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Experience of Science Teachers and Students in the Conduct of Laboratory Experiments: Basis for a Laboratory Management and Intervention Plan

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Abstract: Science as a subject has many challenges to teach because it demands hands-on experience for learners to fully grasp the concepts. Through laboratory activities, these concepts are taught more effectively. However, conducting a laboratory activity has many challenges that need to be addressed. Therefore, this proposed research aims to identify the experiences and challenges encountered by science teachers and students in conducting laboratory experiments in junior high school, which will serve as a basis for a laboratory management and intervention plan. To identify these challenges, this study will use a qualitative descriptive design. The participants will consist of three teachers and three students across the Ilocos Sur division. Face-to-face interviews or Google Meet will be used for data gathering. The interviews will explore the experiences of teachers and students and the specific challenges they encounter. The data will be subjected to thematic analysis to identify themes in preparation for the creation of an intervention and management plan to address those challenges.

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I. INTRODUCTION

- *Background of the Study*

Studying science is one of the most complex subjects, not just for the learners but for the teachers as well, as it demands a variety of methods to teach its concept. One effective method is through hands-on activity or through laboratory activities, as it provides a concrete experience to the learners. It also gives an effective way' of teaching the learners, as it encourages engagement and participation actively by every learner. Topics such as chemistry, physics and other topics cannot be fully learned or be easily taught without the use of lab work. That's the reason why a certain school should have good and functioning laboratory facilities with quality equipment.

However, a laboratory activity will only be effective if the learners are fully engaging in the activity itself. Since lab work is student-centered, the learners should possess the skills and ability to process instructions and solve problems by themselves in the conduct of the laboratory activity. A lot of students often do not participate, and sometimes teachers don't do it at all due to many challenges. Those challenges can be lack of equipment, facilities or even lack of student engagement and disinterest.

On the global scale Oliveira and Bonito (2025) identified five main limitation categories: (a) teacher concerns and professional content knowledge issues, including weak pedagogical content knowledge (PCK), classroom management, collaboration, and language demands; (b) distortion of practical work by assessment, where written tests and high-stakes exams dominate and students may complete science without doing practical work; (c) economic, organizational, and environmental constraints, such as lack of facilities, equipment, chemicals, time, qualified teachers, technicians, funding, and large classes; (d) "cookbook" or overly descriptive tasks that limit creativity and critical thinking; and (e) motivational problems, including stress, anxiety, and insufficient motivation.

In addition, Pereira et al. (2025) mapped systemic difficulties: precarious infrastructure, insufficient teacher

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training, inadequate management, lack of biosafety protocols, material shortages, theory–practice disconnect, teacher overload, poor stock/waste management, and safety risks.

A study conducted in Kenya and India also revealed that schools lacked permanent laboratories, with 25% using modified rooms; gaps included fume cupboards, chemical/apparatus stores, tap water/sinks, and shared laboratory spaces (Khamali et al. 2025) and Kumar (2026). In Zambia, Pemba and Banja (2018) reported overcrowding, language barriers, inadequate professional development, insufficient instructional time, poor administrative support, lack of materials, high pupil–teacher ratios, and preference for demonstration due to inadequate apparatus and time.

Meanwhile, in Pakistan, Muzammal and Hashmi (2025) found resource limitations, inadequate equipment, safety and maintenance problems, urban–rural disparities, lack of trained staff, financial constraints, and insufficient government support. Rafique et al. (2024) also reported lack of basic laboratory facilities, chemicals, apparatus, support staff, safety measures, and time; students feared accidents.

Olajide et al. (2017) in Nigeria and Jalal (2019) in Iraq found laboratory resources were largely unavailable, teachers did not use available facilities, and students were rarely involved in practical activities. While in Myanmar, Hein and Khine (2020) found laboratory work was not conducted every lesson, teachers were weak in doing laboratory work, equipment/materials/chemicals were lacking, no laboratory manual existed, materials were old or faded, laboratory assistants were absent in some sites, time was limited, and teacher-led demonstrations were used because materials were incomplete.

Lelaka (2025) reported that about 80% of public schools in South Africa had no laboratory, only about 20% had internet for teaching and learning, and teachers faced qualification gaps, lack of training, low digital skills, time constraints, large classes, resource shortages, load shedding, maintenance problems, and safety concerns. Supported by Shivolo and Mokiwa (2024), which found traditional/cookbook conceptions of practical work, lack of training and resources, large classes, time limitations, insufficient teacher skills, learner behavioural challenges, and resource unavailability.

In the Philippine Monta and Perdio (2025) identified seven interconnected themes: resource limitations, limited exposure to virtual laboratory tools, professional development and technical training needs, administrative support gaps, teacher motivation issues, low student engagement, time constraints and heavy workload, and safety/student discipline concerns.

A Philippine study on laboratory-based teaching reported resource limitations such as inadequate equipment, chemicals, water supply, sinks, and outdated equipment; time constraints; safety concerns; curriculum/instructional challenges including misalignment and lack of training; and large class sizes (IJSATE, 2025).

The study by de Borja and Marasigan (2020) found only one laboratory shared by all classes in Calamba City, inadequate equipment and furniture, no chemicals, no laboratory assistant, safety issues, reduced science time to four hours per week, large class sizes, calibration problems, limited teacher training, specialization mismatch, and budget constraints are the challenges they face.

Meanwhile, Navarro et al. (2024) found scarcity of laboratory tools affected instructional strategies and lesson planning, made experiments and student engagement difficult, forced teachers towards theoretical teaching, required more time for modifying or creating alternatives, and led to inadequate equipment, limited hands-on experience, minimal laboratory sessions, difficulty grading laboratory reports, sharing of equipment, and limited learning opportunities. The findings of some studies were also observed by the researcher in Sta. Maria Ilocos Sur. Lack of equipment, and a conducive laboratory facility is the number one barrier to the conduct of lab work.

The researcher also found out the following research gap, there is limited quantified severity data on JHS laboratory challenges, especially safety, time, and student engagement. In addition, there is no JHS-specific interconnected model explaining how resources, teacher competence, time, safety, and engagement interact. The current study will operationalize the five challenge areas laboratory facilities and equipment, safety and risk management, teacher preparation and competence, time allocation and scheduling, and student behavior and engagement—as interrelated constructs measured through validated instruments and JHS science teacher interviews, which provide the ground to conduct this research study. It will be a good help to assist struggling teachers who have an intervention plan to solve their problems inside the laboratory.

- *Theoretical Framework*

This study is guided by the General systems theory by Ludwig Von Bertalanffy which views system as a set of interconnected and interacting components. The condition or functioning of one component can affect other components and the functioning of the system. The study identifies 5 challenges involving resources, teacher competence, time, safety, student engagement, and management. In which the following challenges will not be view as a separate entity but rather interconnected things that affects one another. It will serve as basis to anchor and see the connection of the 5 challenges. For example, inadequate equipment may require teachers to modify an experiment. That modification may consume additional preparation time, affect student participation, and potentially create additional safety-management concerns. This would also support the proposed output because the intervention plan can address the laboratory system rather than treating each challenge as completely independent.

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The second theory is the Ecological Systems Theory by Urie Bronfenbrenner which explains human activity and development in terms of interacting environmental systems. The common system is microsystem, mesosystem, ecosystem, and macrosystem. The study will directly identify that challenges of learners and teachers in the conduct of laboratory work in which the problems are affected by the different systems such as microsystem which affects teacher–student interaction, student behavior, engagement, laboratory activities. This framework can help reveal that teachers' laboratory challenges may originate from different layers of their educational environment. It provides a useful explanation for why some challenges may be beyond the teacher's immediate control like the limited resources or not functioning facility. The framework will be useful in classifying the sources of challenges according to their environmental level. Teacher interviews could explore whether a reported difficulty originates from the teacher/student interaction, relationships within the school, administrative and resource-management practices; or broader institutional conditions.

The last framework is the Experiential Learning Theory by David A. Kolb which proposes that learning occurs through a cycle involving Concrete Experience, Reflective Observation, Abstract Conceptualization and Active Experimentation. Since laboratory experiments provide the concrete experience from which students can observe, reflect, conceptualize, and experiment further the appearance of challenges will disrupt the flow. For example, the facilities and equipment could restrict the opportunities for concrete experimentation. Safety and risk management may limit or modify the student's laboratory activities. Teacher preparation and competence may also affect the production of the learners. The framework provides a basis for the intervention plan on why it is important to identify challenges and propose solutions or plan to address it to improve and maintain the concrete experiences of the learners and help teachers reduces barriers towards active experimentation and conceptualization through hands on activities or laboratory works.

➢ *Statement of the Problem*

Generally, the study aims to identify the experiences and challenges encountered by science teachers and students in the conduct of laboratory experiments in junior high school which will serve as a basis for a laboratory management and intervention plan Specifically;

- What is the profile of the faculty and students;
- What are the experiences encountered by Junior High School Science teachers and students in the conduct of laboratory experiments in science subjects in terms of;

✓ Laboratory facilities and equipment
✓ Safety and risk management
✓ Teacher preparation and competence
✓ Time allocation and scheduling, and
✓ Student behavior and engagement

- What significant difficulties or issues do Junior High School Science teachers experience under each identified challenge area during the conduct of laboratory experiments in science subjects?
- What laboratory management and intervention plan can be developed based on the identified challenges and specific difficulties encountered by Junior High School Science teachers in the conduct of laboratory experiments?

➢ *Scope and Limitations of the Study*

This study focuses on the experiences and challenges face during a laboratory activity for teachers and students in the junior high school science class excluding senior high school. The study will be conducted within Ilcocos Sur that offers high school. The respondents of the study will be high school teachers and students from different schools.

This study is limited to junior high school science teachers handling Grades 7–10 in both public and private schools across Ilocos Sur and high school students, using a qualitative research design with 6 survey respondents. The findings may not be generalizable to senior high school teachers, other grade levels, other provinces, or broader national and international contexts; the relatively small sample may not fully represent all JHS science teachers across the province; it relies mainly on interview data that may be affected by social desirability, recall bias, and subjectivity, while secondary documents may be incomplete or inconsistently maintained; its cross-sectional design captures only a single time point and cannot establish causality or track changes over time; the study excludes virtual or alternative laboratory approaches, so the results and proposed plan should be interpreted within these boundaries and used as a basis for further context-specific research rather than as universally applicable conclusions.

➢ *Importance of the Study*

The results of the study will be of great benefit to the following:

- *The Department of Education*

The results of the study shall be the basis for the law makers in the department of education to provide appropriate action towards laboratory activities.

- *The School Heads/Principals*

The results will guide the school heads or principals as to what support is needed by their science teachers and learners.

- *Teacher*

This study will help teachers solve challenges faced in the laboratory setting and will increase their efficiency in conducting their lab work.

- *Students*

The students will have a more meaningful experience as the challenges they face will be reduced.

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- *Researchers*

Future researchers could benefit from this study where they can get some information that might be needed and this research may answer some of their questions.

- *Future Researchers*

Future researchers can use this as a basis for further research and as a reference to their own research.

➢ *Definition of Terms*

The following terms are operationally defined to establish an effective understanding of the study.

- Laboratory works/lab works – This refers to hands-on, practical learning experiences where students interact directly with materials, tools, data, and scientific models rather than just reading or listening to lectures.
- Challenges – This refers to a difficult task, test, or situation that requires effort, skill, or determination to overcome.
- Experiences – This refers to things you personally encounter, live through, or observe.
- Laboratory management – This refers to the process of organizing, supervising, and coordinating human, financial, material, and technological resources to ensure safe, accurate, and efficient lab operations.
- Intervention plan – This refers to the structured, data-driven action blueprint used in education, social work, and healthcare to help individuals or groups build specific skills, overcome challenges, or change behaviors.

II. REVIEW OF LITERATURE

Studying science concepts is challenging without actual demonstration or practical application. However, despite the development of many strategies and many activities related to the teaching of science concepts, a lot of challenges or barriers arise. One of the most useful activities is laboratory work, but a lot of schools face challenges such as lack of materials, utility, teacher competencies, and other factors. This literature review synthesizes studies from 21 studies ranging from 2014 to 2026 that were conducted internationally and in the country.

The literature on laboratory experiments in science education reveals a consistent gap between curriculum expectations and actual practice, driven primarily by lack of resources, time constraints on preparation, safety neglect, and limited student engagement. However, the evidence base is fragmented, methodologically uneven, and disproportionately focused on senior secondary or pre-service contexts, leaving junior high school (JHS) laboratory challenges under-theorized (Oliveira & Bonito, 2025; Pereira et al., 2025).

➢ *Laboratory Facilities, Equipment, and Resource Availability*

The most frequently identified challenge is the physical condition of laboratories and equipment, since these are primary conditions for conducting laboratory work. Whether a school has a laboratory facility largely determines the success of the activity. However, the condition of a conducive laboratory varies across countries and areas, with low- and middle-income countries suffering the most, including scarcity of equipment and non-facility facilities. De Borja and Marasigan (2020) reported that only one laboratory room is shared by all classes in a single junior high school, while Lelaka (2025) stated that 80% of South African public schools lack laboratory facilities. Olajide et al. (2017) specifically noted that beakers, boiling tubes, and conical flasks are available to only 40% of schools; hand lenses to 22.9%; ammeters to 20%; and meter rules, rheostats, and spatulas to 2.86%. Myint Kyaw Hein and Khin Mar Khine (2020) similarly found insufficient equipment, materials, chemicals, and teaching aids.

Jalal (2019) revealed that 90.9% of teachers did not use school laboratories because most basic schools lacked laboratory tools. Rafique et al. (2024) supported this, noting that most schools lacked basic laboratory facilities such as chemicals and apparatus. Sanjito and Hyams-Ssekasi (2025) emphasized resource-related challenges including lack of safety equipment, inadequate apparatus, and shortage of consumables. Pereira et al. (2025) identified infrastructure—absence of laboratories and lack of materials or equipment—as a central obstacle, while Oliveira and Bonito (2025) mentioned economic, organizational, and environmental constraints as barriers.

Conversely, Khamali et al. (2025) and Muzammal and Hashmi reported that most laboratories are present and functional. This contradiction reflects differences in the presence of rooms and the support and resources given to schools. Even where laboratories exist, the quality, maintenance, and usability of equipment determine whether practical work can occur. Sanjito and Hyams-Ssekasi (2025) noted shortages of consumables and inadequate apparatus; Rafique et al. (2024) added low-quality chemicals and insufficient apparatus and models; and De Borja and Marasigan (2020) identified limited equipment inventory, no chemicals, water supply problems, and microscopes and balances with inconsistent calibration as consistent problems. Similarly, although facilities are available, teachers do not use them due to unavailable resources (Olajide et al., 2017). Others resort to using photos or videos from the internet as substitutes, and laboratory work is not systematically recorded, resulting in no laboratory manual being used (Myint Kyaw Hein & Khin Mar Khine, 2020). Khamali et al. (2025) stated that most apparatus and chemicals are sufficiently available, but this is contradicted by other studies in similar contexts. Again, this contradiction comes down to the amount of support a particular institution receives.

➢ *Safety and Risk Management*

Despite the importance of material availability, another important factor is the safety and risk management of teachers and learners. Risks involve inadequate safety equipment, lack of training, and student fear of accidents and unsafe chemicals. De Borja and Marasigan (2020) identified safety procedures and training as concerns, which

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is supported by Kumar (2026), who found that training improved safety management. Despite this, Dantic et al. (2026) showed satisfactory safety knowledge (mean 7.06/10) and always-practiced safety compliance (mean 3.72), but a knowledge–practice gap exists. Lack of biosafety protocols was identified as a key challenge, and waste management and chemical storage inadequacy were also identified by Pereira et al. (2025) as challenges. Remperas (2025) reported that safety concerns include large class sizes, lack of personal protective equipment, and difficulty supervising experiments. Lack of safety equipment was rated as the most significant resource challenge by Sanjito and Hyams-Ssekasi (2025). Rafique et al. (2024) found that students feared accidents due to a lack of safety measures and no safety measures existing in chemistry laboratories, while Monta and Perdio (2025) identified safety concerns and student discipline as themes.

Nevertheless, Muzammal and Hashmi reported relatively high safety compliance (75%), while Rafique et al. (2024), Sanjito and Hyams-Ssekasi (2025), and Pereira et al. (2025) reported severe safety deficits. Dantic et al. (2026) found satisfactory safety knowledge but a gap between knowledge and practice. The contradiction may reflect differences in measurement, context, or what constitutes safety measures. Despite these findings, safety protocols will be impossible to achieve if teachers themselves lack the necessary training, since they will be less likely to provide safety protocols and management in handling emergencies and problems inside the laboratory.

- *Teacher Preparation, Competence, and Professional Development*

Teacher preparation and competence are central to laboratory management. Lelaka (2025) highlighted that only 2 of 6 teachers were qualified to teach natural sciences. Monta and Perdio (2025) argued that teachers lacked formal training in laboratory management and safety and relied on outdated college-era knowledge. Pemba and Banja (2018) showed positive perceptions but no translation to practice, with 78.1% not supervised. Myint Kyaw Hein and Khin Mar Khine (2020) found that teachers were weak in doing laboratory work and had no laboratory manual. De Borja and Marasigan (2020) discovered that teachers had limited training in proper handling of equipment and chemicals. Shivolo and Mokiwa (2024) found positive perceptions and conceptions that did not translate into practice. Rafique et al. (2024) found that teachers believed laboratories were well-equipped while data contradicted this. These contradictions suggest a belief–practice gap that is itself a significant finding. Oliveira and Bonito (2025) also identified weak pedagogical content knowledge, while Sani (2014) noted teacher-dominated discourse. Amuh (2024) reported that teachers are not well-versed in content. Taken together, these studies indicate that teacher competence is linked to the successful conduct of laboratory work and that professional development is a recurring need.

- *Time Allocation and Scheduling*

Time allocation and scheduling pose significant constraints on practical science instruction. According to Pemba and Banja (2018), due to insufficient time to cover the syllabus, practical work is sacrificed. De Borja and Marasigan (2020) noted that science time is reduced to 4 hours per week and most activities are time-consuming, so teachers use YouTube videos due to time constraints. Remperas (2025) identified time constraints in setup, execution, and cleanup that consume most class time. Rafique et al. (2024) reported insufficient time allocated for practical work in the school timetable. Jalal (2019) supported this, noting that only 40-minute periods were allocated, making it difficult to organize practical work. Shivolo and Mokiwa (2024) identified time constraints, workload, and number of periods as factors, while Sanjito and Hyams-Ssekasi (2025) reported that 78.5% of schools had insufficient time for practical sessions. Taken together, these studies are consistent and none contradict each other, showing a strong problem with time. Time constraints are also related to learners' behavior, motivation, engagement, and willingness to participate, which determine whether laboratory time is used productively.

- *Student Engagement, Behavior, and Participation*

Students generally prefer hands-on practical work and are more engaged when they can manipulate equipment, but resource limitations, teacher-centered approaches, and safety concerns often restrict their active participation. Amuh (2024) found that students were positive about teachers' attitudes: 91.1% said teachers allow active participation; 87% said teachers are friendly; and 95% said teachers allow questions. However, 32.3% said teachers missed practical lessons; 74.4% said teachers do not allow free interaction; and 55% said teachers predominantly use the lecture method. Monta and Perdio (2025) mentioned that student engagement is hindered by resource limitations, safety concerns, and teacher confidence, and students miss out on learning due to lack of tools. Oliveira and Bonito (2025) showed that active student participation is identified as an advantage in 67.9% of studies, while motivational effects are identified as a disadvantage in 5.7%. Rafique et al. (2024) demonstrated that students feared accidents, and fear distracted them from actively and confidently performing practical work. De Borja and Marasigan (2020) showed that students are unable to perform experiments due to inadequate equipment, and group sizes of 9–11 members limit individual participation. Shivolo and Mokiwa (2024) also linked constrained laboratory conditions to off-task or disruptive conduct.

- *Interconnected Challenges and Contradictions in Evidence*

The difficulties are interconnected and mutually reinforced. Resource scarcity creates pedagogical improvisation, which is constrained by teacher competence, time, safety concerns, and student engagement. This challenge is particularly acute in laboratory facilities and equipment, where non-availability of resources is a primary obstacle (Olajide et al., 2017). Schools often contend with inadequate equipment and persistent maintenance issues

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(Muzammal & Hashmi), forcing all classes to share a single laboratory room (De Borja & Marasigan, 2020). The situation is further exacerbated by a lack of essential chemicals and reliable water supply (De Borja & Marasigan, 2020; Remperas, 2025), as well as insufficient equipment, a dearth of laboratory manuals, and the absence of a laboratory assistant (Myint Kyaw Hein & Khin Mar Khine, 2020).

Under safety and risk management, the literature identifies lack of safety equipment (Sanjito & Hyams-Ssekasi, 2025), student fear of accidents (Rafique et al., 2024), lack of personal protective equipment and large class sizes (Remperas, 2025), lack of biosafety protocols (Pereira et al., 2025), and a knowledge–practice gap in safety (Dantic et al., 2026). Teacher preparation and competence studies reveal a lack of training (Jalal, 2019; Monta & Perdio, 2025), weak pedagogical content knowledge (Oliveira & Bonito, 2025), teacher-dominated discourse (Sani, 2014), a belief–practice gap (Pemba & Banja, 2018; Shivolo & Mokiwa, 2024), teachers not well-versed in content (Amuh, 2024), and no laboratory manual with weak laboratory work skills (Myint Kyaw Hein & Khin Mar Khine, 2020). Time allocation and scheduling constraints are widely reported (Pemba & Banja, 2018; Sanjito & Hyams-Ssekasi, 2025), with setup, execution, and cleanup consuming substantial class time (Remperas, 2025), 78.5% of respondents identifying insufficient time as a problem (Sanjito & Hyams-Ssekasi, 2025), short 40-minute periods (Jalal, 2019), and science reduced to four hours per week (De Borja & Marasigan, 2020). Student behavior and engagement are also affected by restricted interaction (Amuh, 2024), fear of accidents (Rafique et al., 2024), off-task or disruptive conduct (Shivolo & Mokiwa, 2024), and group sizes too large for individual participation (De Borja & Marasigan, 2020). The specific difficulties are largely consistent across studies, but their relative severity varies by context. For example, safety is a top concern in Sanjito and Hyams-Ssekasi (2025) and Rafique et al. (2024), but less prominent in Khamali et al. (2025) and Muzammal and Hashmi.

- *Proposed Interventions and Implications for a Laboratory Management and Intervention Plan*

The literature converges on a multi-level intervention model that addresses infrastructure, teacher training, safety protocols, time allocation, and student engagement, but few studies propose a structured, validated management plan. On infrastructure and resource interventions, Muzammal and Hashmi suggest upgrading equipment through partnerships with local businesses and increasing the quantity of laboratory tools. Kumar (2026) suggests institutionalizing laboratory teacher training, using low-cost experimentation and independent development, and coaching. De Borja and Marasigan (2020) pointed out that the government should support laboratory funding, class size reduction, and a 3-year development plan. Pereira et al. (2025) proposed integrated interventions in infrastructure, teacher training, and management policies. Lelaka (2025) stressed infrastructure support, digital literacy development, and subject specialists.

In teacher training and professional development, Kumar (2026) suggests that a 30-hour training intervention produced significant gains and recommends institutionalization. Monta and Perdio (2025) recommend funding, professional development, administrative empowerment, and virtual laboratory training. Sanjito and Hyams-Ssekasi (2025) emphasize infrastructure, training, curriculum reform, and ICT integration. Jalal (2019) suggested training courses, resources, and administrative support. Shivolo and Mokiwa (2024) recommend equipping laboratories with science kits, increasing budget allocation, conducting workshops, and reforming timetables. Oliveira and Bonito (2025) emphasize teacher training, economic support, flexible learning spaces, and assessment training. Amuh (2024) calls for resource enhancement, teacher training, improvisation, technology integration, and collaboration, while Remperas (2025) similarly highlights improvisation, technology integration, collaboration, and time management. Rafique et al. (2024) argue for the provision of all required resources, safety training, adequate time, in-service training, and a conducive environment. Myint Kyaw Hein and Khin Mar Khine (2020) recommend systematic laboratory work, direct experiences, on-the-job training, adequate resources, and the establishment of a laboratory in every school.

On safety and risk management interventions, Sanjito and Hyams-Ssekasi (2025) suggest safety equipment, training, and curriculum reform. Dantic et al. (2026) suggest targeted interventions, workshops, and manual or laboratory guide development. Pereira et al. (2025) pointed out biosafety protocols, waste management, and management policies. Under time allocation and scheduling interventions, De Borja and Marasigan (2020) asserted a 3-year development plan and proper scheduling. Sanjito and Hyams-Ssekasi (2025) and Shivolo and Mokiwa (2024) added curriculum reform and timetable allocation, while Pemba and Banja (2018) suggest monitoring, resource provision, and professional development. Finally, under student engagement interventions, Amuh (2024) proposed active participation and resource enhancement. Oliveira and Bonito (2025) also suggest that active student participation and hands-on/minds-on knowledge are important, while Remperas (2025) pointed out that collaboration, time management, and technology integration are means to approach the problem.

The intervention literature suggests a multi-level model, but the evidence base is fragmented and lacks JHS-specific validation. Beyond this, methodological approaches were also examined, and most studies are dominated by qualitative and descriptive designs with small, purposive samples; mixed methods and systematic reviews are emerging but remain a minority; safety and JHS-specific challenges are rarely measured systematically.

The reviewed literature reveals a predominance of qualitative and descriptive research designs. Case studies were employed by Sani (2014), de Borja and Marasigan (2020), and Myint Kyaw Hein (2020), while Monta and Perdio (2025) utilized a phenomenological approach.

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Descriptive survey designs were also common, as seen in the works of Pemba and Banja (2018), Olajide et al. (2017), Jalal (2019), Rafique et al. (2024), and Amuh (2024). This methodological concentration suggests that the field has largely relied on exploratory and descriptive accounts of laboratory resource challenges rather than experimental or longitudinal designs.

In addition to purely qualitative and descriptive studies, several investigations employed mixed methods designs, including Kumar (2026), Sanjito and Hyams-Ssekasi (2025), Shivolo and Mokiwa (2024), and Muzammal and Hashmi. Systematic and scoping reviews were also represented, with Oliveira and Bonito (2025) conducting a systematic review and Pereira et al. (2025) undertaking a scoping review. These approaches indicate a growing effort to synthesize evidence and triangulate findings across diverse contexts.

Meanwhile, sample sizes across the reviewed studies varied widely. Small samples were common in qualitative investigations, such as de Borja and Marasigan (2020) with eight teachers, Monta and Perdio (2025) with ten teachers, Myint Kyaw Hein (2020) with six teachers, and Lelaka (2025) with six teachers. In contrast, larger samples were utilized in survey-based studies, including Khamali et al. (2025) with 80 students and 8 teachers, Olajide et al. (2017) with 300 students and 35 teachers, Jalal (2019) with 250 teachers, Amuh (2024) with 180 students, Muzammal and Hashmi with 100 teachers, Sanjito and Hyams-Ssekasi (2025) with 64 teachers, Shivolo and Mokiwa (2024) with 133 teachers, and Dantic et al. (2026) with 85 students. This range reflects the differing epistemological orientations and resource constraints of the studies.

Data collection methods were diverse. Surveys and questionnaires were the most frequently used instruments across studies. Interviews were conducted by Monta and Perdio (2025), Sanjito and Hyams-Ssekasi (2025), Shivolo and Mokiwa (2024), de Borja and Marasigan (2020), Lelaka (2025), Myint Kyaw Hein (2020), and Amuh (2024). Observations were employed by Sanjito and Hyams-Ssekasi (2025), Shivolo and Mokiwa (2024), Lelaka (2025), and Myint Kyaw Hein (2020). Document analysis was used by de Borja and Marasigan (2020) and Khamali et al. (2025), while focus groups were utilized by Amuh (2024) and Lelaka (2025).

Also, analysis methods also varied. Thematic analysis was the most common qualitative approach, used by Monta and Perdio (2025), Sanjito and Hyams-Ssekasi (2025), Shivolo and Mokiwa (2024), and Lelaka (2025). Descriptive statistics were employed by Jalal (2019), Rafique et al. (2024), Olajide et al. (2017), and Amuh (2024). Inferential statistics were utilized by Khamali et al. (2025), Muzammal and Hashmi, Kumar (2026), and Dantic et al. (2026). Content analysis was conducted by Oliveira and Bonito (2025), Myint Kyaw Hein (2020), and Pereira et al. (2025). This mix of analytical techniques reflects the integration of qualitative and quantitative paradigms in the reviewed literature.

Despite extensive documentation of laboratory challenges, several critical areas remain under-researched: safety and risk management in JHS, JHS-specific laboratory challenges, quantified levels of challenge, time allocation as a standalone variable, student behavior and engagement, structured laboratory management intervention plans, comparative studies, and longitudinal studies.

Under safety and risk management, only Muzammal & Hashmi; Remperas (2025); Sanjito & Hyams-Ssekasi (2025); Rafique et al. (2024); Dantic et al. (2026); and Pereira et al. (2025) address safety directly. Only de Borja & Marasigan (2020), Olajide et al. (2017), Amuh (2024), and Pemba & Banja (2018) focus on JHS, or junior secondary. Most studies describe challenges qualitatively or report frequencies; Khamali et al. (2025) and Sanjito & Hyams-Ssekasi (2025) provide some quantification. Meanwhile, no study treats time as a standalone variable; it is mentioned incidentally. On the intervention plans, recommendations are broad; few propose structured, validated plans. The gaps themselves are not contested; they are consistently acknowledged across the reviews and primary studies. These gaps justify the current study's focus on JHS science teachers' laboratory challenges and the development of a context-specific intervention plan.

The five challenge areas, laboratory facilities and equipment, safety and risk management, teacher preparation and competence, time allocation and scheduling, and student behavior and engagement are not independent; they form an interconnected system in which resource scarcity constrains teacher practice, which in turn shapes student engagement, which is further constrained by time and safety concerns.

In summary, the review reveals that most of the challenges faced by teacher and students in doing laboratory works are laboratory facilities and equipment, safety and risk management, teacher preparation and competence, time allocation and scheduling, and student behavior and engagement. There is limited quantified severity data on JHS laboratory challenges, especially safety, time, and student engagement. In addition, No JHS-specific interconnected model explaining how resources, teacher competence, time, safety, and engagement interact. the current study will operationalize the five challenge areas—laboratory facilities and equipment, safety and risk management, teacher preparation and competence, time allocation and scheduling, and student behavior and engagement—as interrelated constructs measured through validated instruments and JHS science teacher interviews. Quantitative data will establish the prevalence and severity of each challenge, while qualitative data will explain how these challenges interact in practice. Findings will then inform the development of a context-specific Laboratory Management and Intervention Plan.

This chapter presents the discussion of the research design, sources of data, research instrument, data gathering procedure, analysis of data, and ethical considerations utilized in this study.

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➢ *Research Design*

This study is qualitative descriptive design since the study stays close to participants' own words, does not force data into an imported theoretical framework, and is well suited to producing a practical, context-specific output such as a laboratory management and intervention plan. This design has already been used successfully with Junior High School science laboratory teachers in the Philippine public-school context to examine competencies, challenges, and professional needs. It is also consistent with phenomenological work on science teachers' struggles with insufficient laboratory equipment, where in-depth interviews and thematic analysis were used to surface both difficulties and coping strategies.

➢ *Selection and Study Site/ Sources of Data*

The study will be conducted in Ilocos Sur, selected through purposive sampling due to its diverse educational landscape. Ilocos Sur hosts a mix of public junior high schools, laboratory schools, and private schools, providing varied contexts for examining laboratory challenges. Some schools in the area have science-related facilities, while others do not, creating a range of conditions that will yield rich, comparative data. This variation is essential for understanding how different resource environments shape the challenges teachers encounter.

The site was chosen because it represents a microcosm of the broader educational context in Ilocos Sur, allowing the researcher to capture both the commonalities and the unique circumstances of laboratory instruction in junior high schools.

The study will use purposive, homogeneous sampling with maximum variation within the defined participant groups. Homogeneity will be ensured by selecting licensed Junior High School Science teachers who have conducted at least one laboratory experiment in the current or previous school year and Junior High School students who have participated in at least two laboratory experiments in a science subject, while maximum variation will be sought across grade level, sex, length of teaching experience, and science subject specialization among teachers so that contrasting perspectives are captured without fragmenting the sample. A total of six participants will be included, specifically three teachers and three students. Guest et al. (2006) found that as few as six interviews can generate high-level overarching themes when the scope is narrow, the data are rich and in-depth, and participant characteristics are tightly specified to the study aims. The three teachers may be drawn from different grade levels or science specializations, and the three students may be selected from different grade levels or with varied levels of engagement as identified by the teacher, with care taken not to label students negatively; the sample size is therefore not intended for statistical representativeness but for information power, as the participants are purposively chosen for their direct experience of laboratory experiments and their capacity to speak to the five challenge areas of the study.

➢ *Sources of Data*

The study will utilize both primary and secondary data sources. Primary data will be gathered directly from junior high school science teachers and students through in-depth interviews and focus group discussion.

Secondary data will be obtained from school records and documents: Laboratory schedules, equipment inventories, safety incident logs, and curriculum guides (if permitted by school administrators). DepEd policies and guidelines: Relevant Department of Education memoranda and policies on laboratory management and safety. Published research and literature: Studies on laboratory challenges, science education, and intervention strategies from 2014 to 2026.

These secondary sources will be used to corroborate self-reported challenges, provide contextual background, and inform the development of the laboratory management and intervention plan. The inclusion of secondary data strengthens the study by triangulating findings and reducing reliance on self-report alone.

➢ *Research Instrument*

The study will use three complementary sources of data to address the research questions and support triangulation. The primary source will be semi-structured individual interviews. Teacher interviews will last 45–60 minutes and will be conducted outside class hours in a quiet room, while student interviews will last 30–45 minutes and will be conducted in a safe, familiar school space using age-appropriate language. The interview guide will be organized around the five domains of the second research question: laboratory facilities and equipment; safety and risk management; teacher preparation and competence; time allocation and scheduling; and student behavior and engagement. For teachers, additional probes will address the third research question, particularly the question "Which of these areas creates the most significant difficulty for you, and what makes it difficult?" For students, probes will focus on what they have seen, done, and felt during laboratory experiments.

The second source will be a focus group discussion with the teacher participants, lasting 60–90 minutes. The FGD will not be used to generate a second data set from scratch; rather, it will stimulate collective reflection, surface shared norms, and identify department-level difficulties that individual interviews may not reveal. This approach mirrors the design used in a Philippine qualitative descriptive study of Junior High School science laboratory teachers, which combined FGDs and semi-structured interviews with thematic analysis. The third source will be document analysis and non-participant observation as supplementary data. Documents will include laboratory manuals, safety policies, equipment inventory lists, class schedules, and any existing laboratory activity sheets. Observation will cover one or two laboratory sessions per grade level using a structured observation guide focused on the five domains of the second research question. The observation will be non-participant and will not evaluate individual teachers or

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students; instead, it will provide contextual evidence that can be used to corroborate or contrast the interview accounts.

Finally, profile data for the first research question will be collected through a short demographic data sheet completed by the participants. For teachers, the sheet will collect age, sex, highest degree, teaching experience, science specialization, and relevant laboratory training. For students, it will collect grade level, sex, science subject currently enrolled in, and number of laboratory experiments attended in the current school year. This is not a separate quantitative survey and will not be used for statistical inference; it will be used descriptively to contextualize the qualitative findings, which is appropriate for a small-sample qualitative study.

➢ *Data Gathering Procedure*

The researcher will get permission from the ethics committee and to the participating schools for the conduct of the interview.

The researcher will contact selected participants to schedule interviews at times that do not disrupt classes

Interviews will be conducted one at a time, either face-to-face or via video call, lasting 45–60 minutes for teachers and 45-30 minutes for students.

Recorded audio will be transcribed verbatim.

Focus group discussion will takes place after consolidating the participant for their time availability.

Transcripts will be returned to participants for member checking to validate accuracy and interpretations.

➢ *Analysis of Data*

The researcher will transcribe the interviews and conduct thematic analysis following Braun and Clarke's six-phase framework: familiarization, coding, generating themes, reviewing themes, defining themes, and writing up. Code inductively will be utilized to identify patterns of specific difficulties under each of the five challenge areas. Cross-case synthesis will also be used to identify recurring themes and divergent perspectives. A matrix that maps quantitative ratings against qualitative themes will also be used. For example, if "time allocation" has a high mean score (severe challenge), the qualitative themes explain why (e.g., "schedule conflicts with other subjects," "experiments take longer than allotted period"). The integrated findings will be used to draft the laboratory management and intervention plan, ensuring each strategy is grounded in both the prevalence and the specific nature of the challenge.

➢ *Ethical Consideration*

The researcher will observe the following ethical standards throughout the conduct of the study.

- *Ethical Clearance and Institutional Permission*

The researcher will secure approval from the institutional research ethics committee before data collection. Permission will also be obtained from the school heads/principals of the selected public junior high schools in Sta. Maria, Ilocos Sur. Copies of the research proposal, instruments, and consent forms will be submitted as required.

- *Informed Consent*

Teacher participants will be given a letter of consent for them to participate in the study. The consent will explain the purpose of the study and will ask for voluntary participation of the activity, those who do not sign the letter will be excluded from the study.

- *Confidentiality, Anonymity, and Data Privacy*

The study will comply with the Data Privacy Act of 2012 (RA 10173) and relevant DepEd policies. Names of schools and teachers will not appear in any report. Codes or pseudonyms will be used since the participants are in a small scale. Raw data will be stored in password-protected files accessible only to the researcher and will be destroyed after the required retention period.

- *Sensitivity in Handling Teacher Competence and Student Behavior Data*

Teacher preparation and competence can be sensitive. These will be framed neutrally and systemically, focusing on challenges and possible solutions rather than blaming individuals. Data will not be used for performance evaluation, promotion, disciplinary action, or any administrative purpose.

- *Cultural and Contextual Sensitivity*

The researcher will respect the local culture, language, and public-school context of Sta. Maria, Ilocos Sur. Data collection will be scheduled at times that do not disrupt classes. Instruments will be reviewed for appropriateness and clarity, and participants will be given enough time to respond.

- *Researcher Integrity*

The researcher will avoid fabrication, falsification, plagiarism, and conflicts of interest. Findings will be reported honestly, whether positive or negative, and proper credit will be given to all sources and participants.

- *Dissemination and Use of Results*

Results will be used primarily to develop a laboratory management and intervention plan. A copy of the output will be shared with the participating schools and concerned DepEd offices in aggregate form. No data will be used for commercial purposes or any unauthorized activity.

III. CONCLUSION

This proposed study addresses the challenges encountered during laboratory activities. It will explore certain experiences that teachers and students face in order to create an intervention. By interviewing teachers and

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students in depth, the researcher will identify challenges and develop a context-based solution. The study's importance lies in the fact that students learn more when they experience concepts firsthand; to achieve this, laboratory experiments should be enhanced by removing the barriers or challenges that teachers and students encounter. Although the respondents and data sources of the study are limited, the ultimate goal of the study is to create an intervention and management plan that can be used within its scope. Because teachers and students encounter a variety of scenarios in the laboratory, the plan will not be generalized; instead, it will be a context-based plan.

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