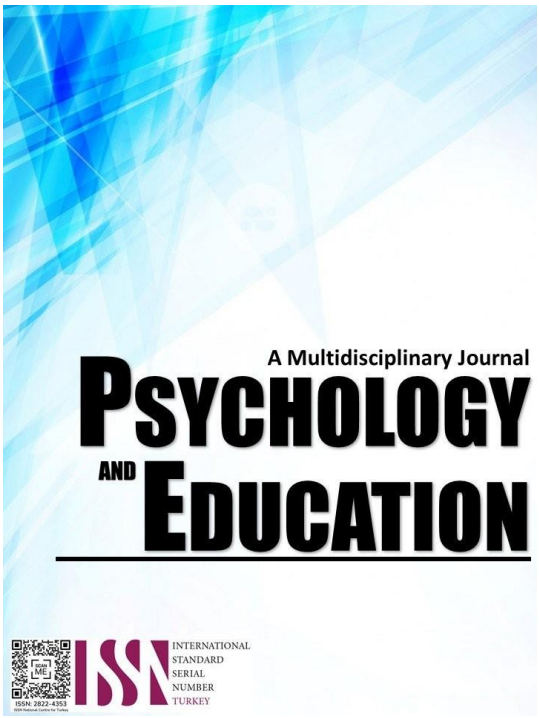
EVALUATION OF LABORATORY SERVICES: ENVIRONMENT, EQUIPMENT, AND ENGAGEMENT IN SCIENCE, TLE, AND COMPUTER LABORATORIES OF SAINT MARY'S UNIVERSITY JUNIOR HIGH SCHOOL



PSYCHOLOGY AND EDUCATION: A MULTIDISCIPLINARY JOURNAL

Volume: 40
Issue 10
Pages: 1303-1315
Document ID: 2025PEMJ3931
DOI: 10.70838/pemj.401005
Manuscript Accepted: 05-19-2025

Psych Educ, 2025, **40**(10): 1303-1315, Document ID:2025PEMJ3931, doi:10.70838/pemj.401005, ISSN 2822-4353

Research Article

Evaluation of Laboratory Services: Environment, Equipment, and Engagement in Science, TLE, and Computer Laboratories of Saint Mary's University Junior High School

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Abstract

This exploratory study evaluated laboratory services in Science, TLE, and Computer laboratories at Saint Mary's University Junior High School for the 2024-2025 school year. Employing quantitative (teacher observations and student surveys) and qualitative methods, the research compares perceptions and observations of laboratory environment and safety, equipment and resource management, and instruction and student engagement. The study, involving eight teachers and 261 students, utilized descriptive statistics, t-tests, and thematic analysis, guided by Activity Theory. Findings indicated generally positive student perceptions but significant teacher-student discrepancies, especially in the TLE laboratory regarding environment and equipment. Cleanliness and organization were concerned across all labs, along with outdated equipment and safety issues. The Computer Laboratory was evaluated most positively. These results indicate a potential disconnect between teacher and student experiences, particularly in the TLE laboratory, pointing towards key areas for focused intervention. Ultimately, this evaluation aims to provide evidence-based insights for enhancing laboratory services at Saint Mary's University Junior High School, aligning with the institution's commitment to quality education and continuous improvement. In conclusion, the study revealed generally positive student perceptions alongside significant teacher-student discrepancies, particularly in the TLE laboratory, highlighting key areas for targeted improvement. Moving forward, it is recommended that the university prioritize enhancing cleanliness and organization, updating equipment, and improving communication regarding laboratory practices to optimize the learning environment.

Keywords: *activity theory, learning environment, outdated equipment, resource management, student perceptions*

Introduction

Laboratory services are widely recognized as crucial for fostering practical skills, scientific inquiry, and technological literacy within the educational landscape (Hofstein & Lunetta, 2004; National Research Council, 2012). Effective laboratory environments, coupled with well-maintained equipment and engaging instructional practices, are essential for maximizing student learning outcomes and preparing them for future academic and professional pursuits (Singer et al., 2006; Kyle et al., 1989). In the context of science education, hands-on experimentation reinforces theoretical concepts and cultivates critical thinking and problem-solving abilities (National Research Council, 2012; Anderson, 2007). Similarly, Technology and Livelihood Education (TLE) laboratories play a vital role in developing crucial vocational skills and promoting experiential learning, bridging the gap between theoretical knowledge and practical application (Billett, 2001; Rauner, 2007). Furthermore, computer laboratories are increasingly indispensable for cultivating digital competence and preparing students for an increasingly technology-driven world, fostering skills in information literacy, digital communication, and computational thinking (Prensky, 2001; Warschauer, 2003; Zhao et al., 2016).

Recognizing the integral role of these diverse learning spaces, this research focuses on evaluating the conditions and practices within the Science, TLE, and Computer laboratories at Saint Mary's University Junior High School. While the significance of well-functioning laboratories for enhancing student learning and fostering scientific inquiry is widely acknowledged in educational literature (Hofstein & Lunetta, 2004; Singer et al., 2006), the specific conditions and effectiveness of these learning environments can vary significantly across institutions and subject areas (Fraser et al., 1993). Within the specific context of Saint Mary's University Junior High School, a formal, comprehensive evaluation of these crucial services has yet to be undertaken. Prior feedback regarding the laboratories has been gathered informally, but a systematic study to assess the environment, equipment, and engagement across Science, TLE, and Computer laboratories has not been conducted. To address this gap, this study employed a quantitative and qualitative approach, utilizing teacher observations and student perception surveys to assess the laboratory environment and safety, equipment and resource management, and instruction and student engagement across the three laboratory types.

The 'Laboratory Environment and Safety' encompasses the physical conditions, including cleanliness, safety equipment availability, adherence to safety procedures, ventilation, lighting, waste disposal, and accessibility. A safe and conducive learning environment is foundational for effective laboratory work and student well-being (Singer et al., 2006; Lunetta et al., 2007). The 'Equipment and Resource Management' aspect focuses on the functionality and availability of equipment and materials, as well as the organization and maintenance of these resources, which directly impact the quality of student learning experiences (Kyle et al., 1989; Tobin, 1990). Finally, 'Instruction and Student Engagement' examines the level of student participation, understanding, equipment usage, critical thinking, and the support provided by laboratory personnel, as active student engagement is a significant predictor of learning success in laboratory settings (Chi & Wylie, 2014; Osborne, 2015).

By investigating these key elements through both teacher observations and student perceptions across the Science, TLE, and Computer

laboratories, this study seeks to provide valuable insights into the strengths and areas for improvement within Saint Mary's University Junior High School laboratory services. The findings will contribute to evidence-based recommendations for enhancing the effectiveness of these learning spaces, ultimately benefiting student learning and skill development.

Research Questions

This study aimed to evaluate the laboratory services provided by Saint Mary's University Junior High School for SY 2024-2025 through teacher observations and student perception surveys. Specifically, the following research questions were addressed:

1. What is the observed and perceived states of laboratory environment and safety in each laboratory?
    1.1 Science Laboratory;
    1.2 TLE Laboratory; and
    1.3 Computer Laboratory?
2. Is there significant difference between teacher observations and student perceptions of laboratory environment and safety in the laboratories?
    2.1 Science Laboratory;
    2.2 TLE Laboratory; and
    2.3 Computer Laboratory?
3. What is the observed and perceived states of equipment and resource management in each laboratory?
    3.1 Science Laboratory;
    3.2 TLE Laboratory; and
    3.3 Computer Laboratory?
4. Is there significant difference between teacher observations of equipment and resource management and student perceptions of equipment usability and availability, across the laboratories?
    4.1 Science Laboratory;
    4.2 TLE Laboratory; and
    4.3 Computer Laboratory?
5. What is the observed and perceived levels of instruction and student engagement in laboratory activities in each laboratory?
    5.1 Science Laboratory;
    5.2 TLE Laboratory; and
    5.3 Computer Laboratory?
6. Is there significant difference between teacher observations of instruction and student engagement and student perceptions of their own engagement and the effectiveness of laboratory activities in the laboratories?
    6.1 Science Laboratory;
    6.2 TLE Laboratory; and
    6.3 Computer Laboratory?
7. What are the themes underlying the feedback given by both students and teachers?

Methodology

Research Design

This study employed both quantitative and qualitative approach to evaluate laboratory services at Saint Mary's University Junior High School. Teacher observations and student perception surveys were collected simultaneously to gather objective and subjective data on the laboratory environment, equipment, and instruction. Quantitative data from both sources were analyzed separately using descriptive statistics and comparative t-tests. Qualitative data underwent thematic analysis. The integrated findings from both quantitative and qualitative strands aimed to provide a comprehensive evaluation through triangulation, leading to evidence-based recommendations.

Respondents

This study was conducted at Saint Mary's University Junior High School, a Catholic institution operated by the CICM, located in Bayombong, Nueva Vizcaya, Philippines. The research focused on the evaluation of laboratory services within the Junior High department, specifically during the School Year 2024-2025.

The primary research areas are the Science Laboratory, situated within the Daelman Building; the Technology and Livelihood Education (TLE) Laboratory, located in the CICM Building; and the Computer Laboratory, housed in the Alloysius Building. These laboratories serve the students from Grades 7 to 10. The dispersed location of these laboratories across different buildings provides a unique context for evaluating the consistency and effectiveness of laboratory services within the institution.

Teacher Participants. The teacher sample for this study consisted of a complete enumeration (census) of all teachers (n=8: 3 Science teachers, 3 TLE teachers, 2 Computer teachers) who conducted laboratory activities in the Science, TLE, and Computer laboratories at Saint Mary's University Junior High School during the School Year 2024-2025. The inclusive criterion for teacher participants was their active involvement in teaching laboratory sessions within the specified laboratories during the study period. There were no specific

exclusion criteria for the teacher participants as the goal was to gather perspectives from all relevant teaching staff.

Student Participants. The student sample (n=261) was selected using stratified random sampling. The student population was stratified by grade level (Grades 7, 8, 9, and 10). Within each grade level, one section from the Science Curriculum and one section from the Regular Curriculum were randomly selected to ensure representation from both curriculum types.

Pilot Testing. The pilot test will involve 5 teachers who were not teaching science, TLE and computer but are knowledgeable of the different laboratories and 30 students, selected randomly across grades 7-10 but not included in the final data collection.

Instrument

This study employed two primary research instruments: the Teacher Laboratory Observation Checklist and the Student Perception Survey, both designed to gather data relevant to the research questions outlined in the Statement of the Problem.

Teacher Laboratory Observation Checklist

This instrument was developed to provide an objective assessment of the laboratory services, directly addressing Research Questions 1, 3, and 5 which inquire about the observed states of laboratory environment and safety, equipment and resource management, and instruction and student engagement in each laboratory (Science, TLE, and Computer). The checklist is structured into three sections, mirroring these key aspects of laboratory evaluation:

Section 1. Laboratory Environment and Safety

This section contains criteria related to cleanliness, safety equipment availability, adherence to safety procedures, ventilation, lighting, waste disposal, and accessibility. Data from this section directly addresses Research Question 1 by providing observational data on the state of these environmental and safety factors in each lab.

Section 2. Equipment and Resource Management

This section includes criteria focused on the functionality and availability of equipment and materials, as well as the organization and maintenance of these resources. Data from this section directly addresses Research Question 3 by providing observational data on how equipment and resources are managed in each lab. This data will also be used in conjunction with student perceptions to address Research Question 4 regarding the correlation between teacher observations and student perceptions of equipment.

Section 3. Instruction and Student Engagement

This section assesses the level of student participation, understanding, equipment usage, critical thinking, and the assistance provided by laboratory personnel. Data from this section directly addresses Research Question 5 by providing observational data on the levels of instruction and student engagement in laboratory activities. This data will also be used in conjunction with student perceptions to address Research Question 6 regarding the alignment between teacher observations and student perceptions of engagement and effectiveness.

Teachers utilized a four-point Likert-type scale ('Consistently Evident' to 'Rarely or Not Evident') to rate the observed conditions and practices. This allowed for the collection of quantitative data on the actual state of the laboratories, as well as qualitative insights through open-ended comments (if included in your checklist, which you can mention here). The high internal consistency of the scale, as indicated by a Cronbach's alpha of 0.91 from the pilot test, indicates that the items reliably measure the intended constructs.

Student Perception Survey

This instrument was designed to capture students' subjective experiences on the same laboratory aspects evaluated by the teachers, allowing for a direct comparison of perspectives and addressing Research Questions 1, 3, and 5 which also inquire about the perceived states of these aspects. The survey mirrors the structure and content of the teacher checklist for data comparability, using a four-point Likert-type scale ('Strongly Agree' to 'Strongly Disagree').

The Student Perception Survey provided valuable insights into student experiences, which may differ from teacher observations. The excellent internal consistency of this scale, with a Cronbach's alpha of 0.94 from the pilot test, indicates its reliability in measuring student perceptions.

Finally, the open-ended questions (if any were included in either instrument) provided qualitative data that was analyzed to address Research Question 7 regarding the underlying themes in the feedback from both students and teachers.

Procedure

The procedure consisted of several key steps. Prior to the main data collection, a pilot test was conducted with five teachers and thirty students who were not included in the final sample. Formal permission to conduct the study was then sought from the school principal of Saint Mary's University Junior High School. Following this, eight teachers who conduct laboratory activities in the Science, TLE, and Computer laboratories completed the Teacher Laboratory Observation Checklist. This instrument was used by the teachers to

reflect upon and evaluate the laboratory environment, equipment, and student engagement based on their experiences during scheduled laboratory sessions. Meanwhile, 261 student participants were administered in the Student Perception Survey. Stratified random sampling was used to select students from grades 7 to 10. Prior to the survey distribution, parental consent forms were sent to the parents or guardians of all selected student participants, and only those with signed consent forms were allowed to participate. The surveys were administered online via Google Forms, with clear instructions provided to participants before they completed the survey.

Data Analysis

Quantitative and qualitative data from teacher observation checklists and student perception surveys were analyzed. Descriptive statistics (means, standard deviations, frequencies) summarized teacher and student responses across Science, TLE, and Computer laboratories for environment/safety, equipment/resources, and engagement (addressing RQ1, 3, 5). Independent samples t-tests determined significant differences between teacher and student perceptions for each lab (addressing RQ2, 4, 6), after checking assumptions of normality and homogeneity of variance. Qualitative data from open-ended questions were analyzed thematically (Braun & Clarke, 2006) to identify recurring patterns (addressing RQ7) through familiarization, coding, theme generation/review/definition, and reporting.

Ethical Considerations

This research study prioritized adherence to strict ethical guidelines to ensure the protection of all participants and the integrity of the data. The following ethical considerations were diligently observed throughout the research process:

Informed Consent. The principle of informed consent was paramount to respect the autonomy and rights of all participants. Prior to their involvement, all teachers and the parents/guardians of student participants were comprehensively informed about the study's purpose, including the aim to evaluate laboratory services for potential improvements. The procedures involved, such as teachers completing an observation checklist reflecting on their experiences and students completing an anonymous perception survey, were clearly explained. Potential risks, such as the time commitment required for participation, were acknowledged and minimized. The potential benefits, including contributing to the enhancement of laboratory learning environments and ultimately improving student learning experiences, were also outlined. Teachers provided their informed consent by signing a consent form after reviewing this information. For student participants, detailed consent forms were distributed to parents or guardians, and active signed consent was required before students were administered the online surveys. Participants were explicitly informed that their participation was entirely voluntary and that they had the right to decline to participate or to withdraw from the study at any time without penalty, ensuring their agency throughout the research process.

*Confidentiality and Anonymity***.** Maintaining the confidentiality of all collected data was crucial to protect the privacy of the participants. All teacher responses on the observation checklists were anonymized during data analysis and reporting to ensure that no individual teacher could be identified in the research findings. Student responses obtained through the online surveys were also strictly anonymous, with the survey platform configured to prevent the collection of any identifying information linked to individual students. For any qualitative data collected through open-ended questions, responses were carefully anonymized by removing any potentially identifying details during transcription and analysis. This rigorous approach to confidentiality and anonymity aimed to foster honest and unbiased responses from all participants.

Voluntary Participation. The voluntary nature of participation was emphasized to all potential participants. Teachers were explicitly informed during the initial communication about the study that their involvement in completing the observation checklist was entirely at their discretion and that they could choose not to participate without any negative consequences. Similarly, students were informed (through the information provided to parents/guardians) that their participation in the survey was voluntary, and they were free to decline to participate or to stop at any point during the survey administration without penalty. This ensured that all participation was based on free will and informed choice.

*Data Security***.** Stringent measures were implemented to ensure the security of all collected data. All data, including completed observation checklists and anonymized survey responses (stored digitally), were stored securely in password-protected digital formats accessible only to the core researchers involved in this study. Physical copies of consent forms were stored in a locked cabinet. Following the completion of the study and the dissemination of findings through publication or other means, the raw data will be archived for a predetermined period in a secure manner and then permanently and securely destroyed to maintain participant privacy and data integrity.

Benefit/Risk Ratio. The study was carefully designed with the primary intention of benefiting the school community by providing valuable, evidence-based insights into the effectiveness of the current laboratory services. The potential benefits of this evaluation, such as identifying areas for improvement that could enhance the learning environment and student outcomes, were weighed against any potential risks to participants. The researchers took all necessary precautions, such as ensuring anonymity and voluntary participation, to minimize any potential risks or harm, ensuring that the potential benefits of the research outweighed any foreseeable risks.

Objectivity and Integrity. Maintaining objectivity and integrity throughout all stages of the research, from data collection to analysis

and reporting, was paramount. The researchers committed to reporting data accurately and honestly, without any personal bias or manipulation of findings. The use of standardized instruments and systematic data analysis procedures aimed to enhance the objectivity of the study and ensure the trustworthiness of the results.

Institutional Approval. Prior to the commencement of any data collection, formal approval to conduct the study was obtained from the office of the principal of Saint Mary's University Junior High School. This approval ensured that the study aligned with the institution's policies and priorities and that it was conducted with the full knowledge and support of the school administration.

Results and Discussion

Section 1. Observed and Perceived States of Laboratory Environment and Safety in each Laboratory

Table 1 presents the observed and perceived states of laboratory environment and safety across the Science, TLE, and Computer laboratories, providing insights into both student experiences and teacher observations.

Table 1. *Observed and Perceived States of Laboratory Environment and Safety in Laboratory*

			Science Laboratory		*TLE Laboratory*		*Computer Laboratory*	
Parameter	*Category*	*N*	*Mean*	*Description*	*Mean*	*Description*	*Mean*	*Description*
1. Lab is clean and free of clutter.	Students	261	3.55	AO	3.55	AO	3.81	AO
	Teachers	8	3.38	FO	2.50	FO	3.75	AO
2. Safety equipment is readily available.	Students	261	3.63	AO	3.69	AO	3.78	AO
	Teachers	8	3.63	AO	3.13	FO	3.38	FO
3. Students follow safety procedures	Students	261	3.44	FO	3.60	AO	3.77	AO
	Teachers	8	3.25	FO	3.00	FO	3.38	FO
4. Ventilation is adequate.	Students	261	3.57	AO	3.59	AO	3.81	AO
	Teachers	8	3.75	AO	3.25	FO	3.38	FO
5. Lighting is sufficient for tasks.	Students	261	3.66	AO	3.70	AO	3.84	AO
	Teachers	8	3.88	AO	3.50	AO	3.38	FO
6. Waste disposal is handled appropriately.	Students	261	3.57	AO	3.60	AO	3.79	AO
	Teachers	8	3.13	FO	2.63	FO	3.50	AO
7. Accessibility for all students is provided.	Students	261	3.68	AO	3.71	AO	3.84	AO
	Teachers	8	3.63	AO	3.38	FO	3.25	FO
Overall	Students	261	3.59	AO	3.63	AO	3.81	AO
	Teachers	8	3.52	AO	3.05	FO	3.43	FO

Legend: 1-1.49-Never Observed (NO); 1.5-2.49- Sometimes Observed(SO); 2.5-3.49-Frequently Observed (FO); 3.5-4-Always Observed (AO)

Science Laboratory

Students generally perceived the environment and safety aspects as consistently present, with all individual parameters and the overall rating described as Always Observed (AO; Mean range: 3.44-3.68). This indicates a positive perception of the Science Laboratory's environment and safety from the students' perspective. Teachers largely corroborated this positive view, also rating the overall environment and safety as Always Observed (AO; Overall Mean: 3.52). However, their ratings for "Lab is clean and free of clutter" (Mean: 3.38) and "Waste disposal is handled appropriately" (Mean: 3.13) were lower, falling into the Frequently Observed (FO) category. This discrepancy indicates a potential area where teachers perceive inconsistencies or room for improvement in the cleanliness and waste management practices within the Science Laboratory, despite the generally positive overall assessment.

TLE Laboratory

A notable divergence emerged in the evaluation of the TLE Laboratory. Students reported all individual environment and safety parameters as Always Observed (AO; Mean range: 3.55-3.71), resulting in an overall perception of AO (Overall Mean: 3.63). In stark contrast, teachers consistently rated several critical aspects as Frequently Observed (FO), including "Lab is clean and free of clutter" (Mean: 2.50), "Safety equipment is readily available" (Mean: 3.13), "Students follow safety procedures" (Mean: 3.00), "Ventilation is adequate" (Mean: 3.25), and "Accessibility for all students is provided" (Mean: 3.38). While teachers rated "Lighting is sufficient for tasks" (Mean: 3.50) and "Waste disposal is handled appropriately" (Mean: 2.63) as AO and FO respectively, their overall observation of the TLE Laboratory environment and safety was Frequently Observed (FO; Overall Mean: 3.05), significantly lower than the students' perception. This substantial difference highlights a potential disconnect between how students experience the TLE Laboratory environment and safety and how teachers observe and evaluate these conditions. Factors such as the nature of TLE activities, which often involve hands-on work with tools and materials, might contribute to the teachers' more critical assessment of cleanliness, safety adherence, and equipment availability.

Computer Laboratory

The Computer Laboratory received the most positive evaluations from students, with all parameters and the overall rating marked as Always Observed (AO; Mean range: 3.77-3.84; Overall Mean: 3.81). This indicates a highly satisfactory environment and safety from the students' viewpoint. Teachers also viewed the Computer Laboratory relatively favorably, with an overall observation of Frequently

Observed (FO; Overall Mean: 3.43). However, similar to the Science Laboratory, teachers rated specific aspects lower as Frequently Observed (FO), including "Safety equipment is readily available" (Mean: 3.75), "Students follow safety procedures" (Mean: 3.38), "Ventilation is adequate" (Mean: 3.38), "Lighting is sufficient for tasks" (Mean: 3.38), and "Accessibility for all students is provided" (Mean: 3.25). The higher student ratings in the Computer Laboratory might be attributed to the potentially less physically demanding and hazardous nature of activities compared to Science and TLE labs.

Overall, while students across all laboratories reported positive perceptions of environment and safety, teachers identified specific areas needing attention, particularly in the Science and Computer Laboratories. The most significant discrepancy was observed in the TLE Laboratory, where teachers held a considerably less favorable view than the students. These findings underscore the importance of considering both student and teacher perspectives in evaluating laboratory services. The specific areas identified by teachers as Frequently Observed (e.g., cleanliness, waste disposal, safety equipment availability, safety procedure adherence, ventilation, accessibility) represent concrete targets for potential improvements in each laboratory to better align with best practices and ensure a safe and conducive learning environment for all.

Section 2. Significant Difference between Teacher Observations and Student Perceptions of Laboratory Environment and Safety in the Laboratories

Table 2 presents a comparison between the mean scores of student perceptions and teacher observations regarding the laboratory environment and safety across the Science, TLE, and Computer laboratories. Independent samples t-tests were conducted to determine if the differences in these mean scores were statistically significant.

Table 2. *Comparison between Teacher Observations and Student Perceptions of Laboratory Environment and Safety*

Laboratories	*Category*	*Mean*	*t-value*	*p-value*
Science Laboratory	Students	3.59	.346	.729
	Teachers	3.52	3.168**	
TLE Laboratory	Students	3.63	1.855	.002
	Teachers	3.05	.346	
Computer Laboratory	Students	3.81	3.168**	.105
	Teachers	3.43		

**Significant at 0.05 ** Significant at 0.01*

Science Laboratory

The mean student perception score for the Science Laboratory Environment and safety was 3.59, while the mean teacher observation score was 3.52. The resulting t-value of 0.346 yielded a p-value of 0.729, which is greater than the significance level of 0.05. This indicates that there was no statistically significant difference between how students perceived and how teachers observed the environment and safety in the Science Laboratory. Thus, both groups generally held similar views on this aspect.

TLE Laboratory

In contrast, the TLE Laboratory revealed a substantial difference between student and teacher perspectives. Students reported a significantly higher mean perception score of 3.63 compared to the teachers' mean observation score of 3.05. The t-value of 1.855 resulted in a p-value of 0.002, which is highly significant ($p < 0.01$). This statistically significant difference demonstrates a clear divergence in views, with students perceiving the TLE Laboratory environment and safety to be considerably more positive than what teachers observed.

Computer Laboratory

For the Computer Laboratory, the mean student perception score was 3.81, while the mean teacher observation score was 3.43. The t-value of 3.168 yielded a p-value of 0.105, which is greater than the significance level of 0.05. Therefore, despite the slightly higher mean score from students, the difference between student and teacher perceptions of the Computer Laboratory environment and safety was not statistically significant. This indicates that, overall, both groups had relatively similar evaluations of this laboratory's environment and safety.

Hofstein and Lunetta (2004) emphasize the critical role of a safe and organized laboratory in fostering effective science learning and student engagement. The generally positive student perceptions across all three laboratories, as indicated by their higher mean scores, imply that students largely view their laboratory environments as conducive to learning, aligning with this principle. However, the teachers' more critical observations, particularly the statistically significant lower scores in the TLE Laboratory, underscore their focus on the practical aspects of safety and management that are crucial for meaningful hands-on activities, as advocated by Hofstein and Lunetta (2004).

The significant discrepancy in perceptions within the TLE Laboratory warrants further attention. The fact that students perceive the environment and safety more positively than teachers observe could indicate a potential disconnect in understanding or awareness of safety protocols, cleanliness standards, or equipment functionality. This divergence might hinder the effective implementation of rich

learning experiences in the TLE lab if underlying issues are not addressed. Conversely, the agreement between student and teacher perceptions in the Science and Computer Laboratories indicates a more aligned understanding, potentially providing a better foundation for effective laboratory activities.

Overall, while students tend to have a more positive view of the laboratory environment and safety, teachers, especially in the TLE Laboratory, appear to be more critical. This highlights the need for open communication and potentially collaborative efforts to ensure that all stakeholders share a common understanding of and commitment to maintaining safe and effective laboratory learning spaces, as emphasized by the importance of a well-functioning lab environment in the literature (Hofstein & Lunetta, 2004).

Section 3. Observed and Perceived States of Equipment and Resource Management in the Laboratories

Table 3 presents the observed and perceived states of equipment and resource management across the Science, TLE, and Computer laboratories, as reported by both students and teachers.

Table 3. *Observed and Perceived States of Equipment and Resource Management in the Laboratories*

			Science Laboratory		*TLE Laboratory*		*Computer Laboratory*	
Parameter	*Category*	*N*	*Mean*	*Description*	*Mean*	*Description*	*Mean*	*Description*
1. Equipment is in good working order.	Students	261	3.67	AO	3.65	AO	3.68	AO
	Teachers	8	2.88	FO	3.00	FO	3.38	FO
2. Necessary materials are readily available.	Students	261	3.64	AO	3.65	AO	3.76	AO
	Teachers	8	3.00	FO	3.13	FO	3.50	AO
3. Storage is organized and efficient.	Students	261	3.66	AO	3.61	AO	3.80	AO
	Teachers	8	3.13	FO	2.75	FO	3.63	AO
4. Inventory of equipment/materials is maintained.	Students	261	3.64	AO	3.64	AO	3.82	AO
	Teachers	8	3.13	FO	3.13	FO	3.50	AO
5. Equipment is regularly maintained and updated.	Students	261	3.65	AO	3.66	AO	3.78	AO
	Teachers	8	2.75	FO	2.88	FO	3.75	FO
Overall	Students	261	3.65	AO	3.64	AO	3.77	AO
	Teachers	8	2.98	FO	2.98	FO	3.55	AO

Legend: 1-1.49-Never Observed (NO); 1.5-2.49- Sometimes Observed(SO); 2.5-3.49-Frequently Observed (FO); 3.5-4-Always Observed (AO)

Science Laboratory

Students generally held a positive view of equipment and resource management in the Science Laboratory, rating all individual parameters, including equipment working order and material availability, as Always Observed (AO; Mean range: 3.64-3.67). Their overall perception also aligned with AO (Overall Mean: 3.65). In contrast, teachers consistently rated all aspects of equipment and resource management as Frequently Observed (FO; Mean range: 2.75-3.13), resulting in a lower overall rating of FO (Overall Mean: 2.98) compared to the students. This significant difference indicates a more critical assessment from teachers regarding the adequacy and management of equipment and resources in the Science Laboratory.

TLE Laboratory

Similar to the Science Laboratory, students in the TLE Laboratory generally perceived equipment and resource management positively, rating all individual parameters as Always Observed (AO; Mean range: 3.61-3.66) and their overall perception as AO (Overall Mean: 3.64). However, teachers again reported a less positive view, rating all aspects as Frequently Observed (FO; Mean range: 2.75-3.13), leading to an overall rating of FO (Overall Mean: 2.98). This consistent pattern of lower teacher ratings in the TLE Laboratory indicates potential concerns regarding the availability, organization, maintenance, and updating of equipment and resources from the teachers' perspective.

Computer Laboratory

The Computer Laboratory received the most favorable ratings from students, who perceived all aspects of equipment and resource management as Always Observed (AO; Mean range: 3.68-3.82; Overall Mean: 3.77). Teachers in the Computer Laboratory held a more positive view compared to the Science and TLE labs, with an overall rating of Always Observed (AO; Overall Mean: 3.55). Specifically, teachers rated the availability of necessary materials (Mean: 3.50), storage organization (Mean: 3.63), and inventory maintenance (Mean: 3.50) as AO. However, they rated "Equipment is in good working order" (Mean: 3.38) and "Equipment is regularly maintained and updated" (Mean: 3.75) as Frequently Observed (FO), indicating some concerns regarding the consistent functionality and upkeep of computer equipment.

The consistent trend of students reporting more positive perceptions (AO) compared to teachers (FO in Science and TLE) regarding equipment and resource management, as highlighted by Kyle, Abell, and Shymansky's (1989) emphasis on the importance of laboratory resources, indicates a potential disconnect in awareness or expectations. Students might perceive "availability" without fully recognizing issues related to age, functionality, or alignment with modern standards of the equipment, particularly in the Science and TLE laboratories.

The teachers' less positive ("Frequently Observed") ratings in the Science and TLE laboratories likely stem from their direct experience with the challenges posed by outdated, non-functional, or poorly maintained equipment. As Kyle, Abell, and Shymansky (1989) indirectly point out through their historical perspective on resource importance, age and lack of updates in physical science and TLE equipment can significantly hinder effective teaching and hands-on learning. Teachers are acutely aware of these limitations that can impede the delivery of quality laboratory activities.

The greater alignment between student and teacher perceptions in the Computer Laboratory, with teachers also giving an overall AO rating, might be attributed to a more consistent and visible updating cycle for digital resources compared to the often more substantial investment and logistical challenges associated with updating physical equipment in Science and TLE labs.

Overall, the findings from Table 3 underscore a clear divergence in the perception of equipment and resource management between students and teachers, particularly in the Science and TLE laboratories. This discrepancy warrants further investigation to understand the underlying reasons and to identify strategies for ensuring that the available equipment and resources adequately support effective teaching and learning, addressing the long-standing concerns about laboratory resources in science education (Kyle, Abell, & Shymansky, 1989).

Section 4. Significant Difference between Teacher Observations and Student Perceptions of Equipment and Resource Management in the Laboratories

Table 4 presents a comparison between the mean scores of student perceptions and teacher observations regarding equipment and resource management across the Science, TLE, and Computer laboratories. Independent samples t-tests were conducted to determine if the differences in these mean scores were statistically significant.

Table 4. *Comparison between Teacher Observations and Student Perceptions of Equipment and Resource Management in the Laboratories*

Laboratories	*Category*	*Mean*	*t-value*	*p-value*
Science Laboratory	Students	3.65	3.51**	.001
	Teachers	2.98		
TLE Laboratory	Students	3.64	3.47**	.001
	Teachers	2.98		
Computer Laboratory	Students	3.77	1.54	.126
	Teachers	3.55		

**Significant at 0.05 ** Significant at 0.01*

Science Laboratory

The mean student perception score for equipment and resource management in the Science Laboratory was 3.6521, while the mean teacher observation score was 2.9750. The resulting t-value of 3.513 yielded a p-value of 0.001, which is highly significant ($p < 0.01$, as indicated by the double asterisk). This statistically significant difference confirms that students held a much more positive view of equipment and resource management in the Science Laboratory compared to the teachers' observations.

TLE Laboratory

Similarly, the TLE Laboratory showed a significant divergence in perspectives. Students reported a significantly higher mean perception score of 3.6414 compared to the teachers' mean observation score of 2.9750. The t-value of 3.466 resulted in a p-value of 0.001, also highly significant ($p < 0.01$). This indicates a strong disagreement, with students perceiving the equipment and resource management in the TLE Laboratory to be considerably better than what teachers observed.

Computer Laboratory

In contrast to the Science and TLE laboratories, the Computer Laboratory showed a different pattern. The mean student perception score was 3.77, while the mean teacher observation score was 3.55. The t-value of 1.54 yielded a p-value of 0.126, which is greater than the significance level of 0.05. Therefore, the slight difference in mean scores between students and teachers regarding equipment and resource management in the Computer Laboratory was not statistically significant. This indicates that both groups generally shared similar overall views on this aspect in the Computer Laboratory.

Discussion and Implications: The statistically significant differences in the Science and TLE laboratories highlight a clear and substantial disconnect between how students experience and perceive the management of equipment and resources and how teachers observe and evaluate these aspects. Students' consistently more positive views may stem from a lack of awareness of underlying functional issues, maintenance needs, or the age of the equipment, as discussed in relation to Table 3. Conversely, teachers' direct experience with the equipment's limitations and the challenges of resource management likely contribute to their more critical assessments. This significant divergence could have implications for the effectiveness of laboratory activities, as teachers might face difficulties in implementing engaging and effective lessons due to resource constraints that students may not fully perceive.

The lack of a significant difference in the Computer Laboratory indicates a more aligned understanding between students and teachers regarding the management of its equipment and resources. This could be attributed to more consistent updates of digital resources and

potentially fewer issues with the fundamental functionality of the computer hardware compared to the physical equipment in the Science and TLE labs.

Overall, the findings from Table 4 reinforce the need to consider both student and teacher perspectives when evaluating laboratory resources. The significant disagreements in the Science and TLE laboratories warrant further investigation to bridge this perceptual gap and ensure that resource management effectively supports the educational goals of these laboratories.

Section 5. Observed and Perceived Levels of instruction and Engagement in the Different Laboratory Activities

Table 5 presents the observed and perceived levels of instruction and student engagement across the Science, TLE, and Computer laboratories, as reported by both students and teachers.

Table 5. *Observed and Perceived Levels of instruction and Engagement in the Different Laboratory Activities*

			Science Laboratory		*TLE Laboratory*		*Computer Laboratory*	
Parameter	*Category*	*N*	*Mean*	*Description*	*Mean*	*Description*	*Mean*	*Description*
1. Students are actively participating in the laboratory activity.	Students	261	3.75	AO	3.75	AO	3.80	AO
	Teachers	8	3.63	AO	3.63	AO	3.75	AO
2. Students demonstrate understanding of the laboratory task.	Students	261	3.70	AO	3.75	AO	3.80	AO
	Teachers	8	3.38	FO	3.13	FO	3.88	AO
3. Students are able to use equipment effectively.	Students	261	3.70	AO	3.72	AO	3.81	AO
	Teachers	8	3.50	AO	3.38	FO	3.63	AO
4. Problem-solving and critical thinking are encouraged in the laboratory task.	Students	261	3.66	AO	3.74	AO	3.80	AO
	Teachers	8	3.63	AO	3.38	FO	3.75	AO
5. Lab personnel provide adequate assistance when needed.	Students	261	3.75	AO	3.73	AO	3.82	AO
	Teachers	8	3.50	AO	3.50	AO	3.75	AO
Overall	Students	261	3.71	AO	3.74	AO	3.81	AO
	Teachers	8	3.53	AO	3.40	FO	3.75	AO

Legend: 1-1.49-Never Observed (NO); 1.5-2.49- Sometimes Observed(SO); 2.5-3.49-Frequently Observed (FO); 3.5-4-Always Observed (AO)

Science Laboratory

Students generally reported high levels of instruction and engagement in the Science Laboratory, rating all individual parameters, including active participation, understanding, equipment use, problem-solving encouragement, and assistance, as Always Observed (AO; Mean range: 3.66-3.75). Their overall perception also aligned with AO (Overall Mean: 3.71). Teachers largely concurred, also rating most aspects as Always Observed (AO; Mean range: 3.50-3.75). However, they perceived that "Students demonstrate understanding of the laboratory task" was only Frequently Observed (FO; Mean: 3.38). Despite this slightly lower rating for student understanding, their overall observation of instruction and engagement remained at Always Observed (AO; Overall Mean: 3.53).

TLE Laboratory

In the TLE Laboratory, students consistently perceived all examined aspects of instruction and engagement as Always Observed (AO; Mean range: 3.72-3.75), which was reflected in their overall positive perception (Overall Mean: 3.74). Teachers, however, held a slightly less positive view. They rated "Students demonstrate understanding of the laboratory task" (Mean: 3.13) and "Problem-solving and critical thinking are encouraged in the laboratory task" (Mean: 3.38) as only Frequently Observed (FO). Consequently, their overall observation of instruction and engagement in the TLE Laboratory was also Frequently Observed (FO; Overall Mean: 3.40), falling below the students' average perception.

Computer Laboratory

The Computer Laboratory received the most positive assessments from students, who rated all individual aspects of instruction and engagement, as well as the overall level, as Always Observed (AO; Mean range: 3.75-3.82; Overall Mean: 3.81). This laboratory also had the highest average scores reported by students across the three labs. Teachers in the Computer Laboratory also held a positive view, rating all aspects of instruction and engagement as Always Observed (AO; Mean range: 3.63-3.75), aligning with the students' perceptions (Overall Mean: 3.75).

Chi and Wylie's (2014) ICAP framework indicates that higher levels of cognitive engagement are linked to deeper learning outcomes. The generally "Always Observed" ratings from students across all three laboratories regarding active participation, understanding, equipment use, problem-solving encouragement, and assistance (as shown in Table 5) indicate that students perceive themselves as being highly engaged in laboratory activities. According to the ICAP framework, this perceived active participation indicates the potential for constructive or even interactive engagement, which are associated with better learning.

However, the teachers' more cautious ratings, particularly the "Frequently Observed" for student understanding in Science and TLE, and for problem-solving encouragement in TLE, indicate a potential discrepancy between students' perceived engagement and the teachers' observations of their cognitive involvement. While students might be actively participating overtly, teachers may perceive a need for deeper understanding and more robust problem-solving during the tasks.

The alignment between student and teacher perceptions of high engagement in the Computer Laboratory is noteworthy. This could be attributed to the nature of computer-based tasks, which might inherently promote active participation and provide more immediate feedback, leading to a shared perception of engagement levels.

Overall, while students generally report high levels of instruction and engagement across all laboratories, teachers' observations, particularly in Science and TLE, point to potential areas where deeper cognitive engagement and understanding could be further fostered. Aligning these perceptions could be crucial for maximizing the learning potential of laboratory activities, as suggested by the link between engagement and learning outcomes in the ICAP framework (Chi & Wylie, 2014).

Section 6. Significant Difference between Teacher Observations and Student Perceptions of Instructions and Student Engagement in the Laboratory Activities

Table 6 presents a comparison between the mean scores of student perceptions and teacher observations regarding the levels of instruction and student engagement across the Science, TLE, and Computer laboratories. Independent samples t-tests were conducted to determine if the differences in these mean scores were statistically significant.

Table 6. *Comparison between Teacher Observations and Student Perceptions of Instructions and Student Engagement in the Laboratory Activities*

Laboratories	*Category*	*Mean*	*t-value*	*p-value*
Science Laboratory	Students	3.72	1.11	.270
	Teachers	3.53		
TLE Laboratory	Students	3.74	2.14	.033
	Teachers	3.40		
Computer Laboratory	Students	3.81	0.40	.690
	Teachers	3.75		

**Significant at 0.05 ** Significant at 0.01*

Science Laboratory

The mean student perception score for instruction and engagement in the Science Laboratory was 3.71, while the mean teacher observation score was 3.53. The resulting t-value of 1.11 yielded a p-value of 0.270, which is greater than the significance level of 0.05. This indicates that there was no statistically significant difference between how students perceived and how teachers observed the levels of instruction and engagement in the Science Laboratory. Thus, both groups generally held similar views on this aspect.

TLE Laboratory

In contrast, the TLE Laboratory revealed a statistically significant difference between student and teacher perspectives. Students reported a significantly higher mean perception score of 3.74 compared to the teachers' mean observation score of 3.4000. The t-value of 2.14 resulted in a p-value of 0.033, which is significant at the 0.05 level. This demonstrates a real divergence in views, with students perceiving the levels of instruction and their engagement in the TLE Laboratory to be significantly higher than what teachers observed.

Computer Laboratory

For the Computer Laboratory, the mean student perception score was 3.8061, while the mean teacher observation score was 3.75. The t-value of 0.40 yielded a p-value of 0.690, which is greater than the significance level of 0.05.

Therefore, the slight difference in mean scores between students and teachers regarding instruction and engagement in the Computer Laboratory was not statistically significant. This indicates that both groups generally shared similar overall views on this aspect in the Computer Laboratory.

The findings from Table 6 indicate a general agreement between students and teachers regarding the levels of instruction and student engagement in the Science and Computer Laboratories. This alignment indicates a shared understanding of the learning environment and the students' involvement in these labs. Such agreement can be a positive indicator of a consistent and potentially effective learning experience.

However, the statistically significant difference observed in the TLE Laboratory, where students reported significantly higher levels of instruction and engagement than teachers observed, warrants further consideration. This discrepancy could stem from various factors. Students might perceive their engagement differently than how teachers observe it, or there might be differences in how each group interprets the indicators of effective instruction and engagement.

This significant divergence could have implications for pedagogical approaches and the design of laboratory activities in the TLE setting. Understanding the reasons behind this difference could inform strategies to better align student experiences with teacher observations and potentially enhance both instruction and engagement in the TLE Laboratory.

Overall, while there is a general congruence in perceptions of instruction and engagement in the Science and Computer Laboratories, the significant difference in the TLE Laboratory highlights a potential area for investigation and discussion to ensure a shared understanding of the learning dynamics within that specific laboratory.

Section 7. Themes Underlying the Feedback from Students and Teachers

The feedback gathered across all laboratories reveals several recurring themes, highlighting areas of satisfaction as well as concerns requiring attention. These themes are categorized into positive feedback, cleanliness-related issues, and suggestions for improvements in organization, safety, equipment, and the overall environment.

Theme 1: General Satisfaction / No Change Needed

A significant portion of the feedback across all laboratories (Science, TLE, and Computer) expresses general satisfaction with the current state.

Many respondents explicitly stated that "None," "N/A," "Nothing," or similar phrases were needed for improvement. Reasons provided often centered on the perceived cleanliness and safety of the labs, with comments like "already clean," "it's safe," "all good," and "everything is perfect" being common. This positive feedback indicates that the current maintenance and safety protocols are perceived well by a considerable number of users.

Theme 2: Cleanliness Concerns (General)

Despite the positive feedback regarding cleanliness in Theme 1, a substantial number of comments across all labs raise concerns about cleanliness. These range from general statements like "Cleanliness" and "It could be more clean" to more specific issues such as dust accumulation (especially around AC units and under tables), the need for regular cleaning schedules, and the importance of students cleaning up after themselves.

The smell of the TLE and Computer labs was also mentioned as a concern by some. These comments imply a need for more consistent and potentially stricter cleaning protocols and a greater emphasis on student responsibility in maintaining a clean environment.

Theme 3: Waste Management

A specific cleanliness-related issue highlighted primarily in the Science and TLE labs is the need for more trash cans or conveniently located trash bins. Respondents indicated that insufficient waste disposal options can contribute to clutter and potentially impact the overall cleanliness of the laboratories.

Theme 4: Organization and Space

Feedback regarding organization and space was prominent, particularly in the Science and TLE labs. Implications included creating separate areas for student projects, improving the arrangement of tables and equipment, providing more cabinets for storage, and generally decluttering the lab spaces. Some respondents in the TLE lab also noted that the room felt crowded, implying a potential need to re-evaluate space allocation.

Theme 5: Safety and Equipment

Safety was a recurring theme across all laboratories. Positive comments mentioned the existing safety measures, but several implications for improvement were also offered. These included adding smoke detectors and first aid kits, ensuring readily available personal protective equipment (like lab coats, goggles, and gloves), maintaining working water sources, and addressing specific hazards like slippery floors and improperly stored knives in the TLE lab. Concerns about broken equipment (computers, glassware), leaking or clogged sinks, and the need for better ventilation were also raised under the umbrella of safety and functionality.

Theme 6: Ventilation and Air Quality

Ventilation and air quality emerged as a specific concern, particularly in the TLE lab, with mentions of bad smells and the need for better airflow. Adding air conditioning was implied for both Science and Computer labs to improve comfort and potentially air quality.

Theme 7: Sinks and Water Issues

Issues related to sinks and water access were noted primarily in the Science and TLE labs. Concerns included clustered sinks, non-working or leaking faucets, clogged drains, and the general cleanliness around the sink areas. Ensuring accessible water within the labs was also highlighted.

Theme 8: Pests/Animals

A singular comment in the TLE lab mentioned the presence of cat poop in the back room, indicating a need to address potential pest or animal-related cleanliness issues.

Theme 9: Specific Equipment Concerns

Beyond general equipment mentions in the organization and safety themes, specific concerns were raised about the condition and maintenance of equipment. This included the cleanliness of lab coats and kitchenware, the need to fix broken computers, and the potential fire hazard posed by tangled wires in the computer lab.

Theme 10: Student Behavior/Responsibility

Several comments across all labs emphasized the role of student behavior in maintaining a clean and safe laboratory environment. Implications included reminding students to clean up after themselves, follow proper equipment handling procedures, and adhere to lab rules.

Conclusion

Overall, students generally perceived the laboratory environments and safety conditions positively across all three laboratories. However, teachers' observations identified specific areas requiring improvement, particularly in the TLE laboratory and in the hygiene, practices observed in the Science laboratory. There was no statistically significant difference between student and teacher perceptions of the environment and safety in the Science and Computer laboratories. In contrast, students viewed the TLE laboratory more positively than the teachers, revealing a significant disparity in perception. Regarding equipment and resource management, students expressed consistently favorable views across all laboratories. Teachers, on the other hand, reported less satisfactory conditions in the Science and TLE laboratories. These differing perspectives were statistically significant in the Science and TLE settings, with students holding more positive views, while no significant difference was noted in the computer laboratory.

In terms of instruction and engagement, students reported high levels across all laboratories. Teachers largely agreed with this assessment in the Science and Computer laboratories but noted lower levels of instruction and engagement in the TLE laboratory. The data showed that student and teacher perceptions were aligned in the Science and Computer laboratories, yet students reported significantly higher levels than teachers in the TLE setting. Although there was a general sense of satisfaction, qualitative feedback revealed a consistent need for improvements across all laboratories. These included concerns related to cleanliness, waste management, organization, safety, equipment maintenance, ventilation, and student responsibility.

To enhance alignment between student and teacher perceptions and improve laboratory conditions, it is recommended that regular joint walk-throughs be conducted with teachers and student representatives, especially in the TLE laboratory. These sessions can facilitate the collaborative identification and resolution of problem areas. Considering the significant difference in perceptions of the TLE laboratory's environment and safety, focused discussions between teachers and students should be organized to explore the roots of this discrepancy and formulate actionable solutions.

Attention should also be directed toward evaluating the current systems of equipment and resource management in the Science and TLE laboratories. Teacher feedback should be used to address issues concerning availability, functionality, and maintenance. To support this, a transparent process for equipment requests, repairs, and upgrades should be implemented, ensuring clear communication between faculty and students.

The gap in perception regarding instruction and engagement in the TLE laboratory warrants a thorough investigation, possibly through classroom observations and open teacher-student dialogues. These efforts can help surface specific needs and encourage strategies that enhance instructional quality and student involvement. Lastly, comprehensive and consistently enforced policies should be developed to improve cleanliness, waste disposal, organization, safety protocols, equipment care, ventilation, and student accountability, thereby ensuring a functional and supportive learning environment in all laboratory settings.

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