Evaluation of Science Laboratories on Academic Engagement

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ABSTRACT

This study investigated the influence of science laboratory experiences on student academic engagement. Recognizing the complex nature of this influence, a comprehensive evaluation framework was employed, encompassing the quality, availability, and functionality of laboratories, tools, and equipment; the alignment of laboratory activities with learning objectives; and the instructor's ability to facilitate inquiry-based learning. Additionally, employing a quantitative approach, a validated survey questionnaire was administered to a sample of second- and fourth-year college students and instructors at Laguna University. The results revealed that the p-values for standard laboratory conditions were less than the significance level of 0.05, indicating that the null hypotheses were rejected. This demonstrates a significant relationship between the quality, availability, and functionality of science laboratories and the students' hands-on learning and academic engagement. In conclusion, the findings confirmed that the standard of science laboratories significantly impacts student academic engagement, with the lack of appropriate tools and equipment identified as a key factor hindering engagement.

Keywords: Science laboratories, academic engagement, tools and equipment, student engagement, hands-on learning

INTRODUCTION

School facilities play a vital role in improving student achievement, especially in science education. Without adequate facilities, it is difficult for students to develop scientific attitudes and problem-solving skills. One of these essential facilities is a science laboratory where students can actively explore scientific concepts through hands-on experiments. A hands-on experience enhances their understanding, making complex theories more accessible. Additionally, engaging in experiments not only helps with information retention but also allows students to apply their knowledge to real-world situations. The use of laboratory tools and equipment further fosters student involvement in their education, ensuring a deeper understanding of the scientific process. Without access to well-equipped science laboratories, many students might miss out on this interactive and impactful learning experience. In line with this concern, the researchers conducted this study titled "Evaluation of Science Laboratories on Academic Engagement" to determine the significant relationship between the laboratories and the experiential learning of the students and to develop a recommendation for standardized equipment which supports the teaching and learning process as well as students' academic engagement.

Background of the Study

Laboratories and equipment play an important role in science education as they allow students to learn by doing experiments and to understand concepts in real-life situations. When students have access to adequate laboratory equipment, they are better able to develop the skills and knowledge they need to succeed in science and technology.

In line with this, the Commission on Higher Education Memorandum Order (CMO) No. 52, S. 2007, Sec. 5, states that for programs offering specializations in the science and technology fields, the appropriate laboratory facilities specified in the course specifications should be complied with. This emphasizes the need for adequate laboratory facilities in science and technology programs to ensure students receive practical training essential

for their education and future careers. Additionally, CMO No. 75 S. 2017 Sec. 6.3.4, outlines the minimum standards specifically for the Bachelor of Secondary Education (BSEd) Major in Science degree program. It emphasizes the importance of students demonstrating a deep understanding of scientific concepts and principles, as well as their ability to apply scientific inquiry in teaching and learning. Thus, the memorandum highlights the importance of utilizing effective science teaching and assessment methods, indicating the importance of pedagogical approaches in the field of science education.

However, many schools in the Philippines face shortages of laboratories and equipment. The Department of Science and Technology (DOST) reported that over one-third of high schools in the Philippines lack a functioning laboratory, and many of the labs that do exist lack modern equipment. This is due to a number of factors, including limited funding, scarce resources, allocation of funds, logistical issues, maintenance expenses, and the fast-paced evolution of technology.

Moreover, despite its commitment to providing quality education, Laguna University has encountered a persistent challenge in its pursuit of academic excellence: a lack of fully-equipped science laboratories. While science can be taught using books, hands-on activities are essential for effective learning. Therefore, to address this concern, the researchers came up with the idea of conducting a study titled "Evaluation of Science Laboratories on Academic Engagement" to determine the significant relationship between the quality, availability, and functionality of the laboratories, tools, and equipment as well as students' hands-on learning. This study also aimed to develop recommendations for standardized equipment which supports the teaching and learning process and enhances students' academic engagement.

Research Problem and Objectives

This study was mainly concerned with the Evaluation of Science Laboratories on Academic Engagement. Specifically, the study sought to answer the following questions:

1. What are the laboratory equipment needed for the course program BSEd- Science Students?

2. What is the level of perception of BSEd Science Instructors and Science Students with regards to science laboratories, tools, and equipment in terms of:

2.1. Quality,
2.2. Availability, and
2.3. Functionality?

3. What is the level of students' hands-on learning and academic engagement towards science laboratories, tools, and equipment?

4. Is there a significant relationship between the level of perception of BSEd Science Instructors and Students with science laboratory's quality, availability and functionality and students' academic engagement?

5. Is there a significant relationship between the level of perception of BSEd Science Instructors and Students with science laboratory's quality, availability and functionality and students' hands – on learning?

Hypothesis

H1: There is no significant relationship between the level of perception of BSEd Science Instructors and Students with regards to science laboratory, tools, and equipment in terms of quality, availability, and functionality and students' academic engagement.

H2: There is no significant relationship between the level of perception of BSEd Science Instructors and Students with regards to science laboratory, tools, and equipment in terms of quality, availability, and functionality and students' hands – on learning.

Significance of the Study

The findings and the results of this study would be beneficial to the following:

- Students. This study provides information to the students, especially to those who utilize laboratories and equipment. It can also help the students to discoveries in enhancing their skills and abilities that are essential for success in school, in the workplace, and in life.

- Teachers. This study provides information to teachers, especially to those who value learning by doing. It can also help teachers to identify areas where improvement is needed and make changes to ensure that students are having the best learning experience.

- School. This study provides schools with relevant information, especially those seeking to make laboratories as a conducive learning environment for students, and improves the quality of their education. This can help them develop standardized well-equipped laboratories. The materials produced from this study can also be used during school accreditation.

- Stakeholders. This study provides information to the stakeholders, especially in planning to provide enough fund to support building well-equipped laboratories, training more science teachers, and purchasing adequate teaching and learning resources including books, teaching models, laboratory equipment, apparatus, and chemicals.

- Community. This study provides information in the changing world where scientific skills are relevant, especially to society, to become aware of the significance of school laboratories to the scientific discoveries and developments that are made in laboratories today. Additionally, the community will benefit from having more educated and scientifically literate students.

- Future Researchers. This study would be beneficial to the future researchers as it can help them to have useful information that is focused on laboratories to support their needs in conducting research. The material that will be produced can be their guide in gathering data or information and may also serve as their review of related studies (RRS) about the Evaluation of Science Facilities on Academic Engagement.

Scope and Limitations of the Study

This research incorporated quantitative approaches for evaluating science laboratories through academic engagement. The chosen respondents of this study were the second- and fourth-year students of the program BSEd-Science, as well as the BSEd Science Instructors at Laguna University. The research focused on the laboratory equipment needed for the course program BSEd—Science and the quality, availability, and functionality of the Science Laboratories (Physics, Chemistry, and Biology Laboratory), tools, and equipment, and examined how these factors contributed to students' academic engagement and hands-on learning.

Definition of Terms

- Evaluation: The process of systematically assessing and examining science laboratories, within Laguna University, to determine their relationship on students' hands-on learning and academic engagement.

- Science Laboratories: Specific school facilities (physics, biology, and chemistry laboratory) within Laguna University where the study is focused on determining their relationship to the hands – on learning and academic engagement of the students.

- Quality: In this context, this refers to the overall state of the physical space, resources, and procedures that support safe and effective scientific research.

- Availability: This refers to the presence and accessibility of resources needed for scientific activities.

- Functionality: Refers to the operational status of the available resources.

- Experiential Learning: This is an educational approach that will be used in this study to emphasize meaningful learning through the hands-on, problem-based, and reflective learning experiences of Laguna University's Science major students in utilizing laboratories and equipment.

- Hands-on Learning: This involves actively engaging with and applying concepts through experimentation, building, or doing, leading to deeper understanding and enhanced memory compared to passive methods.

- Academic Engagement: Utilized to assess the extent of student engagement in science classes and practical lab sessions.

REVIEW OF RELATED LITERATURES AND STUDIES

Foreign Literature

School Facilities on Academic Engagement

Shahzadi, I. et al. (2023), stated that science education requires hands-on experimentation using specialized equipment for effective learning and understanding. Students should actively engage in experiments using tools specifically designed for scientific inquiry. By conducting experiments, students develop a sense of curiosity about the natural world and learn how to approach problems systematically.

A study by Mira (2022), found that the physical environment of a classroom significantly impacts student learning. Well-designed spaces with natural light, good air quality, and flexible layouts can boost student performance. Conversely, poor conditions like inadequate ventilation or overcrowding can negatively affect student outcomes.

However, in the study of Shahzadi, I. et al., (2023), it was reported that many schools still have insufficient science apparatus, lack of properly established laboratories, and other necessary learning resources. In line with this, the conditions of existing laboratories in many secondary schools are often substandard, with insufficient space and inadequate facilities. These issues significantly hinder the teaching and learning of science subjects.

Chen and Zhang (2023) explored the connection between school facilities and the learning atmosphere in Canada. Their findings revealed that school facilities significantly influence student learning outcomes. For instance, schools with newer and better-maintained facilities are associated with higher student achievement levels. Additionally, schools with ample natural light and improved ventilation fostered greater student engagement and reduced absenteeism.

Science Laboratory on Experiential Learning

Science education in schools involves transforming from an academic discipline into a school subject is called recontextualization. Gericke, N., et. al. (2022) also categorized the recontextualized science education curriculum into three main learning goals: learning science (the knowledge), learning about science (how the students discover knowledge), and learning to do science (applying scientific method). The authors revealed that “doing science" goes beyond experiments and includes critical thinking skills like data analysis and building arguments. Although laboratory work contributes significantly, it is not the only method for attaining the goals. In accordance, the laboratory is not about finding correct answers but about learning how to observe and understand the world. The focus should be on developing observational skills and interpreting what is observed with honesty and intellectual integrity.

However, according to Gökmen, A., et. al. (2021), effective laboratory learning requires students to actively select, add and remove or use equipment, and materials to explore scientific concepts. Proper equipment is important for successful experiments and knowledge retention. The importance of laboratory equipment has

been recognized for centuries, as evidenced by the work of Abu Bakr Razi. Therefore, acquiring a deep knowledge of laboratory equipment and materials is important for ensuring safety and efficiency within the laboratory environment.

In addition, students are most concerned about the impact of laboratory activities on their learning, and they prefer learning engagement that are more independent, participatory, and interactive. Nicol, C.B., (2022) emphasized the importance of student perspectives in shaping effective laboratory instruction. Students' insights can be used to design new strategies to inform pedagogies that will enhance students' learning of science inquiry processes interactive.

Instructional laboratories are critical components of tertiary STEM education. They serve as controlled environments where students can transition from theoretical knowledge to practical application. By conducting experiments, students gain hands – on experience with scientific and engineering principles, developing essential skills in observation, measurement, and experimentation (May et al., 2023). Students are challenged to tackle increasingly complex problems, fostering both technical proficiency and a deeper understanding of their field. Through laboratory work, students acquire not only subject – specific skill but also transferable skills valuable for future careers.

Local Literature

School Facilities on Academic Engagement

Bali (2023) stated that the Philippines facing a challenge in providing equal and quality education opportunities to all the students due to a lack of resources and infrastructure in schools. Additionally, according to the Department of Education, over a thousand of schools throughout the country, in both rural and urban areas, do not have basic necessities like electricity, clean water, enough classrooms, or up-to-date learning materials. These insufficiencies can lead to irregular attendance, hindered focus, and limited access to information, all vital for effective learning. Proper facilities and resources are essential for students to succeed and contribute to the nation's development

However, the academic factor appears to be the most important. School facilities have a positive relationship with school effectiveness (Yangambi, 2023). Studies have shown that school facilities are linked to student success in learning. The availability of school physical facilities and the quality of the school learning environment have been shown to be powerful factors influencing student success in the learning.

One vital aspect of science education that holds great potential for student engagement and learning is laboratory learning. Students view laboratories as unique environment where they can actively engage with scientific concepts, develop critical thinking skills, and apply theoretical knowledge rather than just passively learning about it. Through hands-on activities, group data collection, and analysis, students get a more profound comprehension of science. In addition, in the Philippines, it is critical to investigate ways to make laboratories more equipped and more productive to enhance science instructions and learning (Kilag, O.K., et al. 2023).

Science Laboratory on Experiential Learning

The study of Balmeo (2022), asserted the significance of laboratory in the teaching and learning of chemistry education. Laboratory enhance classroom learning, particularly for comprehending difficult topics (Kennepohl, 2021). However, challenges arise due to inadequate resources for laboratory activities and experiments (Duban et.al., 2019). Due to the lack of supplies, teachers is seeking for materials or conduct experiments in their place, which could hinder the hands-on learning that is essential for helping students understand chemistry principles.

Furthermore, teachers believe that for students to fully understand scientific concepts and procedures, practical work is significant component in science education. More importantly, it was also found that laboratory raise students' interest and enhance their scientific knowledge which revealed that the insufficiency of well-equipped laboratories in schools had brought challenges and difficulties to support students' learning, laboratory works and activities (Juanico et.al., 2021).

In the Philippines, science laboratory equipment/apparatus is inadequate for public schools (Juanico, et.al., 2021; Tupas & Matsuura, 2020). In addition, despite the fact that online laboratories have become popular as a replacement, it affects teachers' ability to deliver the K-12 curriculum effectively of providing students with the same hands-on learning opportunities.

In line with these concerns, the Philippine Department of Science and Technology (DOST) is upgrading the science laboratory at Camiguin National High School (CNHS) to enhance science education (Paculba, 2023). This initiative involves providing new science equipment and installing interactive educational technologies (IETs) such as Outbreak Vanguard and WHIMC. The goal is to improve students' hands-on learning experiences, critical thinking, and problem-solving skills, ultimately fostering interest in science, technology, and innovation. This project is expected to benefit approximately 1,500 students and aligns with DOST's broader efforts to improve science education in the region.

Nagal (2020) developed and assessed a resource package for teaching Earth and Life Science in the K to 12 Program that uses glocalized experiential learning. There are few glocalized experiential learning materials for Earth and Life Science, even though they can improve critical thinking skills and independent learning. Earth and Life Science is a required core subject in the K to 12 Program, so it is important to support students' learning in this subject.

Therefore, getting hands-on learning experiences are essential for fostering deep understanding and long-term retention of scientific concepts. By actively engaging with materials and conducting experiments, students can connect theoretical knowledge with real-world applications, leading to a more meaningful and engaging learning experience (National Academies of Sciences, Engineering, and Medicine, 2021).

Foreign Study

School Facilities on Academic Engagement

Education is a basic human need as pointed out by Pareek, R., (2019). Science is a body of knowledge acquired by scientists, while science education builds on students' existing knowledge and skills to help them understand scientific principles, laws, and theories. In addition, science teaching and learning should focus on enabling students to learn scientific concepts through hands-on activities (Pareek, 2019). Science laboratories have a direct impact on students' attitudes and academic performance. It is generally believed that constant practice leads to proficiency, hence the saying "practice makes perfect.” The quality of teaching and learning experiences depends on the adequacy of laboratory facilities in secondary schools and the teacher's effectiveness in using them. Research has shown that adequate laboratory facilities have a significant positive effect on students' academic performance in science.

Recent years have seen a growing emphasis on the design and planning of education infrastructure to support child development. Aligned with the United Nation's Sustainable Development Goals (SGD), there is a global pursuit of evidence on how learning environments impact child development. Improved education facilities promise benefits including energy efficiency, safety, health, and enhanced student performance (Barrett et al., 2018).

School facilities and infrastructure significantly influence 21st-century learning (Nugroho & Wibowo, 2020). To optimize student learning, schools must adapt their physical spaces to accommodate evolving teaching methods. The availability of resources like libraries, laboratories, and computer facilities can enhance outcomes, their effective use by teachers and students is essential. Moreover, school's physical appearance also influences parental perceptions and overall educational effectiveness.

School facilities significantly impact student academic achievement. According to Otchere et al. (2019), inadequate facilities negatively affect student motivation, attention, and concentration, leading to lower academic performance. Conversely, well-maintained facilities can positively influence student attitudes, behaviors, and academic success. Investing in school infrastructure is crucial for improving teacher

effectiveness, student behavior, and overall academic outcomes. Collaborative efforts between school leaders, governments, and communities are essential for maintaining and upgrading school facilities.

Science Laboratory on Experiential Learning

Science laboratories are essential for successful chemistry, physics, and biology education in schools (Reza, M., et al. 2023). Students and teachers need access to facilities and equipment as it provides hands-on experience for students to learn by doing, bridging the gap between theory and practice. Research assistants and work managers also play important roles in supporting experiential learning in science laboratories.

Umarji et al. (2023) emphasized the superiority of experiential learning over traditional, content-rich curriculum. It aligns with Swami Vivekananda's belief that true knowledge comes from experience, they advocate for an educational shift, "Knowledge can be got in one way; the way of experience, there is no other way.". This shift involves prioritizing the development of critical thinking, problem-solving, creativity, and innovation in students. To achieve this, education policies should focus on these skills, and teaching methods should become more experiential, inclusive, adaptable, student-centered.

Additionally, a study by Gubat M., et al. (2023) stated that experiential learning is a type of learning that occurs through direct experience. By engaging in hands-on activities, students can better grasp classroom concepts and apply them to real-world scenarios. Experiments provide invaluable real-world knowledge that cannot be fully comprehended through theoretical instruction alone.

By engaging in hands-on experiments, students can effectively apply theoretical chemistry concepts to real-world situations. These practical experiences foster interest in science and develop essential skills like scientific inquiry. Experiential learning through laboratories is crucial for bridging the gap between theory and practice, promoting critical thinking, problem-solving, and creativity. Educators are encouraged to integrate such learning opportunities to provide a well-rounded education that equips students with both theoretical knowledge and practical abilities (Gubat M., et al., 2023; Adebusuyi, O., 2023).

As mentioned by Sulaiman, N., et al. (2023), physics lab courses are essential for undergraduate physics degrees. They allow students to experience physics firsthand, learn what it means to be a physicist, and develop their sense of belonging, identity, and epistemology (i.e., beliefs about the nature of learning and physics). Physics lab courses also provide students with the opportunity to acquire essential experimental skills for their future careers, such as understanding measurement uncertainty, troubleshooting equipment, working in teams, and communicating effectively.

Local Study

School Facilities on Academic Engagement

School laboratories play a vital role in students' science education, but still, many schools face challenges in providing adequate resources (de Borja, & Marasigan, A. 2020). This can limit students' opportunities to learn through hands-on experiences, which can hinder their understanding of complex science concepts.

For example, the study of Noroña (2021) found a direct correlation between inadequate and unused laboratory facilities, and poor student performance. Students unfamiliar with laboratory equipment often struggle in exams. Not well-funded institutions with limited learning resources intensify this issue. To address this, increased government funding for science laboratories and smaller class sizes are important for optimal student outcomes in science.

Beyond laboratory facilities, the overall classroom environment plays a significant role in student learning. Aquino (2019) emphasized the importance of proper facilities and instructional materials in creating a conducive learning environment. A well-equipped classroom not only benefits students but also positively influences teacher morale and effectiveness, contributing to improved student performance.

Moreover, a positive learning environment, enriched with diverse activities and resources, stimulates student learning and motivation. Unfortunately, resource scarcity can hinder effective teaching strategies like extrinsic rewards. To address this, updating and providing necessary school resources is crucial. Research, such as Navarro (2022), consistently demonstrated the positive impact of improved school infrastructure on learning outcomes. The relationship between resources, motivation, and student achievement is evident. Well-equipped schools can foster a stimulating learning environment that motivates students. Conversely, resource limitations can negatively impact both students and teachers.

Students are viewed as the primary customers, and universities strive to provide services that meet their needs (Alimen et al., 2020). This includes well-equipped laboratories, particularly in engineering programs. These labs are unique learning environments that facilitate inquiry-based learning, directly impacting how students grasp concepts. Student satisfaction is closely linked to their learning experiences in these practical settings. A well-equipped laboratory significantly enhances learning, highlighting the importance of maintaining and improving these facilities.

The emphasis on student satisfaction and learning aligns with research by Delfino (2019) who found a positive correlation between student engagement and academic performance. The study also identified a positive correlation between school facilities, including laboratories, and student engagement. Additionally, the study suggests that strong collaboration between teachers and universities to provide students with engaging learning opportunities, supported by well-equipped facilities, contributes to meaningful learning experiences and ultimately, academic success.

In conclusion, universities must prioritize the quality of their physical infrastructure, particularly laboratories in engineering programs. These facilities are not just about space and equipment, but about creating an environment that fosters inquiry-based learning, improves student satisfaction, and ultimately enhances academic performance.

Science Laboratory on Experiential Learning

Laboratory activities have been a fundamental aspect of science education, providing learners with hands-on experiences in real-world phenomena. In addition to well-equipped laboratories, the presence of qualified science teachers is crucial for effective science education. The research by Abas and Marasigan (2020) highlighted the challenges faced by teachers, particularly in remote areas, in implementing the K-12 science curriculum due to inadequate laboratory resources. This research served as a valuable foundation for the Department of Education (DepEd) to develop strategies aimed at improving science education by addressing the identified gaps and challenges.

Moreover, adequate laboratory equipment is essential for effective science teaching and learning. It allows educators to fully engage students in hands-on experiments, enhancing understanding of scientific concepts. However, a significant challenge in Philippine public schools is the severe shortage of science laboratory equipment. This lack of resources hinders the teaching and learning process, as reported by The Manila Times and confirmed by the Department of Education (DepEd) as cited by Lourdes, et. al., 2021.

Furthermore, a study by Dela Cruz, M. et al. (2021) examined the effects of hands-on laboratory activities on the science learning of Grade 10 students in the Philippines. Their findings revealed that the activities had a beneficial impact on students' science performance. The researchers observed enhanced learning outcomes among students, suggesting that hands-on experiences improved their comprehension and engagement in science education. The study highlighted the significance of integrating practical, interactive components into science education to promote student learning in the Philippines.

Additionally, Santos, J., et al. (2019), examined the impact of inquiry-based science labs on students' teamwork and problem-solving abilities. The findings revealed that students who participated in the labs significantly improved in both areas. The benefits were observed across different student experience levels. However, the study also noted that more experienced learners might develop negative attitudes towards teamwork within this setting. Overall, the study supports the effectiveness of inquiry-based labs in enhancing students' collaborative and problem-solving abilities.

A study by Elesio J. (2023) examined the influence of various elements of the science laboratory environment on the attitudes of senior high school STEM students toward chemistry lessons. The science laboratory environment has been credited with fostering positive attitudes toward science and generating interest in the subject among students. Moreover, laboratory activities conducted in the science laboratory in an engaging and supportive manner have been shown to improve students' academic performance in science, potentially leading to more positive attitudes toward science, particularly chemistry.

Educators in the field believed that laboratories play a vital role in teaching practical aspects of science theories. The researchers highlighted that engaging in laboratory work enhances students' scientific literacy and boosts their motivation. However, studies point out that the lack of well-equipped science labs in schools poses challenges to effective teaching and hands-on activities.

Synthesis

The aim of the studies listed above was to demonstrate the importance of experiential learning in science education. Well-equipped laboratories are essential to facilitate this type of learning. Studies show that laboratory teaching improves student comprehension and achievement. Further, these literatures and studies revolve around enhancing student learning (improved student performance, enhanced scientific understanding), promoting experiential learning and practical skills (hands-on experiences, skill development), and creating a positive learning environment. It also highlights the importance of science laboratories in creating an environment that supports both academic and personal growth for all students. In this regard, schools can empower students to reach their full potential and become well-rounded individuals prepared for success in their future endeavors. In addition, laboratory activities foster critical thinking, problem-solving, and observational skills by allowing students to apply scientific principles in a practical setting.

Despite the recognized advantages of laboratory instruction, there are challenges to its effective utilization, such as inadequate facilities and limited resources. To overcome these challenges, schools need to invest in improving laboratory infrastructure and securing funding for laboratory equipment and materials.

High-quality school facilities, including well-equipped classrooms and modern science laboratories, are essential for elevating student achievement, particularly in science education. Research continues to show a positive correlation between the accessibility of such facilities and improved student performance. The design and quality of educational infrastructure have a profound influence on student development and learning. Additionally, well-maintained and flexible school environments enhance learning by providing secure and effective educational settings. They allow students and educators to bridge the gap between theoretical knowledge and practical application through hands-on experiences. The experiential learning that takes place in science laboratories equips students with practical skills, real-world knowledge, and the ability to apply theoretical concepts to real-life situations.

In today's educational landscape, the Next Generation Science Standards (NGSS) underscore the significance of hands-on science learning. Recognizing this opportunity, researchers have undertaken studies to enhance students' ability to engage in hands-on activities and experiments. Evidence suggests that hands-on science learning fosters experiential learning, cultivates problem-solving skills, and encourages critical thinking. Moreover, it deepens students' understanding of the scientific process and the cultural dimensions of science. In light of these findings, education should shift its focus from solely imparting knowledge to empowering students to think critically, solve problems creatively, and innovate. As Swami Vivekananda aptly stated, "Knowledge can be got in one way; the way of experience, there is no other way."

Theoretical Framework

Recent studies have focused on the impact of school facilities on students' academic performance. After reviewing these studies, the researchers identified theories that are instrumental in understanding the relationship between science laboratories and academic engagement.

In alignment with the K–12 curriculum's objectives and features, the science curriculum adopts a learner-centric and inquiry-based approach, providing students with essential competencies for both society and the workforce. It necessitates that students actively engage with materials to grasp scientific concepts and refine their scientific skills. This approach draws on the Theory of Constructivism, which emphasized hands-on learning, with teachers encouraging students to gain experiences and conduct experiments to facilitate independent discovery and knowledge acquisition rather than traditional lecturing and control of classroom activities.

Moreover, according to Main, P. (2023), John Dewey highlighted the idea of "Learning by Doing," giving practical learning a lot of weight. In his theory, Dewey asserts that knowledge is actively generated by the learner by experience rather than being passively absorbed. As a result, learning becomes a dynamic interaction between the knowledge object and the learner. This learning by doing theory, an experiential approach, is relevant to what the researcher seeks to evaluate, focusing on the evaluation of science laboratories on academic engagement. It emphasized the active participation of students in their learning process, leads to deeper understanding, increased motivation, and enhanced retention of knowledge. In addition, education researcher, Dr. Linda Darling-Hammond once said, "Active learning—that is, learning by doing—is not only more memorable, it also allows students to engage in the kind of collaboration and problem-solving they will encounter in the world of work." This aptly encapsulates the essence of Dewey's "Learning by Doing" philosophy.

Further, in the study of Kong, Y. (2021), Experiential Learning Theory (ELT), developed by Kolb in 1984, is a theory that focuses on learning through experience and evaluating learners in line with their previous experiences.

The findings from this study can provide valuable insights into how science laboratory experiences influence academic engagement. By understanding this relationship, educators and institutions can adapt and improve laboratory practices to enhance students' engagement.

Conceptual Framework

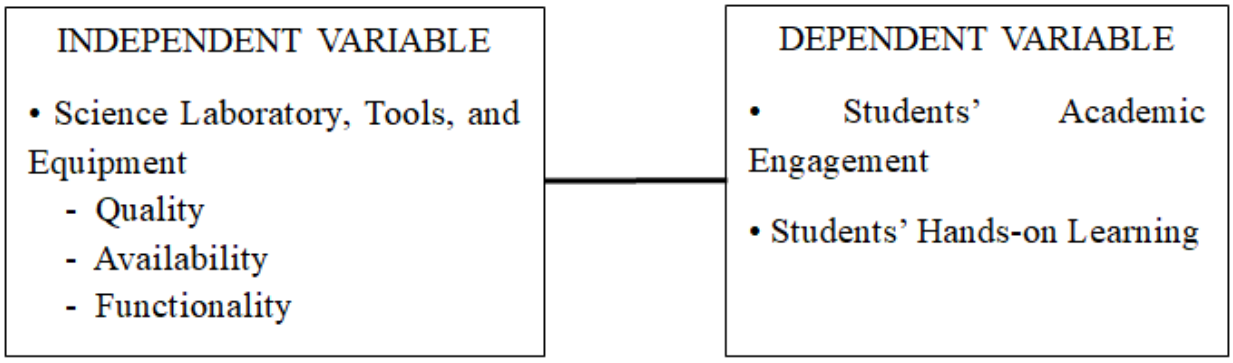

Figure 1. Research paradigm of the study.

The researchers used the IV-DV model in describing the conceptual framework. The Independent Variable and Dependent Variable Model used to show the relationship between the Science Laboratory and Academic Engagement in a research problem. This figure shows the research objective: to identify the laboratory equipment needed for the course program BSEd-Science; to determine the level of perception of BSEd-Science Instructors and Students with regards to science laboratories, tools, and equipment's quality, availability, and functionality; to determine the level of students' on hands-on learning and academic engagement; and to determine if there is a significant relationship between the level of perception of BSEd – Science Instructor and Students with science laboratory's quality, availability, and functionality, on academic engagement and hands – on learning.

The independent variable includes the science laboratories, tools, and equipment focused on assessing the quality, availability, and functionality.

The dependent variable includes students' academic engagement and students' hands-on learning.

Therefore, in this study, the science laboratory is the factor that affects students' academic engagement and hands-on learning.

METHODOLOGY

Research Design

In this study, the researchers utilized and employed the quantitative method to determine the importance of the study by testing a theory or hypothesis and either accepting or rejecting it based on findings. To collect and analyze numerical data for describing, predicting, or controlling variables of interest on (Sreekumar, 2024). The first part of the survey questionnaire used check boxes to identify the laboratory equipment needed for the BSEd-Science course program, while parts two and three with 10 questions each variable used Likert scale to assess the quality, availability, and functionality of science laboratory tools and equipment, as well as students' perceptions of academic engagement, particularly in hands-on learning.

Furthermore, this method was utilized to determine the level of perception among BSEd Science Instructors and Science Students regarding the quality, availability, and functionality of science laboratories, tools, and equipment. The study assessed students' hands-on learning and academic engagement with these resources. Separately, it aimed to investigate whether there is a significant relationship between the quality, availability, and functionality of science laboratories and students' academic engagement and hands-on learning.

Research locale

The study was conducted at Laguna Sports Complex, Brgy. Bubukal, Santa Cruz, Laguna, specifically at Laguna University, Ramil L. Hernandez building. The researchers chose this location as the study site and gather data from second- and fourth-year science students. The research took place in the first semester of the academic year 2023-2024.

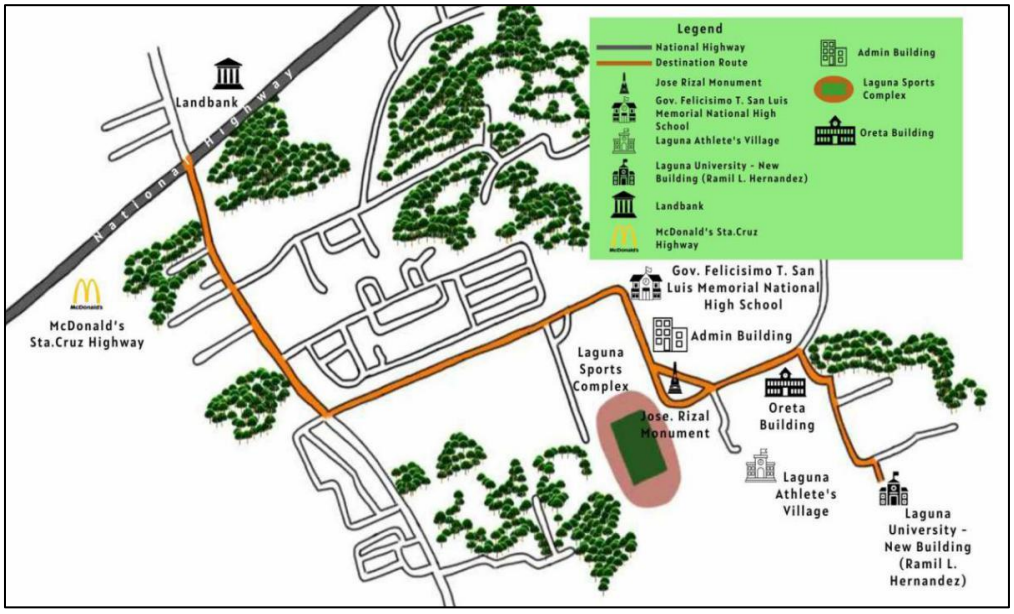

Figure 2. Location of Laguna University – New Building (Ramil L. Hernandez Building)

Figure 2 depicts the location of the study and the orange line represents the destination route, or the path to the respondents.

Population of the Study

In this study, the research participants were 46 college students from selected year levels of the program, Bachelor of Secondary Education Major in Science, namely, the second- and fourth-years of Laguna University-College of Education and the 2 BSEd Science Instructor. The purposive sampling technique was utilized by the

researchers to gather the needed information by virtue of the participants' knowledge and experience in science laboratories.

Research Instrument

The data for this study was gathered through a survey questionnaire. The questionnaire consisted of three parts. Part one focused on assessing the laboratory equipment needed for the courses of the program BSEd-Science, such as physics equipment, glassware, devices, and safety equipment. Parts two and three of the questionnaire used the Likert scale. The questions on this scale asked the respondents to assess the quality, availability, and functionality of the science laboratories, tools, and equipment, as well as the students' perceptions in terms of academic engagement and hands-on learning. Additionally, the researchers interpreted the weighted mean scores on the Likert scale to determine the level of BSEd Science Instructors and Science Students with regards to science laboratories, tools and equipment in terms of quality, availability and functionality, and the level of students' hands – on learning and academic engagement towards science laboratories, tools and equipment,

The questionnaire was specifically designed to gather information about the experiential learning acquired by the two selected blocks of Science Major students, namely, second- and fourth at Laguna University during their laboratory activities.

Before distributing the instrument, the questionnaire was validated by a research instrument validator or research expert with expertise in doing qualitative and quantitative research.

Data Gathering Procedure

The researchers made a letter that was sent to the Bachelor of Secondary Education Program Chair and Dean of the College of Education to request approval for conducting the study among second- and fourth-year BSED-Science students.

After the letter was approved, the researcher disseminated the questionnaire to the forty-six (46) Science students, and two (2) Science Instructors of Bachelor of Secondary Education Major in Science under the College of Education program. Questionnaire was consisted of three parts. Part one was a checklist that focused on assessing the laboratory equipment needed for the courses of the program BSEd-Science, such as physics equipment, glassware, devices, and safety equipment. Parts two and three of the questionnaire used the Likert scale, "1" was the lowest and "4" was the highest.

The data gathering was done with a span of 1 week. After that, the researchers consulted a statistician for the statistical/ data analysis and looked for a grammarian/editor for the checking of grammatical errors, spelling, and grammar count in the paper.

Statistical Treatment of Data

In this study, the purpose of the statistical analysis is to determine the relationship between the level of science laboratories, tools and equipment's quality, availability and functionality and students' academic engagement. Moreover, the researchers utilized the following statistical tools based on the research problems:

1. Frequency and Percentage

$$P = \frac{f}{n} \times 100$$

where:
P - Percentage
f - Frequency of the lab equipment perceived by the respondents
n - Number of Respondents

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Frequency was used to determine how frequent a certain response appeared in the collected data and percentage was used to illustrate the proportion of a whole sample, in this context, laboratory tools and equipment.

Mean

In order to measure the level of the quality, availability, and functionality of science laboratories, tools, and equipment, as perceived by the respondents, the researchers intended to use this tool to determine the average or mean level of the variables.

$$\bar{x} = \frac{\Sigma x}{n}$$

where:
x = mean
x = Science laboratory, tools, and equipment's quality, availability, and functionality
n = total number of x-variable

Standard Deviation

This was used to determine how far the answers of the participants are from the mean.

$$SD = \sqrt{\frac{\Sigma(x_i - x)^2}{n - 1}}$$

where:
SD = standard deviation
n = sample size
x_i = values of the x-variable in a sample
$\bar{x}$ = sample mean

Pearson Correlation

A tool that was used to determine if there is a correlation between the Science laboratories, tools, and equipment's quality, availability, and functionality and students' academic engagement.

$$r = \frac{\Sigma(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\Sigma(x_i - \bar{x})^2 \Sigma(y_i - \bar{y})^2}}$$

where:

r = correlation coefficient

x_i = values of the quality, availability and functionality of science laboratories, tools, and equipment

$\bar{x}$ = mean of the values of the x-variable

y_i = values of the hands-on learning and academic engagement

$\bar{y}$ = mean of the values of the y-variable

Moreover, to determine the level of BSEd Science Instructors and Science Students with regards to science laboratories, tools and equipment in terms of quality, availability and functionality, and the level of students'

hands – on learning and academic engagement towards science laboratories, tools and equipment, the following scale and interpretation was used:

Table A. Interpretation of Weighted Mean Scores on the Likert Scale

Point of Scale	Range of Weighted Mean	Descriptive rating	Remarks
4	3.50-4.00	Always	Very High
3	2.50-3.49	Often	High
2	1.50-2.49	Sometimes	Low
1	1.00-1.49	Never	Very low

RESULT AND DISCUSSION

This chapter presents, analyzes, and interprets the data gathered that determined the significant relationship between the Level of Science Laboratory's Quality, Availability and Functionality and Students' Academic Engagement.

Table 1 Distribution of Laboratory Equipment Needed for the Course Program of the BSEd – Science Students as *Perceived by the Students and Instructors*

Type	Laboratory Equipment Needed	Students	Science Instructors	Total	Percentage (%)
Physics Equipment	Magnet	38	1	39	81.25%
	Balance Scale	31	2	33	68.75%
	Spring Scale	19	1	20	41.6%
	Convex Lens	24	1	25	52.08%
	Meter Stick	31	2	33	68.75%
	Thermometer	39	2	41	85.42%
	Battery Eliminator	14	1	15	31.25%
	Stopwatch	30	2	32	66.6%
	Power Supply	31	2	33	68.75%
	Vernier Caliper	12	2	14	29.16%
	Others	0	0	0	0.00%
Glassware	Beakers	45	2	47	97.92%
	Test Tube	41	2	43	89.58%
	Micropipette	28	2	30	62.5%
	Burette	26	2	28	58.3%
	Petri Dish	32	2	34	70.83%
	Funnel	35	2	37	77.08%
	Graduated Cylinder	40	2	42	87.5%
	Desiccator	17	2	19	39.58%
	Volumetric Flask	30	2	32	66.6%
	Erlenmeyer Flask	23	2	25	52.08%
Devices	Microscope	41	2	43	89.58%
	Centrifuge	24	2	26	54.16%
	Hot Plate	24	2	26	54.16%
	Multimeter	41	2	43	89.58%
	Autoclave	24	2	26	54.16%
	Chromatography Apparatus	23	2	25	52.08%
	Incubator	20	2	22	45.83%
	Magnetic Stirrer	15	2	17	35.42%
	Spectrophotometer	24	2	26	54.16%
Safety Equipment	Safety Goggles	43	2	45	93.75%
	Lab Gown/Coat	43	2	45	93.75%
	Nitrile Glove	34	2	36	75%
	Fume Hood	25	2	27	56.25%
	First Aid Kit	40	2	42	87.5%
	Eye Wash	30	2	32	66.6%
	Biosafety Cabinet	36	2	38	76.16%
	Fire Extinguisher	37	2	39	81.25%
	Chemical Split Kit	32	2	34	70.83%
	Emergency Shower	28	2	30	62.5%

Table 1 revealed the Distribution of Laboratory Equipment Needed for the Course Program of the BSEd–Science as perceived by the Students and Science Instructors. The table shows that students placed the highest relative importance on magnets with 38 or 82.61% and thermometers with 39 or 84.78% in terms of Physics Equipment. In the study of Guo, J. (2024), magnets had help scientists understand the magnetic properties of atoms and electrons. Through the analysis of magnetic materials, scientists have revealed phenomena such as electron spin and quantum entanglement, which are key concepts in quantum mechanics. On the other hand, unlike the medical or clinical thermometer which is used solely to measure human body temperature, a laboratory thermometer has different uses. A laboratory thermometer is used to measure the boiling point and freezing point during science experiments. It is also used to measure the temperature of substances (Equip, S., 2021).

However, in terms of Glassware items such as beakers, test tubes, burettes, graduated cylinders, and volumetric flasks are considered essential, and there's a high level of agreement among Students and Science Instructors. Beakers are a common type of laboratory glassware used for preparing and holding solutions and other samples. Beakers are used in most chemical, biological, clinical and industrial laboratories and other industrial situations where testing is carried out as provide a convenient easily used container to store and mix liquid while test tubes are used for chemicals, heating/cooling samples, and storing samples. This versatility makes the test tubes essential for conducting a wide range of experiments and studies. Additionally, test tubes provide a safe environment for potentially hazardous chemical reactions and are crucial for preserving samples in research settings (Heney, P., 2024; Campwala, M., 2023). Burettes are essential laboratory tools for precise liquid measurement and dispensing. They are particularly useful in titrations, where they help determine the concentration of unknown solutions. Burettes are versatile and can be used in various chemical reactions, including acid-base and redox reactions. Due to their accuracy and versatility, burettes are indispensable in quantitative chemical analysis and are widely used in both research and educational settings (Microlit, 2024).

Additionally, to must-have tools, volumetric flask that is used for conducting chemical analysis, producing standard solutions, and performing titration and cylinders that are used to calculate displacement, which is a measurement of the change in the volume of water when additional materials are added to it (ChemScience; Campwala, M., 2022)

On the other hand, there is some variation on how important different groups perceive certain equipment to be in terms of Devices. All of the devices are considered essential by 100% of Science Instructors, but only 41 or 89.13% of the students placed highest relative importance on microscope and multimeter, and lowest relative importance on magnetic stirrer with 15 or 32.61%. As mentioned by Campaign, S., (2022), microscopes are important for student engagement as they provide an alternative to book learning, rote memorization, and other passive forms of learning. Instead, they provide hands-on, experiential learning that ignites a sense of wonder and builds natural curiosity. In contrast, multimeter is one of the most common tools used by technicians, students, and engineers across the globe as it is used to measure multiple parameters of an electric circuit like voltage, current, and resistance. And familiarizing the components of a multimeter and how to set it for various measurements has become inevitable while dealing with an electrical circuit (Joy, A. T., 2024)

Further, students place the highest relative importance on safety goggles and lab gown with 43 or 93.48%, and they place less emphasis on eye wash with 30 or 65.22% and emergency shower with 28 or 60.87%. To minimize serious injury, students should wear proper PPE, such as lab coats, gloves, safety goggles, face masks, and hearing protection, depending on the sort of experiment being undertaken (Discovery, R., 2024). These essential attires serve as a protective barrier against potential hazards and offer numerous benefits that contribute to a safe and efficient laboratory experience (Westlab., 2023).

Based on the study of Reza, M., Hasnidar, S., & Hanum, L. (2023), science laboratories are essential for successful chemistry, physics, and biology education in schools. Students and teachers need access to facilities and equipment to test theories and learn about the relationship between theory and practice through hands-on activities. Research assistants and work managers also plays an important role in supporting experiential learning in science laboratories. This means that by emphasizing the combined importance of facilities, and equipment, it underlines the holistic nature of effective science lab education. It suggests that investing in well-equipped labs, qualified instructors, and supportive personnel is essential for providing students with valuable learning experiences that complement theoretical knowledge with practical application.

Table 2 Level of the Quality of the Science Laboratories, Tools, and Equipment as Perceived by the Students and Science Instructors

Statements	Students			Science Instructors		
	Mean	SD	Remarks	Mean	SD	Remarks
The science laboratory facilities are spacious and well-designed	2.52	0.913	Often	1.50	0.707	Sometimes
The science laboratory facilities are well-lit and ventilated.	2.20	0.910	Sometimes	1.50	0.707	Sometimes
The science laboratories are well-equipped and maintained.	2.20	0.910	Sometimes	1.50	0.707	Sometimes
The science laboratories are safe and conducive to learning.	2.48	0.913	Sometimes	2.00	0.00	Often
The science laboratories are well-stocked with supplies and materials	2.02	0.906	Sometimes	1.50	0.707	Sometimes
The science laboratories are clean and organized.	2.52	0.888	Often	1.00	0.000	Sometimes
The science laboratories have adequate space for students to work and collaborate.	2.57	0.958	Often	1.50	0.707	Sometimes
The science laboratories support experiential learning of the students.	2.50	0.937	Often	1.00	0.000	Never
The science laboratories are used regularly for hands – on activities and experiments.	2.48	1.049	Sometimes	1.50	0.707	Sometimes
The science laboratories are equipped with technology to support student learning in Physics, Chemistry, and Biology course.	2.11	0.994	Sometimes	1.50	0.707	Sometimes
Weighted Mean	**2.36**			**1.45**		
SD	**0.938**			**0.495**		
Verbal Interpretation	**Low**			**Very Low**		

Table 2 presented the Level of the Quality of the Science Laboratories, Tools, and Equipment as perceived by the Students and Science Instructors. Data revealed that for the Science students, the statement "The science laboratories have adequate space for students to work and collaborate." obtained the highest mean of 2.57 and standard deviation of 0.958 with a remark of often. This means the students agreed that the laboratories have adequate space. While for the Science Instructors, the science laboratory facilities are sometimes safe and conducive to learning (M=2.00)

The level of the Quality of the Science Laboratories, Tools, and Equipment as perceived by the students obtained a verbal interpretation of low (M=2.36, SD=0.938). On the other hand, as perceived by the Science Instructors, the level of the Quality of the Science Laboratories, Tools, and Equipment obtained a verbal interpretation of very low (M=1.45, SD=0.495). There is a noticeable difference in perceptions among students and instructors. Students perceived the quality as low, while the instructors perceived it as very low.

Equip, S. (2019) emphasized the importance of fully equipped science labs for effective teaching. Hands-on learning through physical experimentation is crucial for understanding complex scientific concepts. Theoretical knowledge should be complemented with practical experience in labs to grasp how actions lead to reactions. Therefore, schools should invest in the best possible laboratory equipment.

Moreover, the accuracy of laboratory measurements and analysis results is influenced by the caliber of the equipment used in the lab. Quality is defined as the collection of a product's attributes that establish its fitness to fulfil the intended use and satisfy anticipated customer demands (Aljamali & Shallal, 2021).

Table 2.1 Level of the Availability of the Science Laboratories, Tools, and Equipment as Perceived by the Students and Science Instructors

Statements	Students			Science Instructors		
	Mean	SD	Remarks	Mean	SD	Remarks
The resources of science laboratory resources are sufficient for the number of students using them.	1.98	0.906	Sometimes	1.50	0.707	Sometimes
The science laboratory resources are well-maintained and in good condition.	2.26	0.929	Sometimes	1.50	0.707	Sometimes
The science laboratory resources are arranged in a way that promotes safety and efficiency.	2.39	0.954	Sometimes	1.50	0707	Sometimes
The science laboratory is adequately stocked with glassware and equipment.	2.07	0.975	Sometimes	1.50	0.707	Sometimes
The science laboratory first aid kits and emergency equipment are accessible.	2.07	0.952	Sometimes	1.50	0.707	Sometimes
The science laboratory equipment is up-to-date and functional.	2.15	0.988	Sometimes	1.50	0.707	Sometimes
The science laboratory has sufficient electrical outlets, enough sinks and faucets for experiments.	2.22	0.964	Sometimes	2.00	1.141	Sometimes
The science laboratory has enough microscopes, specimen and samples for practical classes.	1.85	0.988	Sometimes	2.00	1.141	Sometimes
The science laboratory has sufficient chemicals and reagents available.	1.87	0.957	Sometimes	2.00	1.141	Sometimes
The availability of resources in the science laboratory supports students' learning.	2.22	0.964	Sometimes	2.00	1.141	Sometimes
Weighted Mean	**2.11**			**1.70**		
SD	**0.598**			**0.990**		
Verbal Interpretation	**Low**			**Low**		

Table 2.1 displays the results of the level of the Availability of the Science Laboratories, Tools, and Equipment as perceived by the Students, Science Instructors. It shows that for the students the statement "The science laboratory resources are arranged in a way that promotes safety and efficiency." attained the highest mean of 2.39 and standard deviation of 0.954 with a remark of sometimes while the statement "The science laboratory has enough microscopes, specimens and samples for practical classes." attained the lowest mean of 1.85 and standard deviation of 0.9888 which can be interpreted as sometimes.

As perceived by the Science Instructors, they believed that sometimes the science laboratory resources are sufficient for the number of students using them (M=1.50, SD=0.707), well-maintained and in good condition (M=1.50, SD=0.707), arranged in a way that promotes safety and efficiency (M=1.50, SD=0.707), adequately stocked with glassware and equipment (M=1.50, SD=0.707), science laboratory first aid kits and emergency equipment are accessible (M=1.50, SD=0.707), up-to-date and functional (M=1.50, SD=0.707), have sufficient electrical outlets, enough sinks and faucets for experiments (M=2.00, SD=1.141), have enough microscopes, specimens and samples for practical classes (M=2.00, SD=1.141), have sufficient chemicals and reagents available (M=2.00, SD=1.141) and the availability of resources in the science laboratory supports students' learning (M=2.00, SD=1.141).

The table illustrates how Students, and Science Instructors assessed the availability of science laboratories, tools, and equipment. Their respective means are 2.11 and 1.70. This suggests that science instructors and students perceived the availability of science laboratories, tools, and equipment as low, with science instructors having a slightly more negative perception.

As stated in the study of Restiana, & Djukri (2021), laboratory equipment and materials are used concurrently to test the truth and achieve specific goals. The use of equipment and chemicals can improve hand skills, operational abilities, answer questions raised by observations, and convert abstract perceptions into concrete perceptions in order to comprehend a theory. The proper use of laboratory equipment and supplies is critical to the effectiveness of laboratory activities. However, many schools continue to operate with inadequate science equipment, improperly set up labs, and other essential instructional materials (Shahzadi, I. et al., 2023).

Divergent perspectives could suggest that open dialogue and cooperation between stakeholders are necessary to identify particular issues and potential areas of development.

Similarly, research by Abbey-Kalio (2024) in Rivers State, Nigeria, examined the relationship between laboratory resource factors—availability, accessibility, and utilization—and chemistry students' academic performance. The study found significant correlations between these factors and student achievement, with accessibility emerging as the strongest predictor of performance outcomes. The findings indicate that students with greater access to laboratory resources demonstrated better practical skills and higher test scores. This highlights the crucial role of hands-on learning opportunities in reinforcing theoretical knowledge. The author recommends that governments and stakeholders invest in improving educational infrastructure and training teachers to enhance practical exercises in chemistry education.

In conclusion, the interpretation points to a difference in perspectives and emphasizes the significance of a thorough and cooperative approach to resolve any problems pertaining to the accessibility of science labs, instruments, and supplies.

Table 2.2 Level of the Functionality of the Science Laboratories, Tools, and Equipment as Perceived by the Students and Science Instructors

Statements	**Students**			**Science Instructors**		
	Mean	**SD**	**Remarks**	**Mean**	**SD**	**Remarks**
The science laboratory has sufficient variety of tools and equipment for conducting the required experiments.	2.09	0.962	Sometimes	1.50	0.707	Sometimes
The tools and equipment are reliable and in good working condition.	2.17	0.950	Sometimes	1.50	0.707	Sometimes
The tools and equipment are up-to-date and reflect current technological advancements in the field.	1.93	0.868	Sometimes	1.50	0.707	Sometimes
The tools and equipment are adequately maintained and calibrated to ensure accurate results.	2.07	0.952	Sometimes	1.50	0.707	Sometimes
Microscopes are in good condition and provide clear and magnified images.	1.89	0.994	Sometimes	1.50	0.707	Sometimes
Bunsen burners are readily available and function safely and efficiently.	1.87	0.957	Sometimes	1.50	0.707	Sometimes
Balances are accurate and easy to use for measuring mass.	2.04	1.032	Sometimes	1.50	0.707	Sometimes
Graduated cylinders and beakers are available in various sizes and accurate for measuring volume.	2.30	1.072	Sometimes	1.50	0.707	Sometimes
Test tube and racks are readily available and in good condition.	2.24	1.139	Sometimes	1.50	0.707	Sometimes
Forceps, tweezers, and spatulas are available	2.02	1.022	Sometimes	1.50	0.707	Sometimes

and in good condition.						
Weighted Mean	**2.07**			**1.50**		
SD	**0.995**			**0.707**		
Verbal Interpretation	**Low**			**Low**		

Table 2.2 displays the findings of the Level of the Functionality of the Science Laboratories, Tools, and Equipment as perceived by the Students and Science Instructor. As perceived by the Science Students and Science Instructors, the science laboratory sometimes has sufficient variety of tools and equipment for conducting the required experiments, the tools and equipment are reliable and in good working condition, up-to-date and reflect current technological advancements in the field, adequately maintained and calibrated to ensure accurate results, microscopes are in good working condition and provide clear magnified images, Bunsen burners are readily available and function safely and efficiently, balances are accurate and easy to use for measuring mass, graduated cylinders and beakers are available in various sizes and accurate for measuring volume, test tubes and racks are readily available and in good condition, forceps, tweezers, and spatulas are available and in good condition. The means for these statements for the students was 2.09, 2.17, 1.96, 2.07, 1.89, 1.87, 2.04, 2.30, 2.24, and 2.02 respectively, and 1.50 for Science Instructors.

The results revealed that the weighted means of the functionality of the Science Laboratories, Tools, and Equipment as perceived by the Science Students and Science Instructors was 2.11 and 1.70 with a low remark of the level of functionality of the Science Laboratories, Tools, and Equipment. This means that there is a consistent perception of low functionality among both Science Students and Instructors.

In conclusion, the weighted averages and remarks show that Science Instructors and students generally perceive low functionality. In order to address this discrepancy, it could be necessary to work together to improve and optimize the functionality in accordance with the needs and expectations of all parties involved. As posted by USA Lab Equipment (2021), the functionality of laboratory tools and equipment is a critical aspect of scientific education and research. It encompasses the effectiveness, reliability, and overall performance of the tools and equipment used in laboratory settings. Continuous assessment, regular maintenance, and a commitment to adopting best practices contribute to the overall functionality of laboratory tools and equipment. This ensures that scientific research and experimentation are conducted with precision, accuracy, and safety.

Table 3 Level of the Students' Hands – on Learning towards Science Laboratories, Tools and Equipment

Statements	**Students**		
	Mean	**SD**	**Remarks**
I enjoy using glassware (beakers, flasks, test tubes, etc.) and devices (microscopes, centrifuge, hot plate, etc.) in the laboratory.	2.63	1.019	Often
I feel confident in my ability to use microscopes to prepare slides, view specimens, and identify features at different magnifications.	2.39	0.930	Sometimes
I am able to safely and effectively use a variety of equipment and other scientific instrument to perform experiments in the laboratory.	2.43	0.834	Sometimes
I am able to perform laboratory procedures that require hands -on skills.	2.76	0.93	Often
I am able to use appropriate tools and techniques to handle equipment and samples without damaging them.	2.87	0.944	Often

I am motivated to learn how to handle new types of equipment and samples.	2.93	0.952	Often
I am able to use laboratory equipment precisely.	2.69	0.949	Often
I feel that I am learning more in the laboratory because I am able to perform laboratory procedures precisely.	2.87	1.024	Often
I feel confident in my ability to accurately follow laboratory procedures.	2.98	1.00	Often
I enjoy performing laboratory procedures with precision.	2.96	1.074	Often
Weighted Mean	**2.75**		
SD	**0.972**		
Verbal Interpretation	**High**		

Table 3 uncovers the findings of the level of Students' Hands-on Learning towards Science Laboratories, Tools and Equipment. The level of students' hands-on learning in science laboratories, with respect to tools and equipment, is a crucial aspect of science education. Hands-on learning provides students with practical experience, fostering a deeper understanding of scientific concepts and enhancing their skills. The data revealed that it attained the overall weighted mean of 2.75 and a standard deviation of 0.972 with a verbal interpretation of high. The data indicates a generally high level of students' hands-on learning in science laboratories, with recognition of some variability in individual experiences.

As stated by USA Lab Equipment (2021), with the use of science lab equipment, students may do experiments instead of merely reading about them. Rather than slogging through boring notes, they can watch and finish fascinating experiments. It is frequently simpler to understand difficult theories and concepts when learning is done hands-on. Students may thus become more interested in the material they are learning and grow to have a greater respect for the sciences.

The Science Students also believed that they sometimes feel confident in my ability to use microscopes to prepare slides, view specimens, and identify features at different magnifications (M=2.39, SD=0.930), able to safely and effectively use a variety of equipment and other scientific instrument to perform experiments in the laboratory (M=2.43, SD=0.834). in addition to that, the data revealed that the Science Students they often enjoy using glassware (beakers, flasks, test tubes, etc.) and devices (microscopes, centrifuge, hot plate, etc.) in the laboratory (M=2.63, SD=1.019), able to perform laboratory procedures that require hands – on skills (M=2.76, SD=0.993), able to use appropriate tools and techniques to handle equipment and samples without damaging them (M=2.87, SD=0.944), feel motivated to learn how to handle new types of equipment and samples (M=2.93, SD=0.952), able to use laboratory equipment precisely (M=2.69, SD=0.949), feel that they are learning more in the laboratory because they are able to perform laboratory procedures precisely (M=2.87, SD=1.024), feel confident in my ability to accurately follow laboratory procedures (M=2.98, SD=1.000) and enjoy performing laboratory procedures with, students have positive perceptions of their hands – on learning experiences in the laboratory, including enjoyment, confidence, motivation, and perceived skill levels. The variability in responses indicated by standard precision (M=2.96, SD=1.074).

The data suggests that, on average deviations suggests that individual experiences and perceptions vary among students.

However, as stated in the study of Ivory (2024), hands-on learning goes beyond mere experimentation and fun. It is a proven method to enhance student engagement and comprehension of scientific concepts. Hands-on learning environments that are more inclusive and productive can be achieved by attending to the different needs and experiences of students. Laboratories provide students with various opportunities to learn and experiment, which plays a crucial role in the ongoing intellectual development of students at any academic level. Science labs give students the time, space, and resources to explore and experiment (Cross, 2022).

Additionally, Kırılmazkaya & Dal (2022) found that hands-on science activities using simple tools significantly improved students' academic achievement and fostered more positive attitudes toward science. Their quasi-experimental study with 40 secondary school students in Turkey revealed that practical experiences were more effective than traditional methods in enhancing both understanding and interest in science.

Table 4 Level of the Students' Academic Engagement towards Science Laboratories, Tools and Equipment

Statements	**Students**		
	Mean	**SD**	**Remarks**
I find science more engaging when we have hands – on activities.	3.37	0.928	Often
I find that hands – on activities in science class makes It easier for me to grasp scientific concepts.	3.35	0.900	Often
I am actively involved in discussions during science laboratory activities.	3.02	1.000	Often
I work collaboratively with my peers in science laboratories	3.30	0.891	Often
I enjoy working with others to solve problems during science laboratory activities.	3.17	0.950	Often
I feel encouraged to ask questions and explore different ideas during science laboratory activities.	3.09	0.939	Often
I am able to make connections between science concepts learned in the classroom and my experiences in the laboratory.	3.11	0.971	Often
I am able to apply the knowledge skills learned in science laboratories to another subject.	3.13	0.919	Often
I develop deeper understanding the world around me through the help of science laboratory activities.	3.20	0.934	Often
I believe that the knowledge and skills acquired through science laboratory activities will be useful in my future career.	3.28	0.886	
Weighted Mean	**3.20**		
SD	**0.932**		
Verbal Interpretation	**High**		

The table above unveils the results of the Level of Students' Academic Engagement towards Science Laboratories, Tools and Equipment. Academic engagement refers to the extent to which students actively participate, invest effort, and show interest in their academic activities. It shows that the statement "I believe that the knowledge and skills acquired through science laboratory activities will be useful in my future career." obtained a highest mean of 3.28 and a standard deviation of 0.886 with a remark of often. The data indicates a generally positive outlook among students regarding the practical utility of knowledge and skills gained through science laboratory activities. The mean score suggests that, on average, students lean towards agreement with the statement, indicating a belief in the future applicability of laboratory-acquired knowledge and skills. The Science Students believed that they often actively involved in discussions during science laboratory activities attaining a lowest mean of 3.02 and standard deviation of 1.000. In conclusion, the data indicates a moderate level of active involvement in discussions during science laboratory activities among students. Addressing the factors contributing to variability in engagement levels can contribute to fostering a more participatory and interactive learning environment in the laboratory setting.

The level of Students' Academic Engagement towards Science Laboratories, Tools and Equipment was high with an overall weighted mean of 3.20 and standard deviation of 0.932. The data suggests that, on average, students are highly academically engaged in science laboratories, indicating active participation, interest, and involvement in laboratory activities. Laboratory learning is an essential component of science education that has enormous potential to increase student engagement and learning (Hofstein & Lunetta, 2004 as quoted by Kilag, O.K., Tamayo, J.M., Eleno, J., Jalin, A. 2023). Students can actively investigate scientific ideas, hone their critical thinking abilities, and apply their theoretical knowledge to real-world scenarios in laboratories, which offer a distinctive setting. It underscores the value of laboratory learning in science education, highlighting its potential to engage students, foster critical thinking, and provide a practical context for the application of theoretical knowledge. The acknowledgment of laboratory learning as a unique and enriching environment aligns with established principles in science education.

Table 5 Significant Relationship Between the Level of Science Laboratory's Quality, Availability, and Functionality on Students' Hands – on Learning and Academic Engagement

Laboratory Equipment	**Hands – on Learning**				
	r – value	**Correlation Interpretation**	**p – value**	**t – value**	**Analysis**
Quality	0.727	High Positive Correlation	<0.001	-4.289	Significant
Availability	0.71	High Positive Correlation	<0.001	-6.662	Significant
Functionality	0.751	High Positive Correlation	<0.001	-7.541	Significant
Laboratory Equipment	**Academic Engagement**				
	r - value	**Correlation Interpretation**	**p – value**	**t – value**	**Analysis**
Quality	0.515	Moderate Positive Correlation	<0.001	-6.960	Significant
Availability	0.553	Moderate Positive Correlation	<0.001	-9.129	Significant
Functionality	0.541	Moderate Positive Correlation	<0.001	-9.219	Significant

Table 5 displays the findings of significant relationship between the Level of Science Laboratory's Quality, Availability and Functionality and Students' Hands-on Learning. Pearson r was used to test the formulated hypothesis. Data revealed that quality ($r=0.727$, $p<0.001$, $t=-4.289$), availability ($r=0.71$, $p<0.001$, $t=-6.662$) and functionality ($r=0.751$ $p<0.001$, $t=-7.541$) have a high positive correlation with the students' hands-on learning. This denotes that as the quality increases, hands-on learning tends to increase as well. Higher availability is associated with higher engagement in hands-on learning activities. Higher functionality is strongly associated with higher engagement in hands-on learning activities.

It revealed that the p-values of Laboratory Equipment's quality, availability and functionality are less than the significance level of 0.05 indicating that the null hypothesis was rejected. Therefore, there is a significant relationship between the Level of Science Laboratory's Quality, Availability and Functionality and Students' Hands-on learning. It can be inferred that as the quality, availability, and functionality of the science laboratory increase, students' hands-on learning experiences are likely to improve as well. This emphasizes the importance of well-equipped, accessible, and functional science laboratories in promoting effective hands-on learning among students.

According to Arnejo et al. (2021), STEM students' interest in science can be piqued and expanded through practical science instruction in lab settings. Simply by giving students a hands-on experience with their experiments and activities, using science laboratories to teach science—especially physics, chemistry, and biology, which demand for laboratory apparatuses—can expand their ideas. Additionally, functional laboratories

can assist students in developing a broader interest in science and in selecting courses linked to medicine or science.

On the other hand, the table also shows the result of significant relationship between the Level of Science Laboratory's Quality, Availability and Functionality and Students' Academic Engagement. To test the formulated hypothesis, Pearson r was used. The results revealed that quality ($r=0.515$, $p<0.001$ $t=-6.960$), availability ($r=0.553$, $p<0.001$, $t=9.129$) and functionality ($r=0.541$ $p<0.001$, $t=-9.219$) have a moderate positive correlation with the students' academic engagement. The positive correlations indicate that there is a tendency for higher-quality, more available, and functional science laboratories, tools and equipment to be associated with increased levels of students' academic engagement. The strength of the correlations, being moderate, suggests that these factors are related but that other variables may also contribute to students' academic engagement.

It revealed that the p-values of Laboratory Equipment's quality, availability and functionality are less than the significance level of 0.05. This means that the null hypothesis was rejected implying that there is a significant relationship between the Level of Science Laboratory's Quality, Availability and Functionality and Students' Academic Engagement.

The findings indicate that the quality, availability, and functionality of science laboratories are important factors that can influence and contribute to students being more academically engaged. This has implications for educators, administrators, and policymakers looking to enhance the overall learning experience for students in science education. Improvements in these aspects of science laboratories may positively impact student engagement and, subsequently, their learning outcomes.

A study by Nicol, C. B., et. al., (2022) provides empirical evidence supporting Freedman's (1997) claim that hands-on experiences positively influence students' attitudes towards science and academic achievement. High-quality laboratory equipment enhances hands-on engagement, fostering positive attitudes and contributing to improved performance. This stage, where students actively engage in practical applications of scientific principles and hands-on experiments within the laboratory setting, is fundamental to their education.

As Delfino (2019) states, the degree of involvement, experience quality, and equipment interaction can significantly impact academic engagement. Moreover, a study by Cinkir et al (2022) provides empirical evidence supporting Delfino's (2019) claim that the degree of involvement, experience quality, and equipment interaction significantly impact academic engagement in science laboratories. Their findings indicate that students' perceptions of service quality, including access to well-equipped laboratories, directly influence their commitment and academic performance. Similarly, a study on Undergraduate Science Labs (2019) highlights the importance of student-equipment interaction, emphasizing that meaningful engagement with laboratory tools enhances learning outcomes.

Furthermore, Lazaro & Paglinawan (2025) investigated the correlation between the availability of laboratory resources and the engagement levels of Grade 12 STEM students at Dologon National High School. Utilizing a structured survey administered to 66 students, the research found a moderately strong correlation ($r = 0.49$) between resource availability and student engagement. The findings suggest that increased access to laboratory resources positively influences student involvement in science activities, highlighting the importance of well-equipped laboratories in fostering student participation and interest in STEM education.

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

Summary

This study aimed to evaluate the significant influence of science laboratories on students' academic engagement. Specifically, to determine the significant relationship between the level of quality, availability, and functionality of science laboratories, tools, and equipment and students' hands-on learning and academic engagement.

The study also utilized a quantitative approach, where quantitative methods are employed to collect and analyze the data from the survey questionnaires. Based on the gathered data and analyses that were conducted, the

following findings are presented: the results of the lab equipment needed for the course program BSEd Science are a magnet, balance scale, spring scale, convex lens, meter stick, thermometer, battery eliminator, stop watch, power supply, vernier caliper, and many more.

The study also found that most students rarely used this equipment in the lab.

However, the school laboratory coordinator perceived the level of quality, availability, and functionality of the science laboratories, tools, and equipment as high, while for students and science teachers, the verbal interpretation is either low or very low.

On the other hand, the data revealed on students' perceptions in terms of academic engagement and hands-on learning was obtained with a verbal interpretation of high. The data also indicates a generally high level of students' hands-on learning in science laboratories, with some recognition of variability in individual experiences.

Moreover, the level of students' academic engagement with science laboratories, tools, and equipment was interpreted as high. The data suggests that, on average, students are highly academically engaged in science laboratories, indicating active participation, interest, and involvement in laboratory activities.

The results reveal that there is a significant relationship between the level of science laboratories' quality, availability, and functionality and students' hands-on learning and academic engagement. It can be inferred that as the quality, availability, and functionality of the science laboratory increase, students' hands-on learning experiences are likely to improve as well. This emphasizes the importance of well-equipped, accessible, and functional science laboratories in promoting effective hands-on learning among students.

In addition to that, the findings indicate that the quality, availability, and functionality of science laboratories are important factors that can influence and contribute to students being more academically engaged.

Conclusion

The following conclusions are drawn based on the study's various findings in order to address the problem's stated requirements.

The hypothesis was rejected, implying that there is a significant correlation between the level of science laboratory, tools, and equipment's quality, availability, and functionality and students' hands-on learning. This implies that when schools have fully equipped science laboratories, students performed well and received quality science education in terms of hands-on learning.

It also revealed that hypothesis was rejected indicating that there is a significant correlation between the level of science laboratory, tools, and equipment's quality, availability, and functionality and students' academic engagement. The result infers that the students were engaged academically if schools' science laboratories are quality and fully equipped.

Recommendations

Based on the findings and conclusions drawn, the following were recommended to improve the quality, availability, and functionality of science laboratories, tools, and equipment, ultimately leading to enhanced academic engagement in science education:

1. Schools should enhance science laboratories with diverse equipment, modern tools, and optimized facilities for safe and engaging scientific exploration. This includes reliable tools, improved ventilation and lighting, secure storage, and detailed laboratory manuals. Technology like simulations and data visualization tools should be utilized to engage students and develop digital skills. These enhancements empower students to take ownership of their scientific journey.

2. School administrators should adopt a data-driven and sustainable approach to evaluating and funding science laboratories. Regular assessments should measure student engagement and laboratory effectiveness, guide resource allocation, and prioritize upgrades. Also, dedicated budgets for maintenance, equipment upgrades, and teacher professional development should be advocated, highlighting the positive impact on student learning.

3. Future researchers can explore this issue by conducting studies with a larger and more diverse sample size. This would enable them to examine the relationship between science laboratory quality, the availability and functionality of tools and equipment, and students' academic engagement. Such research could offer valuable insights into the significance of well-equipped and functional science labs in promoting effective experiential learning for students.

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