts to real-world situations.

Table 13. Level of Teachers' Instructional Effectiveness in Science Classroom in terms of Concept Mastery

Statement My teacher...	Mean	SD	Remarks
explains key concepts in each lesson.	4.72	0.50	Strongly Agree
provides feedback to adapt lessons and improve concept mastery outcomes.	4.55	0.65	Strongly Agree
guides us to identify areas where concept mastery may be lacking	4.74	0.51	Strongly Agree
uses intervention strategies to support us while struggling.	4.66	0.56	Strongly Agree
helps us to connect concepts to new or real-world situations.	4.69	0.51	Strongly Agree
Weighted Mean	4.67		
SD	0.55		
Verbal Interpretation	Very High		

The level of Teachers' Instructional Effectiveness in terms of Concept Mastery attained an overall weighted mean of 4.67 with a standard deviation of 0.55, verbally interpreted as Very High. This indicates that teachers actively support students in mastering scientific concepts, bridging gaps in understanding, and applying knowledge in meaningful contexts.

Table 14 illustrates the level of Teachers' Instructional Effectiveness in Science Classroom in terms of Classroom Management.

The respondents strongly agree that teachers use positive reinforcement to create a supportive environment, build respectful relationships, set and achieve personal goals to enhance commitment, practice conflict resolution to maintain harmony, and establish classroom routines that promote focus and order.

Table 14. Level of Teachers' Instructional Effectiveness in Science Classroom in terms of Classroom Management

Statement My teacher...	Mean	SD	Remarks
chooses positive reinforcement creating a supportive classroom environment.	4.81	0.46	Strongly Agree
builds strong relationships that foster respect and trust in the classroom.	4.75	0.51	Strongly Agree
sets and achieves personal goals, enhancing our commitment to classroom behavior.	4.75	0.45	Strongly Agree
practices conflict resolution skills promoting a harmonious classroom atmosphere.	4.66	0.54	Strongly Agree
establishes classroom routines that helps maintain order and focus during lesson.	4.67	0.57	Strongly Agree
Weighted Mean	4.73		
SD	0.51		
Verbal Interpretation	Very High		

The level of Teachers' Instructional Effectiveness in terms of Classroom Management attained an overall weighted mean of 4.73 with a standard deviation of 0.51, verbally interpreted as Very High. This shows that teachers maintain a well-organized, respectful, and motivating classroom environment that supports both learning and student engagement.

The results imply that effective classroom management fosters a positive learning atmosphere, enhances student

cooperation, and ensures that lessons are delivered efficiently and effectively.

Significant Correlation between the Teachers' Laboratory Engagement and Teachers' Teaching Practices

This study also examined the significant correlation between Teachers' Laboratory Engagement and their Teaching Practices. Teachers' Laboratory Engagement encompasses Laboratory Skills, Experimental Design, Self-efficacy, Laboratory Safety, Laboratory Proficiency, Equipment Mastery, and Technical Expertise, while Teaching Practices include Instructional Planning, Proper Supervision, and Innovation in Assessment Practices.

The analysis evaluates how the level of engagement in laboratory activities relates to the effectiveness and quality of teaching practices.

Findings from this study reveal that teachers who actively engage in laboratory tasks, demonstrate mastery of equipment, and apply safe and structured experimental designs tend to plan lessons more effectively, supervise student activities efficiently, and implement innovative assessment strategies.

Teachers with strong laboratory engagement are more capable of creating interactive and student-centered learning environments that encourage scientific inquiry and deeper conceptual understanding among learners.

Table 15 illustrates the significant correlation between Teachers' Laboratory Engagement and Teachers' Teaching Practices.

Table 15. Significant Correlation between the Teachers' Laboratory Engagement and Teachers' Teaching Practices

Teachers' Engagement	Laboratory	Teachers' Teaching Practices		
		Instructional Planning	Proper Supervision	Innovation in Assessment Practices
Laboratory Skills	Pearson Correlation	0.5228*	0.569*	0.519*
	Sig. (2-tailed)	0.000	0.000	0.000
	N	118	118	118
Experimental Design	Pearson Correlation	0.553*	0.473*	0.558*
	Sig. (2-tailed)	0.000	0.000	0.000
	N	118	118	118
Self-Efficacy	Pearson Correlation	0.566*	0.560*	0.499*
	Sig. (2-tailed)	0.000	0.000	0.000
	N	118	118	118
Laboratory Safety	Pearson Correlation	0.497*	0.428*	0.512*
	Sig. (2-tailed)	0.000	0.000	0.000
	N	118	118	118
Laboratory Proficiency	Pearson Correlation	0.488*	0.506*	0.423
	Sig. (2-tailed)	0.000	0.000	0.000
	N	118	118	118
Equipment Mastery	Pearson Correlation	0.661*	0.639*	0.546*
	Sig. (2-tailed)	0.000	0.000	0.000
	N	118	118	118
Technical Expertise	Pearson Correlation	0.607*	0.720*	0.547*
	Sig. (2-tailed)	0.000	0.000	0.000
	N	118	118	118

The results indicate that various dimensions of laboratory engagement, such as Laboratory Skills, Experimental Design, Self-Efficacy, Laboratory Safety, Laboratory Proficiency, Equipment Mastery, and Technical Expertise, are significantly correlated with aspects of teaching practices, including Instructional Planning, Proper Supervision, and Innovation in Assessment Practices. This implies that all p-values are greater than 0.05 ($p > 0.05$). Specifically, teachers who demonstrate strong laboratory skills and mastery of equipment tend to plan lessons effectively, provide proper supervision, and incorporate innovative assessment strategies. Likewise, engagement in experimental design, self-efficacy, and technical expertise significantly relate to improved instructional practices. All correlations were statistically significant at the 0.01 level, suggesting that higher levels of laboratory engagement are strongly associated with more effective and innovative teaching practices.

The findings imply that teachers' active involvement, competence, and confidence in laboratory activities contribute positively to the quality of their teaching practices, indicating that hands-on laboratory engagement reinforces instructional effectiveness in science education.

The results are similar to the study of Hattie and Zierer (2018) which highlighted those impactful practices, including giving feedback, encouraging teamwork, and aligning tasks with learning objectives, directly affect student achievement. In science classrooms, these methods are even more crucial, as they make certain that laboratory activities are not only procedural but also meaningful and conceptually coherent. Furthermore, teachers' ongoing innovation and adaptation to educational progress influence the effectiveness with which students cultivate critical thinking, problem-solving abilities, and scientific literacy essential for continuous learning.

Significant Correlation between the Teachers' Laboratory Engagement and Teachers' Instructional Effectiveness in Science Class

This study further investigated the significant correlation of Teachers' Laboratory Engagement on their Instructional Effectiveness in the science classroom. Laboratory Engagement encompasses aspects such as Laboratory Skills, Experimental Design, Self-efficacy, Laboratory Safety, Laboratory Proficiency, Equipment Mastery, and Technical Expertise. Instructional Effectiveness refers to Resource Utilization, Lesson Delivery, Concept Mastery, and Classroom Management.

The findings indicate that higher levels of laboratory engagement positively correlate with teachers' instructional effectiveness. Teachers who demonstrate strong proficiency in laboratory skills, efficiently manage experimental design, and show confidence in handling laboratory equipment tend to utilize resources more effectively, deliver lessons with clarity, ensure mastery of scientific concepts, and maintain a well-managed classroom environment. This significant effect emphasizes that active participation in laboratory practices enhances the overall teaching quality, reinforcing the importance of practical engagement in developing effective instructional strategies in science education.

Table 16 presents the significant correlation of Teachers' Laboratory Engagement on Teachers' Instructional Effectiveness in Science Class.

The findings show that all dimensions of laboratory engagement—including Laboratory Skills, Experimental Design, Self-Efficacy, Laboratory Safety, Laboratory Proficiency, Equipment Mastery, and Technical Expertise—have a significant correlation with instructional effectiveness, as measured by Resource Utilization, Lesson Delivery, Concept Mastery, and Classroom Management.

Table 16. Significant Correlation between the Teachers' Laboratory Engagement and Teachers' Instructional Effectiveness in Science Class

Teachers' Engagement	Laboratory Class	Teachers' Instructional Effectiveness in Science			
		Resource Utilization	Lesson Delivery	Concept Mastery	Classroom Management
Laboratory Skills	Pearson Correlation	0.627*	0.606**	0.492*	0.620*
	Sig. (2-tailed)	0.000	0.000	0.000	0.000
	N	118	118	118	118
Experimental Design	Pearson Correlation	0.651*	0.634	0.556*	0.638*
	Sig. (2-tailed)	0.000	0.000	0.000	0.000
	N	118	118	118	118
Self-Efficacy	Pearson Correlation	0.624*	0.656*	0.544*	0.569*
	Sig. (2-tailed)	0.000	0.000	0.000	0.000
	N	118	118	118	118
Laboratory Safety	Pearson Correlation	0.464*	0.564*	0.509*	0.593*
	Sig. (2-tailed)	0.000	0.000	0.000	0.000
	N	118	118	118	118
Laboratory Proficiency	Pearson Correlation	0.468*	0.529*	0.449*	0.351*
	Sig. (2-tailed)	0.000	0.000	0.000	0.000
	N	118	118	118	118
Equipment Mastery	Pearson Correlation	0.527*	0.607*	0.532*	0.529*
	Sig. (2-tailed)	0.000	0.000	0.000	0.000
	N	118	118	118	118
Technical Expertise	Pearson Correlation	0.611*	0.628*	0.489*	0.497*
	Sig. (2-tailed)	0.000	0.000	0.000	0.000
	N	118	118	118	118

This implies that all p-values are greater than 0.05 ($p > 0.05$). Teachers who actively demonstrate strong laboratory skills, design meaningful experiments, and maintain high self-efficacy contribute to more effective resource use, structured lesson delivery, improved mastery of concepts, and efficient classroom management. The correlation coefficients indicate that higher engagement in laboratory activities directly enhances teaching effectiveness,

highlighting the integral role of hands-on laboratory practices in supporting quality science instruction.

The results of this analysis indicate that teachers' active participation, technical competence, and confidence in laboratory tasks significantly strengthen their overall instructional effectiveness in science classes. This suggests that fostering laboratory engagement is a key factor in enhancing teaching quality and student learning outcomes.

These results are consistent with Stronge (2018), that effective teachers demonstrate a solid grasp of content, clear instructional delivery, and the capacity to motivate students to achieve their learning goals. In science education, this means creating lessons that integrate theory and practice so that students understand concepts while also applying them through experiments and exploration. Effective educators who understand how to instruct can transform abstract scientific ideas into meaningful, practical learning experiences that foster curiosity and facilitate problem-solving. These educators can proficiently oversee classroom and lab environments while prioritizing student safety and involvement.

These results suggest that future research should focus on exploring other factors that may influence teachers' instructional effectiveness in science education, such as access to laboratory resources, administrative support, professional development opportunities, and students' learning environments. Future studies may also examine how laboratory engagement affects students' academic performance, scientific attitudes, and long-term interest in science-related field.

IV. CONCLUSION AND RECOMMENDATIONS

There is a significant correlation between Teachers' Laboratory Engagement and Teachers' Teaching Practices, which led to the rejection of the null hypothesis. The analysis revealed strong positive correlations between all dimensions, teachers' laboratory engagement, including laboratory skills, experimental design, self-efficacy, safety, proficiency, equipment mastery, and technical expertise, and their teaching practices in terms of instructional planning, proper supervision, and innovation in assessment. This indicates that teachers who are more engaged and proficient in laboratory activities are more likely to implement effective teaching practices, which support student learning and engagement.

Teachers' Laboratory Engagement significantly correlates with Teachers' Instructional Effectiveness in Science classroom. Thus, the null hypothesis was rejected. This means that active and competent laboratory engagement significantly improves teachers' instructional effectiveness across resource utilization, lesson delivery, concept mastery, and classroom management. This suggests that teachers' hands-on

involvement, technical competence, and systematic facilitation of laboratory activities play a crucial role in delivering effective science instruction and enhancing overall student outcomes and helps to create a inquiry-rich learning environment that supports students' deeper understanding of scientific concepts.

Based on the drawn conclusions, the following recommendations are strongly proposed to enhance teachers' laboratory engagement and improve teaching practices and instructional effectiveness in science education:

Science Teachers may continuously develop and refine laboratory skills, technical expertise, and experimental design capabilities to maintain high engagement during laboratory activities. Integrate innovative teaching practices, such as interactive experiments, collaborative tasks, and formative assessments, to complement laboratory engagement and improve student learning outcomes. Provide clear instructions, safety protocols, and individualized guidance to support diverse student needs and maximize understanding of scientific concepts.

School Administrators and Educational Leaders may support professional development programs that focus on enhancing teachers' laboratory competence, technical skills, and instructional strategies. Ensure that laboratory facilities are well-equipped, safe, and conducive to hands-on learning activities, allowing teachers to implement best practices effectively. Encourage collaboration among teachers to share innovative assessment methods, instructional planning strategies, and practical approaches to laboratory-based teaching.

Policymakers and Educational Authorities may formulate policies that emphasize continuous training and resource allocation for laboratory-based instruction to maintain high standards of science education. Promote evidence-based strategies for integrating laboratory engagement with instructional planning and assessment practices to enhance overall teaching effectiveness.

Future researchers may conduct similar studies to examine how teachers' laboratory engagement influences student achievement, motivation, and higher-order thinking skills in other science subjects. Explore additional factors, such as students' prior knowledge, classroom environment, and peer collaboration, that may interact with teachers' engagement and instructional effectiveness.

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