



Survey of Teachers' and Students' Perception of Chemistry Laboratory Learning Environment in Senior Secondary Schools in Bauchi South Education Zone

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ABSTRACT

The study surveys teachers' and students' perception of chemistry laboratory learning environment among senior secondary schools in Bauchi South Education Zone. A descriptive survey research design was adopted for the study. The population of the study comprised of 34,007 students offering chemistry and 243 chemistry teachers from 114 Senior Secondary Schools in Bauchi South Education Zone, Bauchi state. Multistage sampling technique was used to select 254 students and 62 teachers. The instrument for data collection was a five-points Likert scale structured questionnaire adapted for the study. The instrument was validated by three experts two from chemistry education, another from test and measurement. The reliability of the instrument was 0.943 determined using Cronbach Alpha. The instrument was administered by the researcher and also assisted by two research assistants. Data obtained were analysed using mean, standard deviation, multiple linear regression analysis and Mann-Whitney test. Findings revealed that the perception of both teachers and students on the chemistry laboratory learning environment is high, with Integration and Rule Clarity dimensions rated highest by teachers, and Cohesiveness and Rule Clarity dimension were perceived highest by students. Gender showed very little influence on perception for both groups. A significant difference was found between teachers' and students' overall perceptions ($p = 0.000$), with teachers having a more positive perception. The study concludes that the chemistry laboratory learning environment in the senior secondary schools was perceived positively by both teachers and students and that material environment was an important factor in shaping perceptions. The study recommends that relevant authorities should place emphasis on strengthening the Material Environment of the laboratory, as it was the only dimension found to significantly shape teachers' overall perception.

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INTRODUCTION

The chemistry laboratory is a vital element of science education, providing students with hands-on experiences that allow them to apply theoretical knowledge, develop scientific inquiry skills, and build confidence in their learning. Numerous studies have highlighted the importance of practical activities in improving

students' academic achievement and fostering deeper understanding of scientific concepts (Kazeem, Gagdi, Muhammad & Rabi, 2023). However, the effectiveness of these laboratory experiences extends beyond the availability of physical resources. It is significantly influenced by how both teachers and students perceive the laboratory learning environment.

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Practical work in chemistry serves multiple educational purposes, including enabling students to engage directly with natural phenomena, develop investigative skills, and experience the processes that define scientific inquiry (Hinson, 2023). Such activities promote curiosity, support conceptual understanding, and contribute to scientific literacy by equipping learners with the skills to conduct investigations and evaluate scientific claims critically (Gupta & Sharma, 2017). The influence of laboratory environments on learning outcomes has been well-documented over the years, with evidence showing that students who participate in well-structured practical work tend to develop more positive attitudes toward science and achieve better learning outcomes.

Despite sharing the same environment, teachers and students may perceive the chemistry laboratory differently. These perceptions are shaped by various factors such as individual experiences, classroom roles, and the quality of the learning environment itself. Research suggests that students' perceptions affect their motivation, engagement, and retention of knowledge (Odutuyi, 2015), while teachers' perceptions often relate to their satisfaction and effectiveness in delivering instruction (Fitria et al., 2021).

Akinbobola (2015) and Fan (2021) emphasized that students prefer participatory and interactive environments, which highlights the importance of monitoring stakeholder perceptions to inform educational reforms. Key dimensions that define the chemistry laboratory environment include student cohesiveness, open-endedness, integration, rule clarity, and material environment (Akinbobola, 2015). These dimensions collectively shape the overall experience and effectiveness of laboratory learning. Therefore, this study seeks to investigate the perceptions of senior secondary school teachers and students toward the chemistry laboratory learning environment in Bauchi South Education Zone, with a view to identifying gaps and opportunities for enhancing science education in the region.

Research Questions

The following research questions guided the study:

1. What is the perception of senior secondary school chemistry teachers across the five dimensions of the chemistry laboratory learning environment?
2. What are the perceptions of senior secondary school chemistry students across the five dimensions of the chemistry laboratory learning environment?
3. Is there a significant difference between teachers' and students' perceptions of the chemistry laboratory learning environment?

Hypothesis

The following hypothesis was tested at 0.05 level of significance

H₀₁: There is no significant difference between the perceptions of chemistry teachers and students regarding the chemistry laboratory learning environment.

LITERATURE REVIEW

This study is anchored on two complementary theories: Moos' Theory of Learning Environments and Constructivist Learning Theory. Moos (1979) proposed that learning environments can be evaluated through three dimensions of relationship, personal development, and system maintenance which provides a lens to analyze how various aspects of the chemistry laboratory environment like student cohesiveness, rule clarity, material environment are perceived by teachers and students. Fraser et al. (1992) adapted Moos' framework to develop the Science Laboratory Environment Inventory (SLEI) which further emphasized how interpersonal, procedural, and infrastructural factors shape educational experiences.

Similarly, Constructivist Learning Theory, as proposed by Piaget (1985) and Vygotsky (1978), views learners as active participants who construct knowledge through



hands-on experience, collaboration, and reflection. This theory supports the study's focus on laboratory activities that promote inquiry-based learning, theory-practice integration, and student autonomy. Together, these frameworks provide a structured lens for interpreting teachers' and students' perceptions of chemistry laboratory learning environment across the five dimensions of student cohesiveness, open-endedness, integration, rule clarity, and material environment. Student Cohesiveness refers to the extent to which students know, help, and are supportive of each other within the laboratory environment.

A high degree of cohesiveness fosters a sense of community and teamwork, which is particularly beneficial for collaborative tasks and problem-solving (Gupta & Sharma, 2017). Studies by Allanas (2021) and Fitria *et al.* (2021) highlight the importance of student cohesiveness. Akinbobola (2015) in his study on evaluating science laboratory classroom learning environment also emphasizes the benefits of cooperative work and its impact on academic achievement, while Odutuyi (2015) in his study on the influence of laboratory learning environment on students' academic performance found that student cohesiveness contributes significantly to student performance in chemistry.

The dimension of Open-Endedness describes the degree to which laboratory activities allow for student autonomy, creativity, and divergent thinking, moving beyond rigid, step-by-step instructions. It encourages students to design experiments, make predictions, and explore outcomes independently. A study conducted by Gupta and Sharma (2017) on teacher student interactions showed that Open-Endedness is the most preferred dimension by students, Allanas (2021) found mixed perceptions, with some students reporting limited opportunities for open-endedness. Interestingly, Arnous and Ayoubi (2018) noted that students in their study preferred less open-endedness. Odutuyi (2015), however, found open-endedness to have the lowest contribution to student performance among the five dimensions, suggesting a need for careful integration.

Integration refers to the extent to which laboratory activities are meaningfully connected to theoretical concepts taught in regular classes. This dimension helps students bridge abstract knowledge with practical applications, reinforcing their understanding. Arnous and Ayoubi (2018) reported that students prefer chemistry learning environments with greater levels of integration. Conversely, Fan (2021) argued that, there is a certain gap between the theoretical foundation and integration in his study on practice teaching of medical laboratory science. Odutuyi (2015) found integration as the second highest contributor to student performance in chemistry.

Another important dimension is Rule Clarity which pertains to the clarity and consistency of rules, safety procedures, and behavioral expectations within the laboratory. A well-defined set of rules ensures a secure and organized learning environment, reducing confusion and promoting safe practices. Allanas (2021) in his study on students' perceptions in the learning environment of chemical laboratory found that students generally perceive rule clarity very positively. Odutuyi (2015) also recognized rule clarity as a significant contributor to student performance.

The Material Environment encompasses the availability, accessibility, and functionality of physical resources, including reagents, equipment, infrastructure, and overall laboratory facilities. This dimension is fundamental for hands-on science learning. Agaba (2023) highlighted that inadequate facilities significantly affect the chemistry laboratory learning environment, impacting students' perception of practical work. Both Allanas (2021) and Gupta and Sharma (2017) observed areas for improvement in the material environment, with students desiring better material support. Odutuyi (2015) emphasized the critical role of material environment, showing it had the highest contribution to student performance in chemistry, reinforcing the recommendations from Agaba (2023) and Akinbobola (2015) for increased investment in laboratory resources and facilities to enhance chemistry teaching and learning.



Several studies have highlighted the shortcomings in laboratory facilities and usage in Bauchi. For instance, Bawa, Mohammed, and Gidado (2024) observed that many schools within Bauchi Metropolis rely on shared science laboratories, with more access to biology equipment than chemistry. Similarly, Haruna, Audu, Balogun and Tanimu (2023) identified persistent challenges such as poor funding, irregular supply of materials, and low motivation among teachers. While these infrastructural issues are vital, they do not fully explain how the users, particularly teachers and students perceived the laboratory environment. There is a growing recognition that users' perceptions of the laboratory environment, including aspects like student cohesiveness, openness to inquiry, integration with theory, clarity of rules, and the material environment, can shape how effectively laboratories are utilized (Nicol, Gakuba & Habinshuti, 2022; Kumari, Mwesigye & Balimuttajjo, 2024). However, limited empirical studies have explored these perceptions systematically.

METHODOLOGY

The study adopted a descriptive survey research design to investigate senior secondary school teachers' and students' perceptions of the chemistry laboratory learning environment in Bauchi South Education Zone. The study population comprised 243 chemistry teachers and 34,007 chemistry students across 114 public senior secondary schools in the seven local government areas (LGAs) of Bauchi South Education Zone. A multi-stage sampling technique was used: 25% of schools were selected proportionately from each LGA through stratified random sampling, all chemistry teachers in these schools were included using purposive sampling, and 25% of students offering chemistry within those schools were randomly selected. The sample size consisted of 62 teachers and 344 students.

Two structured questionnaires; Teachers' Perception of Chemistry Laboratory Learning Environment Questionnaire (TPCLLEQ) and Students' Perception of Chemistry Laboratory

Learning Environment Questionnaire (SPCLLEQ) were used for data collection. Content and face validity were established through expert review by three university academics, and the instrument's reliability was confirmed via a pilot test, yielding a Cronbach Alpha coefficient of 0.943. Data collection was conducted in person with the assistance of trained research assistants to ensure clarity, confidentiality, and completeness of responses.

Data analysis involved both descriptive and inferential statistics. Mean and standard deviation were used to answer research questions i to iii, with perception levels categorized as low (<2.5), moderate (2.5–3.5), or high (>3.5). The hypothesis was tested using Mann-Whitney test at a 0.05 significance level. Data were coded and analyzed using SPSS version 27.

RESULTS

Research Question One:

What is the perception of senior secondary school chemistry teachers across the five dimensions of the chemistry laboratory learning environment?

The results presented in Table 1 reveal the perceptions of senior secondary school chemistry teachers across the five dimensions of the chemistry laboratory learning environment. Among the five dimensions, Integration and Rule Clarity received the highest mean score (Mean = 4.694) indicating a very positive perception. Cohesiveness (Mean = 4.307) and Open-endedness (Mean = 4.239) were also scored highly indicating positive perception. However, Material Environment received the lowest mean score (Mean = 3.739), indicating moderate perception. The standard deviations across all dimensions are relatively low (ranging from 0.437 to 0.610), suggesting that teachers' responses were consistent. Overall, the findings suggest that teachers' perception of the chemistry laboratory learning environment in senior secondary school is high.

Table 1: Mean and Standard Deviation on the Perception of Teachers Across the Five Dimensions of Chemistry Laboratory Learning Environment

Dimension	N	Mean	Std. Deviation
Cohesiveness	62	4.307	0.551
Open-endedness	62	4.239	0.610
Integration	62	4.694	0.465
Rule Clarity	62	4.694	0.437
Material Environment	62	3.739	0.469
Grand Mean		4.335	

Research Question Two:

What are the perceptions of senior secondary school chemistry students across the five dimensions of the chemistry laboratory learning environment?

The results presented in Table 2 reveal the perceptions of senior secondary school chemistry students across the five dimensions of the chemistry laboratory learning environment. Among the five dimensions, Cohesiveness received the highest mean rating (Mean = 4.173),

followed by Rule Clarity (Mean = 4.150), Integration (Mean = 4.115), Open-endedness (Mean = 3.978) and Material Environment (Mean = 3.883). The standard deviations across all dimensions are relatively low (ranging from 0.520 to 0.758), suggesting that students' responses were consistent. Overall, the findings suggest that students' perception of the chemistry laboratory learning environment in senior secondary schools is high.

Table 2: Mean and Standard Deviation on the Perception of Students Across the Five Dimensions of Chemistry Laboratory Learning Environment

Dimension	N	Mean	Std. Deviation
Cohesiveness	243	4.173	0.541
Open-endedness	243	3.978	0.689
integration	243	4.115	0.520
Rule Clarity	243	4.150	0.546
Material Environment	243	3.883	0.758
Grand Mean		4.060	

Research Question Three:

Is there a significant difference between teachers' and students' perceptions of the chemistry laboratory learning environment?

The results presented in Table 3 show the outcome of the Mann-Whitney U test conducted to determine whether there is a significant difference between teachers' and

students' perceptions of the chemistry laboratory learning environment. The result reveals a statistically significant difference between the two groups ($Z = -3.536$, $p = 0.000$). The mean rank for teachers (Mean Rank = 188.33) was higher than that of students (Mean Rank = 143.99), indicating that teachers have a more positive perception of the chemistry laboratory learning environment compared to students.



Table 3: Mann-Whitney Test Result on the Difference between Teachers' and Students' Perceptions of the Chemistry Laboratory Learning Environment

Group	N	Mean Rank	Sum of Ranks	Z	Sig.
Students	243	143.990	34988.500	-3.536	0.000
Teachers	62	188.330	11676.500		

Hypotheses Testing

H₀₁: There is no significant difference in the perceptions of chemistry teachers and students regarding the chemistry laboratory learning environment.

The Mann-Whitney U test was employed to determine whether a significant difference exists between the perceptions of chemistry teachers and students regarding the chemistry laboratory learning environment. The result presented in Table 4 shows that the mean rank for teachers (Mean Rank = 188.330) is higher

than that of students (Mean Rank = 143.990). The test produced a Z-value of -3.536 and a p-value of 0.000, which is less than the 0.05 level of significance. This indicates that there is a statistically significant difference in the perceptions of chemistry teachers and students regarding the chemistry laboratory learning environment. Therefore, the null hypothesis which states that there is no significant difference in the perceptions of chemistry teachers and students regarding the chemistry laboratory learning environment is rejected.

Table 4: Mann-Whitney Test Result on the Difference between Teachers' and Students' Perceptions of the Chemistry Laboratory Learning Environment

Group	N	Mean Rank	Sum of Ranks	Z	p	Decision
Students	243	143.990	34988.500	-3.536	0.000	Rejected
Teachers	62	188.330	11676.500			

DISCUSSION OF FINDINGS

The results of the analysis on the perceptions of the chemistry laboratory learning environment among senior secondary school teachers and students reveal important findings. The first finding shows that chemistry teachers generally had high perceptions across the five dimensions of the laboratory learning environment. The result in Table 1 show that Integration and Rule Clarity are the most highly rated dimensions, this indicate that teachers view the laboratory environment as well-structured and well-aligned with classroom instruction. This suggests a strong connection between theoretical teaching and practical laboratory activities, as well as clear expectations and guidelines within the lab setting. Student Cohesiveness and Open-

endedness also received high ratings, this indicate that teachers perceive their students to collaborate well and believe there is some allowance for student inquiry and independent thinking during laboratory sessions.

However, the Material Environment was rated the lowest among the five, implying that teachers still find laboratory equipment and physical resources insufficient or in need of improvement, even though their perception remains generally positive. These findings are consistent with those of Sakyiwa and Simthembile (2024), who reported that chemistry teachers recognize the value of practical work in engaging students and reinforcing classroom content. Despite facing obstacles such as inadequate laboratory facilities and insufficient

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resources, the teachers in their study demonstrated a strong commitment to integrating laboratory work effectively into their instruction. This aligns with the current study's finding that, although the material environment remains a concern, other dimensions like integration and rule clarity are well-regarded by teachers. Furthermore, these results also echo Fitria *et al.* (2021), who found that teachers' satisfaction with laboratory teaching was significantly related to their perceptions of the learning environment, especially in areas such as rule clarity and student cohesiveness. Similarly, the lower rating of the material environment in this study aligns with Agaba (2023), who highlighted that inadequacy of laboratory facilities was a key challenge in shaping students' and teachers' perceptions of practical chemistry work.

The second finding from the study shows that students had generally high perceptions of the chemistry laboratory learning environment across all five dimensions. As presented in Table 6, students rated Cohesiveness, Rule Clarity and Integration the highest, followed by Open-endedness and Material Environment. These results indicate that students value collaborative interactions, clear guidelines and integrated learning experiences within the laboratory setting. The relatively lower rating for Material Environment, although still positive, suggests some concerns regarding the adequacy of physical resources.

This finding aligns with Agaba (2023), who found that students had favorable perceptions of the chemistry laboratory learning environment, especially when laboratory facilities and teaching-learning activities were adequately provided and well-structured. Agaba emphasized that the availability of resources and effective instructional design were key to fostering positive student perceptions, which resonates with the current findings, particularly regarding the relatively lower rating of the Material Environment dimension. Similarly, the result corroborates Allanas (2021), who reported high student ratings in dimensions like student cohesiveness and rule clarity, while noting variations in perceptions of open-endedness and material environment—

patterns that are also reflected in the present study. Overall, the current findings reinforce the idea that students appreciate a structured, interactive and supportive laboratory learning environment, although there may be room for improvement in the availability and quality of laboratory materials.

The third finding from the analysis, as shown in Table 4, indicates that there is a statistically significant difference between teachers' and students' perceptions of the chemistry laboratory learning environment. Specifically, the result reveals that teachers hold a high perception of the laboratory environment compared to students. This perceptual gap may be attributed to the different roles, experiences and expectations that teachers and students bring into the laboratory context. Teachers may evaluate the laboratory based on instructional delivery, control and safety, while students may prioritize engagement, autonomy and availability of resources. This result aligns with Gupta and Sharma (2017), who reported a disconnect between students' preferred laboratory experiences and the actual environment as structured by teachers. They found that students desired more hands-on, exploratory and student-centered laboratory sessions, which were often underemphasized by teachers. Similarly, Emendu and Emendu (2020) observed significant differences between students' expectations and what was provided in the laboratory environment.

CONCLUSIONS

The study concludes that the chemistry laboratory learning environment in senior secondary schools is perceived highly by both teachers and students, although perceptions differ slightly between the two groups. Material Environment is an important factor in shaping perceptions.

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